

THE ART OF
AESTHETIC
SURGERY

Principles & Techniques

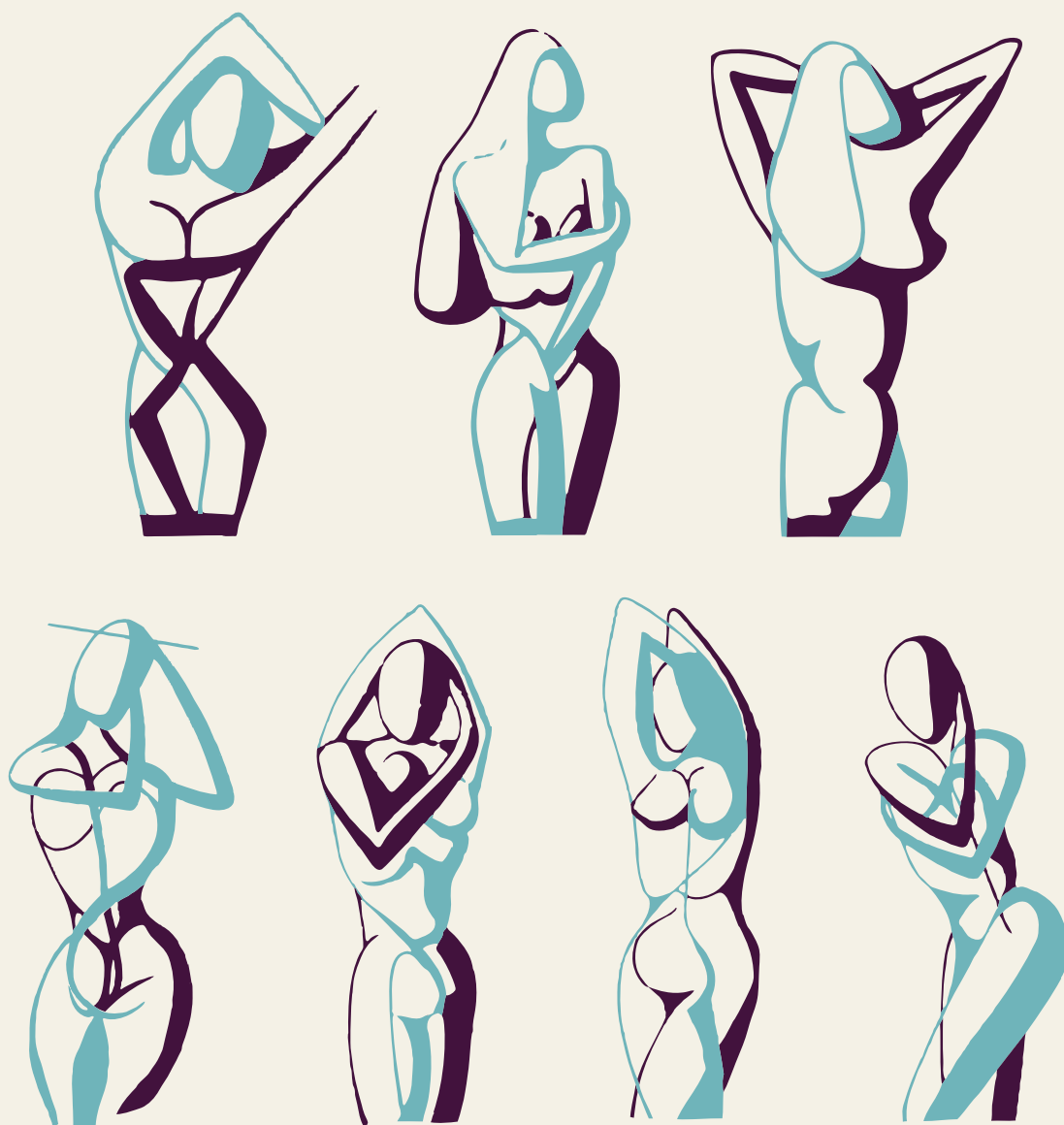
SECOND EDITION



FOAD NAHAI

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SECOND EDITION

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To

Shahnaz

My best friend and partner, whose beauty is only surpassed by the loveliness that radiates from within. You are an inspiration to us all, and your patience and understanding have made me who I am. Thank you for enriching my life.

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Preface



It is hard to believe that 6 years have passed since the first edition of *The Art of Aesthetic Surgery* was published. This was an immense undertaking for me, but it was also a rewarding and educational one. It was written to address the enormous demand for and interest in cosmetic surgery and the need for comprehensive information on that topic. I had not anticipated the warm reception that the book would receive from colleagues throughout the world and have been delighted, humbled, and gratified to witness its continued popularity and enthusiastic readership. Recent translations into Korean and Russian attest to the ongoing global need for education in aesthetic surgery.

Why then a second edition? Surely once was enough for a project of this magnitude. The answer is obvious: this is a dynamic field that is experiencing significant growth, with numerous exciting new developments. Interest in this topic has not abated over the years; in fact, it has grown stronger and more vibrant. While many of the procedures touted 6 years ago are still being performed, others have been replaced by new, less-invasive approaches or techniques that emphasize volume replacement to enhance rejuvenation procedures. Furthermore, new technology, noninvasive techniques, and a number of new devices, fillers, and products have enhanced our ability to provide our patients with a broader spectrum of options and improved outcomes. Clearly, there was a need for a revision of the book to reflect these dramatic and ongoing changes.

Today nonsurgical cosmetic treatments such as injectables continue to gain in popularity, while we have seen a decline in some surgical approaches to facial rejuvenation. Nowhere is this change more dramatic than in the area of brow rejuvenation. Another important trend has been the emphasis on volume enhancement in periorbital and facial rejuvenation. In keeping with these trends, we have increased coverage of nonsurgical treatments and injectables and have added new sections and chapters dealing with volume and its role in facial rejuvenation.

In contrast to the reduction in the number of invasive surgical procedures for facial rejuvenation being performed today, there has been a dramatic increase in breast and body-contouring procedures, in normal-weight patients as well as in individuals who have lost massive amounts of weight. Accompanying this burgeoning interest and demand have been advances, the development of new procedures, and refinements of existing techniques

I did not approach the task of this revision lightly. As with the first edition, it involved many late nights and weekends spent writing and editing. A busy practice, numerous academic and societal commitments, a journal editorship, and an effort to bring more balance into my own life were all forces working against such an undertaking. Then why did I feel this was the right time to take on the responsibilities and make the time commitment for editing a second edition? Obviously, there was more than one reason.

My commitment to learning and teaching was a primary motivator. From my earliest writings on muscle and musculocutaneous flaps to the editing of this three-volume work on aesthetic surgery, I have always felt an obligation to contribute to the literature and to help advance our specialty. This book represents a continuation of my lifelong dedication to this process. It has been a wonderful way to reach out to young and experienced surgeons alike and to offer them insight into the remarkable contributions made by leading experts worldwide. During academic travels and interactions with plastic surgeons and trainees all over the world, I have witnessed their interest in aesthetic surgery and their desire to master the basics of aesthetic surgery and to learn about the latest techniques. This new edition has been written to address that need and to provide information on current advances that emphasize safe and best practices to all aesthetic surgeons.

Every chapter has been revised with new material added. Thirty-nine new chapters, reflecting the growth and diversity of our specialty, have been included. The number of DVDs has also grown, with more than 20 operative videos now included in this edition. It is with great pleasure that I welcome 65 new contributors who, along with our previous contributors, bring valuable insights and considerable expertise to this new edition. These contributors have graciously succumbed to my gentle arm-twisting and have provided us with outstanding chapters on a diverse range of topics. They have all distinguished themselves as educators and innovators.

The positive feedback we have received on the clinical decision-making chapters prompted the expansion of existing chapters and the inclusion of new ones. The additions reflect the increase in the number of options now available for each patient. These chapters reflect my own daily decision-making process, not only in the operating room but also in the clinic when I evaluate new patients and care for them after the operation.

My personal interest and fascination with human anatomy dates back to my first year in medical school. I recall one of my teachers telling the class, “You will learn anatomy three times and forget it three times.” He went on to say that unlike other knowledge we would acquire over the years, anatomy would never change. Of course, he was right; anatomy does not change. However, it is important to note that we change, and our understanding of anatomy evolves and deepens with experience.

Back then, I never imagined that one day as a practicing plastic surgeon not only would I remember all the anatomy I learned, but also I would learn intricate details that were unimaginable then. Little did I know that in some modest way I would even contribute to that knowledge base. Interest in anatomic detail as it applies to aesthetic surgery continues with further clarification of facial anatomy, such as the fat compartments and more detailed descriptions of anatomy of the trunk and breast relating to emerging body-contouring procedures. In keeping with these new findings, all anatomy chapters have been appropriately updated.

The topic of patient safety also assumes a more prominent position in this edition, with a major chapter on safety considerations in aesthetic surgery as well as specific chapters on problems and complications in different anatomic regions.

The third volume, which focuses on breast surgery and body contouring, has been greatly expanded with more than 20 new chapters and many new contributing authors. We now have chapters on fat grafting to the breast, the medial and lateral pedicles in breast reduction, mastopexy and breast reduction in massive-weight-loss patients, and mastopexy-augmentation. The section on body contouring provides information on innovative liposuction techniques and on different approaches to body contouring, with new topics ranging from patient screening to brachioplasty, back and lateral fold contouring, lipoabdominoplasty, gluteal augmentation, female genital surgery, and correction of iatrogenic deformities.

We have updated all of the artwork and redesigned the look of the book to make it more modern. This includes the cover: although we have retained the theme of the “Three Graces,” which symbolizes all aspects of beauty in aesthetic surgery, our graces have now been transformed from the classic Renaissance look of the first edition to modern-day abstraction.

It is my wish that readers will receive this second edition with enthusiasm equal to that of the first publication. I hope that it will provide a source of new information, stimulate thought, and foster innovation. As with any writing project, this book has been a major undertaking, but it has also been a labor of love. I have learned as much as I have taught, and I continue to marvel at the outstanding work being done by my colleagues throughout the world. I am gratified to be able to share it with you in these pages. My goal for this book is to provide trainees as well as experienced practitioners with a solid foundation for learning basic principles and techniques in aesthetic surgery to enable them to build on this foundation and to forge new solutions to ongoing problems and challenges.

Foad Nahai

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Acknowledgments



This book is intended as a testament to all of the surgical pioneers who laid the foundation for modern aesthetic surgery, as well as a tribute to current contributors whose ingenuity and skill are paving the way for future developments. While acknowledging my mentors, I also credit the young surgeons in whose training I have been privileged to participate. Their enthusiasm and quest for knowledge continues to stimulate me.

This work would never have been completed without the support and encouragement of my family, my partners, those with whom I work on a daily basis at Paces Plastic Surgery, and my friends at Quality Medical Publishing. I would be remiss if I didn't mention all of them by name. My wife, Shahnaz, has been a support and a part of my professional life for 41 years. She, more than anyone, has put up with my unusual hours and weekends away from home. My son, Farzad, in practice with me now, and daughter, Fariba, have always been interested in what I do and have encouraged me in my efforts. My partners, Rod Hester, Sonny McCord, Farzad Nahai, and Kristin Boehm, not only contributed to the book but also provided encouragement, advice, and most of all, support in looking after my patients while I was away working on the book. Linda Neal, my personal assistant and right hand for many years, and my new assistant, Lori Meeks, as well as Mary Popp, RN, and Angela Evans, RN, FA, spent endless hours gathering information and putting case histories together. Lester Robertson, who has worked with us as a physician assistant and a professional photographer for 28 years, worked tirelessly to put digital images together for all of us at Paces Plastic Surgery.

I am indebted to all at QMP, notably Brenda Bunch and Amanda Behr, whose talents as medical illustrators are only surpassed by their professionalism and their willingness to revise and rework until I was satisfied. Michelle Berger and Amy Debrecht not only encouraged but also managed to have all the contributors (and the editor as well) submit their manuscripts and videos in a somewhat timely manner. Taira Keele and Olivia Ayes provided the follow-up needed to process the chapters, check on missing items, and keep everything in order and on target. Brett Stone, with the able assistance of Thuy Khuu, did an amazing job of working with the images and the pages, providing color correction, sizing adjustments, and quality control. Suzanne Wakefield's skills as an editor not only took care of my errors but also taught me that my command of English grammar may not be all I thought it was. The intuitive,

graceful layouts and attention to detail of Susan Trail and Elaine Kitsis transformed ordinary manuscripts into a visually appealing book. Sandra Hanley scoured every corner of the pages for correctness and consistency, and Carol Hollett corrected errors and incorporated contributors' changes. With unwavering determination, Carolyn Reich shepherded the three volumes to timely publication. Andrew Berger has led the marketing and sales effort; his unique knowledge of the book's contents is invaluable in informing surgeons about its benefits and helping residents understand its value. He has ensured that this book will, along with QMP's other publications, receive unprecedented exposure through a vibrant marketing campaign and attendance at more than 30 annual plastic surgery meetings worldwide.

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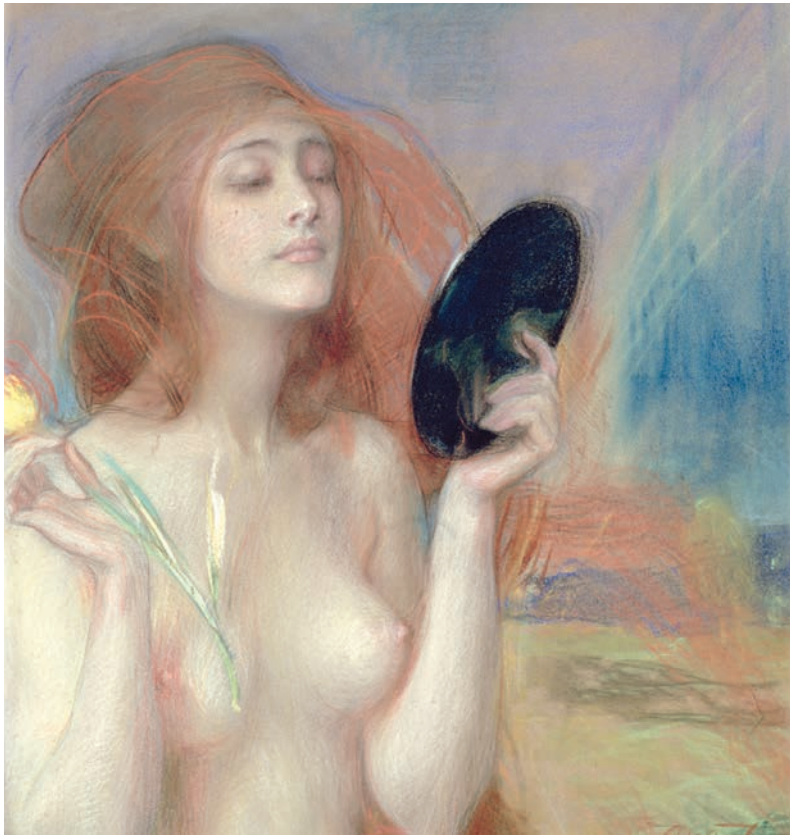
PART I

FUNDAMENTALS



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CHAPTER 1



Spring, Teodor Axentowicz

The Patient

FOAD NAHAI

A well-informed patient is a happy patient.

Our patients are bombarded with information about cosmetic medicine and surgery; it is a pervasive theme in our youth-oriented society, appearing in print, electronic, broadcast, and social media. Although some of the information obtained from these sources may be helpful, much of it is intended to entice rather than enlighten. Advertising for aesthetic surgery is calculated to bring patients into the surgeon's office, often by promising more than can be delivered while minimizing risks, complications, and the possibility of unfavorable or suboptimal results. Websites and social media devoted to cosmetic medicine and aesthetic surgery often overload patients with information promoting one procedure over another. Although the information in itself is not detrimental, it can be confusing. Patients may not have the medical background, experience, or sophistication to sort through this material to make an informed decision. The more conflicting information they receive, the more confusing it becomes, and often the more unrealistic their expectations. It is the surgeon's responsibility to educate the patient by presenting the facts in an unbiased manner. Even then, patients may not be able to reach a decision and may rely on the surgeon's recommendations, trusting his or her knowledge and abilities.

It is this basic concept of trust that is being eroded through the blatant marketing of aesthetic procedures and materials to the public. The implication from this promotional activity is that aesthetic surgeons are mere vendors of a commodity. Having a breast augmentation is not like buying a bra or lingerie, and a face lift is not like purchasing a high-end luxury automobile, where one shops for the most convenient dealership or the best discounts. Nothing could be further from the truth. We are not selling a product; we are providing a service—a service that is personal and customized to each patient, one that carries risks unlike those encountered at the beauty salon or spa. This is a high-end service that encompasses the entire patient experience. This experience begins with the initial telephone inquiry. It progresses through encounters with the receptionist, patient coordinator, nurse, and surgeon, culminating in the surgical procedure. The success of this experience is strongly dependent on the surgeon's skill, experience, and judgment.

Not all surgeons have the same experience, medical knowledge, training, surgical expertise, or technical ability. The well-informed patient should choose a surgeon based on trust, not on hype or cost.

The First Consultation

The decision to seek cosmetic treatments or aesthetic surgery is usually not a spontaneous one. Most likely the patient has been contemplating this possibility for months, if not years, before picking up the phone to make an appointment with a plastic surgeon. Some patients may have extensively researched the procedure, the surgeon, and the surgeon's practice through the Internet and in particular the surgeon's website. Others rely solely on the recommendations of friends and family. These recommendations are best when they are based on personal experience. Satisfied patients are the ideal source of referrals, and far more valuable than any advertising, promotions, or even marketing that money could buy.

The initial consultation does not necessarily begin with the first phone call to schedule an appointment. Most likely the prospective patient has already visited the practice's website, and the first contact may have been through the website. The website and the first telephone contact leave a lasting impression with the patient; if those contacts are unfavorable, the patient may decide against making an appointment or fail to keep it. Prompt responses to the patient's inquiry through the website and proper telephone etiquette are of utmost importance. The phone should be answered after a maximum of five rings, and the voice that greets the caller should be cheerful and inviting, announcing the name of the practice and the name of the person answering, followed by, "How may I help you?" This greeting should be spoken in a clear, understandable voice. Such an encounter will leave the caller with a positive impression. Conversely, an unfavorable impression may be left when the phone is answered by a programmed voice reeling off a list of options, each requiring a separate button to be pushed, until the irritated caller is either disconnected or put in touch with the appropriate person. This type of impersonal answering system can alienate potential patients. By the time the annoyed caller actually reaches a live person, he or she is not in any mood to discuss aesthetic surgery. In any high-end service, immediate contact with a caring individual is essential.

In most offices, the caller is first connected with the person responsible for scheduling appointments. This person needs to understand the importance of flexibility, even for surgeons who are fortunate enough to have large practices with few immediate openings for new patients. Impressive as it may sound to inform a patient that there are no openings because the surgeon is fully booked for 18 months or longer, in most cases rather than impressing the patient, this will only encourage him or her to look elsewhere. We live in a world where everyone is busy. Most of our patients value their time as we do and only have specific days and times when they can afford to miss work for a doctor's appointment. This is particularly true for those seeking aesthetic surgery, who do not wish to ask for sick time or announce to their supervisor that they are going to see a plastic surgeon.

175 & WEST PACES FERRY
ATLANTA, GEORGIA
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HOME BLOG CONTACT US

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Contact us for more
information

Your name:

E-mail:

Phone:

Comments:

Choose your interest:
PROCEDURES

Preferred Paces Location:
CHOOSE LOCATION

Doctor Preference:
CHOOSE DOCTOR

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Enter 6-Digit Code:

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Your website is the face of your practice to the world.

Although we may not always be able to accommodate every patient's scheduling needs for every office visit, it is important to do so for the initial consultation. For this reason, some practices offer evening and Saturday office hours. Patients should be asked how soon they would like to schedule the appointment. Then every effort should be made to schedule the appointment as close to that date as possible, without overcommitting the surgeon, yet leaving sufficient time for the initial consultation. (In my practice, at least 1 hour is allotted.) Although patients assume that doctors are never on time, patients still make every effort to arrive as scheduled. It is a matter of common courtesy, whenever feasible, to see patients at the appointed time. Obviously, this is not always possible. It is good practice, however, to notify patients if you are running late either before they arrive, if possible, or on their arrival.

The scheduler should record the caller's name, address, and contact information. It is also important to inquire about the reason for the consultation. Some individuals may be reluctant to disclose this information to a stranger on the phone. The scheduler should explain that while patient privacy is of the utmost importance, these questions are being posed to determine whether the practice offers the procedure that the patient is seeking. It also provides valuable information for the surgeon to help prepare for the patient's initial consultation and to ensure that sufficient time is allotted for that appointment. Patients seeking removal of a skin lesion may not require as much time at the initial visit as someone seeking facial rejuvenation. Once the appointment is made, patients are told that a package will be mailed to them or can be downloaded from the website. Most practices now offer patients the option of filling out their initial paperwork online, thus eliminating the need to do so in the doctor's waiting room during the initial visit.

Some patients may not want to receive mail, phone calls, faxes, emails, or other communications that are identified as coming from a plastic surgeon's office. Special care should be taken to cater to these needs. The scheduler should ask where the patient would like to receive correspondence from the office. Some thought should be given to using envelopes and fax cover sheets without any indication that this is coming from a plastic surgeon's office; envelopes should have a street address without a practice name or logo. In the interest of patient confidentiality, the scheduler should also specifically ask patients how they wish to be contacted by the practice, for example, home, cell, or office phone, or by email.

Next, an information package is sent from the office that includes general information about the practice, maps and directions, specific information about the surgeon, his or her qualifications and practice philosophy, a letter detailing what will happen during the initial consultation, and a brochure on the procedure the patient is seeking. Most, if not all, of this information is probably already available on the surgeon's practice website. However, it is important to remember that not all patients are Internet savvy, and some may prefer a hard copy; therefore the printed material serves as a reliable resource for all patients regardless of their technical know-how.

Maps and directions to the surgeon's office should be sufficiently detailed to allow patients to easily locate the office. Parking should be ample and convenient. Any special parking instructions should be detailed in the information package. Even though a patient is looking forward to the visit with the plastic surgeon, this initial consultation is a stressful event; getting lost or frustrated over finding a parking space will merely add to patient anxiety.

On the next page is an example of the type of patient letter that is sent with our practice information package.

The patient's first face-to-face encounter in the surgeon's office will be with the receptionist, who should greet the patient and notify the patient coordinator or nurse of the patient's arrival. It is disconcerting for a patient to walk into the surgeon's office for the first time, only to find that no one is there to greet her or him; even worse is when two or three staff members are engrossed in conversation or occupied on the telephone, and the patient is ignored. It is also essential that we respect the patient's privacy during this sign-in process; several points merit particular attention.

Privacy and HIPAA Regulations

Sign-in lists where the patient signs his or her name under the name of the previous patient should be avoided.

The receptionist should sit in an enclosed space, preferably in a glass-enclosed area to maintain privacy yet allow the receptionist to have full view of the waiting room. The receptionist or nurse should refrain from loudly announcing the patient's name in the waiting room.

Under no circumstances should the patient be greeted with the words, "You are here to see Dr. Nahai about your breast enlargement?"

In most states in the United States and in some other countries, the practice is required to display a Patient's Bill of Rights and the privacy statement.

Once a patient has signed in, he or she should be told when to expect to be taken to the consultation room to meet with the patient coordinator. If there is a delay, the patient is given an estimate of the waiting time, and coffee or a soft drink can be offered. Whenever possible, an explanation is provided for the delay. If the delay is inordinate or unacceptable, the patient is offered the choice of rescheduling or waiting. If I am running unacceptably late—a half hour or more—the fee for the initial consultation will be waived and the patient's parking charges paid as a gesture of goodwill.

The patient is then escorted to one of the examination rooms. In my practice, the nurse meets with the patient first. A history is taken and the completed health questionnaire, which has been downloaded from the website or mailed out to the patient before the initial office visit, is reviewed.

Text continued on p. 15

Dear Patient:

I am looking forward to meeting you when you come in for your initial consultation with Dr. _____.
A map and directions to our location are enclosed for your convenience. Parking is available, as indicated on the map.

We are located in the _____ building on the _____ floor. Elevators are located in the lobby of the main entrance to our building and on level _____ of the parking deck.

We realize your time is valuable; please allow 1½ to 2 hours for your consultation. This will permit ample time for your consultation with Dr. _____, for photography and video imaging, and for consultation with our aesthetician, as appropriate. I will also meet with you to discuss the surgical fees and scheduling, and to answer any questions you might have. Most of all, you will be able to familiarize yourself with our practice, our facility, and the staff, without time constraints.

We look forward to seeing you soon. In the meantime, if you have any questions or if you need further information, please feel free to contact me at any time.

Sincerely,

Patient Coordinator

PERSONAL HISTORY QUESTIONNAIRE

This information is confidential and will not be released without your authorization.

Date _____

Name _____ DOB _____ Age _____

LAST FIRST MIDDLE

Ht _____ Wt _____ Sex: M F Marital status: Single Married Widowed Divorced

Date of last physical exam _____ Doctor _____ Referring Doctor _____

Phone _____ Purpose of this consultation _____

PAST MEDICAL HISTORY: Do you have or have you had? (If yes, give date of occurrence.)

AIDS or HIV	N Y _____	Bleeding tendencies	N Y _____	Asthma	N Y _____
Thyroid	N Y _____	Blood pressure	N Y _____	Lupus	N Y _____
Heart	N Y _____	Lungs	N Y _____	Cancer	N Y _____
Kidneys	N Y _____	Nervous problems	N Y _____	Fibromyalgia	N Y _____
Gallbladder	N Y _____	Bleeding problems	N Y _____	Arthritis	N Y _____
Stomach	N Y _____	Diabetes	N Y _____	Scleroderma	N Y _____
Hepatitis	N Y _____	Other serious illnesses you have had _____			

Do you regularly smoke? Y N How much per day? _____

Do you regularly drink over 3 cups of coffee per day? Y N

Do you regularly drink alcohol or beer? Y N How much per week? _____

MEDICATIONS: Are you presently taking any of the following? (Circle.)

Aspirin/Anacin	Cough medicine	Antibiotics	Phenobarbital	Dilantin
Bufferin	Thyroid pills	Blood pressure pills	Blood thinners	Iron
Motrin	Hormones	Insulin/diabetic pills	Digitalis	Sleeping pills
Ibuprofen	Birth control pills	Arthritis medication	Cortisone	Water pills

Other medication not listed _____

Do you take herbal supplements? Y N If yes, what are they? _____

Aspirin and aspirin type products can cause excessive bleeding during surgery.

DRUGS OR SUBSTANCES TO WHICH YOU ARE ALLERGIC _____

FAMILY HISTORY: Have blood relatives had? (Please circle and give reason.)

High blood pressure _____	Arthritis _____	Asthma _____
Diabetes _____	Stroke _____	Goiter _____
Bleeding disorders _____	Breast cancer _____	Other cancer _____

SERIOUS ILLNESSES OR INJURIES: Please list any serious illnesses or injuries and dates.

Illness/Injury _____ Year _____	Illness/Injury _____ Year _____
Illness/Injury _____ Year _____	Illness/Injury _____ Year _____

OPERATIONS: Please list operations and year.

Operation _____ Year _____	Operation _____ Year _____
Operation _____ Year _____	Operation _____ Year _____

WOMEN ONLY

Is there a chance you may be pregnant? Y N Regular menses? Y N Date of last menstrual period _____

Any complications with pregnancies? _____

How many pregnancies? _____ How many children? _____ Did you breastfeed? Y N How many? _____

Date of last mammogram _____ Normal Abnormal

Specify abnormality _____

Breast cancer: L R Date _____ Mastectomy _____ Date _____

Breast biopsy: L R Date _____ Oncologist _____

Surgeon for breast biopsy _____ Address _____

Address _____

GENERAL INTAKE INFORMATION

Date_____

Name_____ Age_____

LAST

FIRST

MIDDLE

Referring Physician_____ Phone_____

CHIEF COMPLAINT _____

REVIEW OF SYSTEMS

PRESENT ILLNESS _____

PAST HISTORY

1. Serious illnesses _____

2. Operations _____

3. Other hospitalizations _____

4. Allergies / medications _____

Latex allergy? Y N

5. Present medications _____

Cigarette smoking / amount? Y N

DVT history? Y N

Bleeding disorders? Y N

Medications affecting bleeding:

ASA

Vitamin E

Ibuprofen

Dietary / herbal supplements

FAMILY HISTORY _____

Date_____

HISTORY

No

Visual acuity: Right_____ Left_____

Eyelid position

Medial canthus

Laxity

Distraction test

Brow

Glabella

Lid-cheek junction

Slit lamp if needed

Name _____ Date _____

LAST FIRST MIDDLE

Goals_____

Children_____ Breastfeed_____ Maximum cup size during pregnancy_____

Family history_____

Last mammogram_____

Bra size_____

Skin: Quality_____ Quantity_____

Breasts: Fatty_____ Fibrous_____

Ptosis: Right: I II III Left: I II III

Asymmetry_____

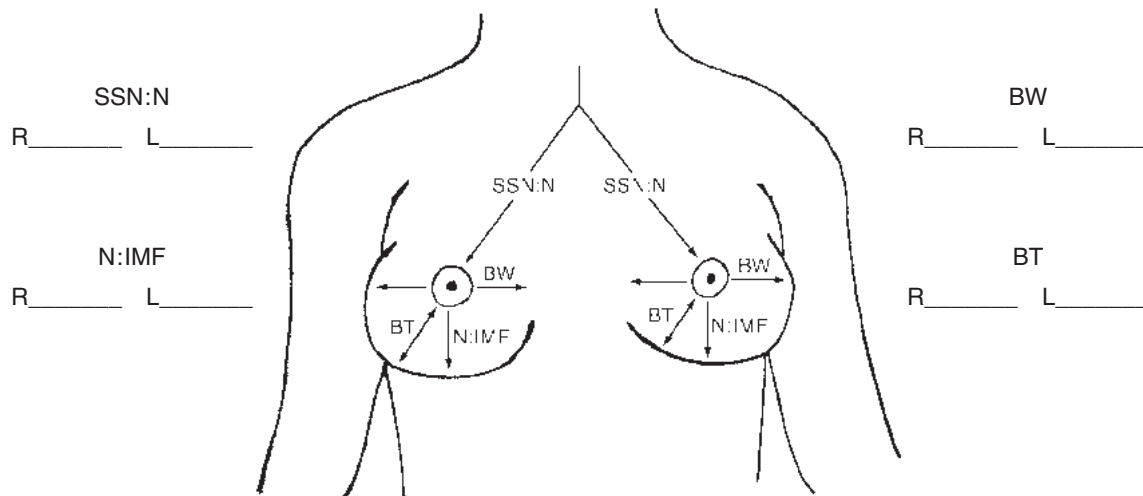
Lumps/masses_____

Nipple sensation: R L

Current implants: Saline_____ Silicone_____

Capsular contractures: R L

Submuscular_____ Subglandular_____



Augment: Saline_____ Gel_____ Moderate/HP_____ Smooth/textured_____

Size(s): Submuscular_____ Subglandular_____

Mastopexy: Periareolar_____ Vertical_____

Name _____ Date _____

LAST FIRST MIDDLE

Goals_____

Height_____ Weight_____ Weight loss/gain (last 12 months): Loss_____lb Gain_____lb

Pregnancy? _____ Weight of child(ren) at birth _____

Hernia

Varicose veins _____



At this time the patient usually discusses the reason for the consultation with the nurse. This takes from 10 to 20 minutes, depending on the patient, the nurse, and the procedure. I then review this information before meeting with the patient. I greet the patient and introduce myself and immediately ask, “What can I do for you?” We then discuss the patient’s goals and what he or she hopes to accomplish through aesthetic surgery. Next we review the patient’s history, including pertinent information on general health and specific information concerning previous aesthetic treatments, procedures, and skin care. Procedure-specific information is discussed in detail. For example, any woman desiring breast surgery is asked specifically about her family history of breast disease, including cancer, history of breast masses and biopsies, mammography, and childbearing history. If the patient is contemplating liposuction or body-contouring procedures, we discuss lifestyle, exercise, nutrition, and weight control. For abdominal procedures, we discuss previous abdominal operations, including liposuction and hernia surgery. For facial rejuvenation procedures, I ask whether patients are currently smoking, but I am also interested in their smoking history—that is, if they have ever smoked, for how long, how heavily, and when did they stop? I question all patients about a history of phlebitis or deep venous thrombosis.

Once the history has been reviewed, I return to the reason for the consultation. Throughout this consultation, I know that the patient is assessing me as a person, a physician, and a surgeon. Clearly, he or she has no way of realistically evaluating my knowledge of aesthetic surgery or my technical abilities. In all likelihood, patients will base their decisions on my demeanor and how warm, caring, and attentive I appear. Meanwhile, I am assessing the patient. Are his or her goals realistic? Will I be able to meet these goals? Do I like the individual? If we have a complication, will I be able to maintain patient confidence while we resolve the problem? I am particularly attentive to the patient’s body language, eye contact, tone of voice, and most of all, his or her enthusiasm and interest during the consultation. I observe the patient’s appearance, hairstyle, makeup, clothing, and accessories. These not only reflect the patient’s tastes but also attention to detail and how exacting the individual will be as a patient. I am concerned when an individual who is sloppily dressed and poorly groomed comes in seeking aesthetic surgery. In a similar manner, the appearance and grooming of the surgeon leaves an important impression about the surgeon’s attention to detail and the care, attention, and meticulous surgical technique that he or she offers to each patient. I certainly would be hesitant to let any sloppily dressed or poorly groomed physician or nurse take care of me!

It is not unusual for patients to come in having researched the procedure on the Internet or on other physicians’ websites. In all likelihood they have sought consultation elsewhere as well. They may have been given conflicting advice and information, which they may or may not share with me. Close to the end of our consultation, I now ask them if I have told them anything that they were not aware of or anything that conflicts with information they may have been given elsewhere.

Dear Patient:

It was nice to meet you at _____ Plastic Surgery on _____. As we discussed, you are a good candidate for breast enlargement. With this operation, we plan to place a saline implant (filled with saltwater) under the muscle of your chest through an incision in the crease below each of your breasts. I am aware of your desires for final breast size and will do my best to address them. However, please remember that we will select your implants based on the dimensions of your breasts rather than the volume of the implants. The operation will be performed in our operating rooms as an outpatient procedure.

It is important to understand that breast augmentation is not maintenance free; the implants are not permanent, will eventually fail, and have to be changed. There is always the risk of capsular contraction (hardening of the breast), which may also necessitate reoperation and implant change. I would be happy to meet with you again to go over this and the other risks and complications that we have discussed before you make a final decision. In the meantime, if you need any more information or if we can assist you in any way, please don't hesitate to call.

Best wishes.

Sincerely,

_____, MD
(Physician Name)

Most patients respond that they were aware of some but not all of the information that we provided. In my experience, this new information is almost always related to expected outcomes and complications. It amazes me that even today I see patients who have researched breast augmentation on the Internet and have had consultations elsewhere, but may not be aware that breast implants are not permanent.

I never pressure patients to make a decision during the initial visit. In fact, I encourage them to ask questions, take home the materials we provide, and to return for a second visit, which is complimentary, before making a final decision. However, we do arrange for our patient coordinator to quote fees and discuss scheduling during this first visit.

I follow up every new consultation with a personal letter rather than a form letter, summarizing our discussion and a brief description of my recommendations; I remind patients that I would be happy to meet with them again before they make a decision or schedule a procedure.

Motivation

A well-motivated patient is a happy patient.

Understanding patient motivation is an essential goal of the initial consultation. Questions probe the reasons for seeking surgery. For whom is the patient pursuing the operation—is it to please someone else? Does the patient think that this will change his or her life? The best patients are those who are seeking surgery for themselves so they can look better. The best motivation is self-improvement. With most patients, I am able to understand what motivates them after a few minutes. Sometimes I will ask patients whether they hope that the aesthetic surgery will change anything in their lives and inquire as to whose idea it was for them to have this procedure.

Almost always, teenagers seeking rhinoplasty or other aesthetic procedures suitable for their age are accompanied by a parent. I make it a point to address the teenagers directly and have them, rather than the parent, tell me what they would like. I usually tell them that they will have to live with the result, not their parents or their surgeon, so they need to carefully consider what they are requesting. Although I will allow the parents to express their opinions, I make it clear to the patients that they should make the final decision.

Patients often have hidden agendas—secret and personal reasons for seeking this procedure. They are reluctant to share this with the surgeon or the staff, and even with their family and friends. These hidden agendas may include attracting the opposite sex, seeking a promotion, or simply a life-altering event. Beware of this hidden

agenda, because despite an excellent result, these patients will never be happy unless the requirements of the hidden agenda have been fulfilled.

When to Say No

Not every person I see is a candidate for a surgical procedure. I classify noncandidates into six general categories, as follows:

1. *Those seeking the procedure before they are ready for it*
For example, breast augmentation for teenagers, face lifts in women who do not need one or who will see little difference, or rhinoplasty in 12-year-olds
2. *Those with unrealistic expectations*
For example, those patients who believe that aesthetic surgery will “change their lives,” save a marriage, or make them look like swimsuit models or movie stars
3. *Patients on whom I would prefer not to operate*
For example, those who are overly demanding, noncompliant, abusive to office staff, or “aesthetic surgery junkies”
4. *Another surgeon’s unhappy patient who has a reasonable result but remains extremely critical of the original surgeon*
5. *Patients who are psychologically unstable*
6. *Those who are seeking to improve on problem areas or imperfections that are not readily recognized by others; these individuals may well have body dysmorphic disorder (BDD)*

Patients in group 1 are counseled that it is too early for the procedure they are seeking. I explain to these patients that I would like them to be my patients and that I will operate on them at the appropriate time. A woman seeking a face lift before she is truly ready will be offered skin care, other ancillary procedures, and injectables, if appropriate, until they are ready for a surgical procedure. I explain to teenagers seeking augmentation that it is best to wait until their breasts have stopped growing. I will make an exception for teenagers with significant breast asymmetry and promise the 12-year-old that as soon as her nose is fully grown, we will take care of it.

I explain to patients in group 2 that I do not believe I can provide them with the result they are looking for or meet their expectations. I also let them know that I am concerned that they will be unhappy or displeased with me.

Patients in group 3 require special tact. I tell these demanding patients that I do not believe that our office will be able to provide them with the level of service that they are seeking. To the abusive patient I explain that the office staff and I are a team and because the patient has already indicated an unwillingness to work with my office staff, I cannot care for this individual because I will not work without my colleagues. Finally, to the patient who has an insatiable desire for plastic surgery, I say you have had it all and it is too early to have any more.

Dissatisfied or unhappy patients in group 4 are told that they have had a reasonable result, that they are being unduly tough on their previous surgeon, and that I doubt I can significantly improve on what has been done. My major concern is that a patient with an average result who is trashing the original surgeon will one day say the same about me, regardless of the result. Any patient who walks in and unjustifiably claims that they were “butchered” or “mutilated” is an immediate noncandidate.

Group 5 includes psychologically unstable patients whose instability is not always readily discernible. I advise them to seek counseling and treatment before considering aesthetic surgery. In fact, anyone under psychiatric care at the time of consultation, regardless of my own personal impression of his or her suitability, is referred back to the psychologist or psychiatrist for clearance before scheduling. It is not uncommon today to see patients who are taking antidepressants such as fluoxetine (Prozac) or bupropion (Wellbutrin). This by itself does not disqualify them, as long as they are stable individuals. Most of the time the antidepressants have been prescribed by their internist or family physician for mild depression rather than for any severe psychiatric condition. Most of these individuals are suitable candidates for aesthetic surgery.

Group 6 individuals may appear normal to the untrained; however, their insistence that a small blemish or minimal deviation from the norm is a major deformity that is ruining their lives and incapacitating them is an indication of BDD. These individuals should be referred for counseling. Surgical or other procedures on these patients lead to further dissatisfaction, disappointment, and anger. Extreme caution should be exercised in handling this group.

I discuss the options available to the patient and make my recommendations. I explain that I prefer to operate in our own office-based surgical center, which is certified and inspected by the American Association for Accreditation of Ambulatory Surgery Facilities (AAAASF) and the state of Georgia. I tell patients that anesthesia will be provided under the supervision of a board-certified anesthesiologist and that I personally will perform the entire operation. I explain that they will be charged for the consultation that day, and if I operate on them, they will be expected to prepay for the surgery. All follow-up visits before and after the operation are included in the charges for the surgery. I do not discuss specific fees and charges; our patient coordinator does that. I do, however, explain to patients that I will perform revisions, if needed, at no additional charge. Although rare, should a complication necessitate the services of other physicians or hospitalization, those expenses would be the patient's responsibility. Years ago, Dr. Gil Gradinger shared with me a letter that he gave to his patients on this subject. I still use a modified version (p. 20) that patients are asked to read and sign before surgery.

However, my no-charge policy for revisions does not always apply to liposuction patients, who often return seeking revisions and repeat liposuction after weight gain,

To My Patients:

Prior to surgery, you will have paid my fee as well as other costs. Although it is very unusual, complications requiring additional surgery, consultation, hospitalization, or other services can occur. There will be no additional charges for any service performed by me or the staff. However, any other doctor, hospital, or related expenses will be your responsibility.

Healing after an operation is usually a predictable process leading to a good result. However, occasionally a surgical revision is necessary to help achieve this result. In this situation there will be no charge for my services, but there may be a small facility charge.

_____, MD
(Physician Name)

I understand and accept the above statements.

(Patient Signature)

(Date)

To My Liposuction Patients:

Approximately two to three weeks after the operation, you will notice some decrease in your weight. The actual weight loss will of course depend on the volume of fat that was removed. Following the operation, it is important that you maintain your weight and avoid any weight gain. Maintaining your weight, or better still, losing weight postoperatively will only enhance your result. In contrast, any weight gain will have the opposite effect.

Normally, there is no charge for a revision or touch-up of liposuction if done within one year of the original surgery, provided your weight has remained the same. However, if there has been a weight gain of 10 pounds or more postoperatively, there will be a fee for any revision.

In order to maintain your good result following liposuction, I encourage you to maintain your weight!

_____, MD
(Physician Name)

I understand and accept the above statements.

(Patient Signature)

(Date)

thereby obviating the results of the original procedure. To avoid future misunderstandings, we talk to these patients preoperatively about the impact of weight gain on long-term liposuction results. Liposuction patients are asked to read and sign an additional form regarding weight gain and repeat procedures (p. 21) so that they fully understand that additional liposuction after a substantial weight gain (10 pounds or more) will not be considered a revision but a new procedure.

Surgeon Shopping

Currently the public is being advised to seek two if not more consultations before selecting a plastic surgeon, so most patients will see another surgeon before proceeding. Although a second or third opinion is not unusual today, I would be wary of patients who have seen numerous plastic surgeons. Occasionally a patient comes in with an information package and video images from another practice and a file full of information and images downloaded from the Internet. Sometimes the patient tells me that a different procedure was recommended by others. This in itself is not a red flag to me, but it requires extra time and discussion. I explain that each surgeon will recommend an operation that, in his or her hands, comes as close as possible to the patient's desired goal. I assure the patient that I have done the same. The fact that my recommendation differs from that of the other surgeon (or surgeons) does not necessarily mean that I am correct and the other surgeons are not; it simply means that I have recommended a procedure that, in my hands, would give the patient the best result.

I tell patients who have seen other surgeons that they should not base their choice of physician on price, on who has the fanciest or sparsest office, or on convenience of location. Rather, the choice should be based on the overall impression of the physician and the office staff, rapport with them, and most of all, confidence and trust. I explain to patients that even in the best of hands complications are possible, and that they should have enough confidence and trust in the surgeon they choose to allow him or her to handle any problems through to resolution. Patients often make the mistake of going to another physician once they have developed a complication, even though the original surgeon would be equally capable of dealing with it. These patients often blame themselves and are convinced that they made the wrong choice. I tell them that if they choose me, they should have enough confidence to allow me to handle any complication unless I recommend that they see someone else.

Patient Education

I discuss outcomes, risks, and complications with the patient during the initial consultation. All patients are informed that all procedures carry risks and that cosmetic treatments and aesthetic surgery are no exception. I explain that the risk of a life-threatening complication is not as small as the risk of flying—and significantly less than driving around Atlanta. Once the patient is reassured in terms of general risks,

I address specific risks. All of my patients are told that infection and bleeding are common to all aesthetic procedures but are extremely rare. I do prepare them for postoperative bruising and swelling which may accompany all cosmetic procedures and aesthetic operations. I explain to all face-lift patients that in my hands the most common complication is hematoma, and the risk is currently 1%; the risk is higher in men, in persons with uncontrolled high blood pressure, and in anyone who is troubled by postoperative nausea and vomiting. I tell them that every precaution will be taken to minimize the risk, but it cannot be eliminated entirely. I add that the risk of permanent nerve damage is extremely rare—on the order of 1 in 1000 cases or less. I inform them that all surgical procedures leave scars and that the quality of the scar reflects not only the surgeon's skill (most patients believe that scars are related solely to the surgeon's skill and that plastic surgery leaves no scars), but also the patient's body chemistry, location of the scar, and tension. I stress that we can improve on any obvious, unsightly, or unacceptable scar through conservative means and, if needed, a scar revision can be done at no additional charge.

I also explain to my patients that although serious complications are rare, reoperations are more common. I will reoperate on a patient whose result falls short of my own expectations as well as those of the patient. These revisions are at no cost to the patient. However, if I feel that the result is the best I can achieve and the patient is still dissatisfied, then I recommend a second opinion. In addition to my explanations, the patient coordinator also reviews the more common complications associated with each procedure, such as capsular contracture, implant failure, and nipple-areolar sensory changes following breast augmentation. Eventually patients also receive a letter and informed consent form, which they are asked to read, initial each page, and sign on the last page. These documents enumerate the complications.

We also discuss postoperative management, including an overnight stay in our suites if needed, the frequency of postoperative visits, restriction of work and other activities, and the expected time to full recovery. I do not minimize the length of time needed for complete resolution of all bruising and swelling. I tell all face lift and blepharoplasty patients that it may take up to 5 weeks for them to look “normal” without makeup.

My first encounter with the patient lasts from 15 to 30 minutes. After that the patient is sent to the photography room, where our professional photographer will do the video imaging. I have found video imaging to be very helpful with facial aesthetic procedures and rhinoplasty. Video imaging is not routinely offered to our breast or body-contouring patients, although there is now some new software that may well make video imaging for body contouring as reliable as it has been for the face and nose. Three-dimensional imaging, though currently very expensive, may one day contribute further not only to video imaging but also to preoperative and postoperative evaluation of results.

All patients are given the opportunity to review our preoperative and postoperative album. Most will have already seen similar images on our website. It is not unusual for patients to even base their decision to come in for a consultation on the before and after images that are posted on the website. Without exception, we show preoperative and postoperative reduction and mastopexy images so the patient will have a clear understanding of the location of the scars. After the video imaging session, I review the projected result and discuss with the patient whether that result is realistic and how close we can approximate it. No promise or implied guarantee of a result is made. At this time the preoperative and postoperative album is reviewed with the patient if needed. Usually it is the patient coordinator and the photographer who show the album to the patient. We do encourage our patients to bring in photographs to demonstrate what they like. For example, rhinoplasty patients bring in pictures of noses that they like and those they do not; the same is true for breast augmentation patients. Reviewing these pictures with the patient provides me with further insight into the patient's aesthetic goals. For facial rejuvenation patients, we ask that they bring in photographs taken 5, 10, and even 15 or 20 years earlier so that we can better assess their features.

At the end of the consultation, the patient spends additional time with the patient coordinator, who will discuss fees, scheduling, and the preoperative routine to be expected. The coordinator again describes the procedure, risks, likely outcomes, and expected recovery. If an overnight stay is planned, an album containing images of our overnight suites is shown to the patient. Occasionally the patient will ask to see the operating rooms and overnight suites. If there is an unoccupied overnight suite and the recovery room is empty, we will accommodate this request. A video tour of our facilities is also available on our website. Most patients will, in fact, schedule or at least ask to have time reserved at that initial visit. We do encourage them to think about things and offer them a return visit before they schedule or the option to schedule by telephone.

Financial Responsibilities

Although the major source of patient dissatisfaction is a result that does not meet expectations, financial misunderstandings and problems with fees are also common sources of patient anger. Far too many patients who were initially happy with their excellent results become dissatisfied and find fault with their results if unexpected charges appear long after the operation has been completed. Financial surprises should be avoided if at all possible.

My patient coordinator clearly delineates the patient's financial responsibilities during the initial visit. The patient is given an itemized quote that includes the surgeon's fee, facilities fee (including anesthesia), charges for an overnight stay, and any im-

plantable devices. It is also made clear that if other procedures are added between the time the patient has prepaid for the procedure and the actual operation, there will be additional fees. The coordinator also explains that if any specimens are removed (such as moles, breast tissues, or breast implants) and sent to the pathologist, there will be a separate bill from the pathologist. We cannot give them a quotation for the pathologist's services; this must come from the pathology laboratory.

In our own surgicenter we do not charge the patient extra if a planned procedure takes longer than anticipated. However, this may not be the case if the procedure is scheduled elsewhere. Far too many patients have prepaid for a 4-hour procedure in a hospital-based surgicenter only to later be billed for extra time when the procedure runs long. Under these circumstances it should be made clear to the patient that although the surgeon's fee is prepaid in full, the surgicenter facility fees are only an estimate, and the actual amount will vary according to the length of time, materials, and equipment used in the surgicenter. The patient may, in fact, receive a bill for the balance several days, weeks, or even months after the procedure. If this policy has been clearly explained, patients are less likely to be dismayed and upset.

Another cause of confusion about financial responsibilities concerns cases in which a combination of aesthetic and reconstructive procedures is performed (for example, nasal airway surgery and cosmetic rhinoplasty or second-stage breast reconstruction combined with aesthetic facial surgery or body contouring), where a third party is responsible for the reconstructive portion and the patient for the aesthetic portion. It may sometimes be difficult, if not totally impossible, to exactly delineate the patient's financial responsibility for these procedures. We have a person in our practice who meets with patients to discuss insurance coverage and such financial problems. Despite all of these efforts, patients must understand that the total cost of all of these combined procedures and their specific financial responsibility may not be determined until long after the procedure. If patients are prepared for a possible financial surprise, they are less likely to become angry and find fault with the result. The patient coordinator and I also discuss financial responsibilities in case of complications, hospitalization, or consultation with other physicians.

Operating on Colleagues, Friends, and Family

As a practice is built and a reputation is gained, colleagues, coworkers, friends, and family will seek your services. This is a tremendous compliment to you as a physician and to your skills as a surgeon. Although this is flattering, the surgeon should understand that it can also be a significant financial drain, because this group of patients expects discounted or even complimentary surgery. Not only do such discounts and complimentary procedures generate little or no revenue to help meet overhead and malpractice costs, but also the time spent on such discounted procedures could

To My Dear Friends and Family:

During the many years that I have been in the practice of plastic surgery, I have extended full courtesy fees to close friends and doctors as a matter of principle. Over the years, I have been fortunate to gain more friends and to enjoy the professional confidence of doctors' families, to the extent that a significant part of my time is now consumed in performing such surgery.

Sadly, with the increasing costs of overhead in the practice of surgery today, not to mention the excessive and growing premium for malpractice insurance, it is no longer possible for me to fully extend such courtesies. Needless to say, it is embarrassing and distasteful for me to charge my usual fees to close friends and colleagues. Therefore, I am pleased to be able to extend a modest courtesy discount. Since all I have to offer is the expertise and skill I have developed as well as my time, I hope you will understand.

Sincerely,

_____, MD
(Physician Name)

have been spent on patients who produce full revenue. Despite this, most surgeons have a sense of obligation to discount services for this group or to selectively provide them on a complimentary basis. Your practice should have a clear policy for such discounts and free services.

I routinely discount my surgical fee for fellow physicians and their families, nurses, and other health care professionals. The amount of the discount will vary, depending on the closeness of my professional relationship with the individual in question. The same is true in dealing with friends and family. Some colleagues and family come in for a consultation expecting to pay full fees, yet others come in expecting free surgery. It is somewhat embarrassing, if not difficult, to discuss this face-to-face with colleagues, friends, and family. Years ago, Dr. Tom Rees shared with me a note that he had colleagues, friends, and family read explaining his policy for extending professional courtesy. I found the letter most useful, and to this day I use the modified version shown on p. 26.

For our office staff, the procedures are usually provided free of charge on an individual basis, reflecting the person's length of service. Each practice should have a clearly delineated policy on employee discounts. It is wise to avoid providing discounted or free operations to patients who hold out the promise of future referrals. These usually do not materialize once the operation has been completed and may well raise ethical issues.

Patient Documentation

I make every effort to dictate the office notes as soon as I have concluded the initial consultation. Although I take additional notes while I am talking to the patient, I make every effort to maintain eye contact with my patient rather than spend the entire time scribbling notes or being preoccupied with the chart. If at all possible, I limit interruptions to those that are absolutely necessary, such as emergencies. I put my cell phone on vibrate mode and ask all our nurses to do the same. It is not conducive to a thorough initial evaluation to have constant interruptions, and I will not leave a patient while I answer a phone call unless it truly is an emergency. It is important to sit down with the patient and focus your attention on him or her. You want to leave the impression that you have plenty of time to talk. Therefore I do not look at my watch or time myself when I am with a patient. I like to have a nurse or assistant present in the room at all times, and I feel it is mandatory to have a female nurse or assistant with me when I examine a female patient for breast augmentation or body contouring, not only to put the patient at ease but also for my own protection.

Once the procedure is scheduled, the patient is given instructions in preparation for the operation. These include prescriptions for skin preparation before chemical peels and laser resurfacing and lists of medications and supplements to avoid taking preoperatively to minimize postoperative bleeding and bruising. We encourage patients to take vitamin C. Patients are scheduled for a preoperative visit 1 or 2 weeks before the operation. Patients who will undergo general anesthesia need to have a physical examination, blood test, and clearance from their primary physician before surgery is scheduled. During the preoperative visit, the patient will meet the anesthesiologist, who performs another preoperative evaluation. The patient also meets again with the coordinator to review and sign the informed consent form and to have any further questions answered. If preoperative photographs have not already been taken, they are taken on this occasion. During this preoperative visit, the patient talks with our financial counselor, who goes over the fees and collects prepayment for the full amount of the procedure, including the surgeon's fee, facility fee, and fees for the overnight stay and materials. If there is any question that additional payments may be necessary after the operation, such as a pathologist's bill, this is clearly pointed out to the patient.

The patient will be evaluating the level of service before the procedure, because it serves as an indication of how well the practice will respond to her or his needs and concerns after the operation. If the patient feels that the staff were not attentive enough, slow to respond, and evasive before the operation, he or she will be concerned this may well be what they should expect after the operation. Unfavorable preoperative experience may justifiably lead the patient to cancel the procedure.

On the day of the operation, I review the patient's record before I meet with the patient to discuss the planned procedures. I take my own finger or a cotton swab and go over every proposed incision. I then mark the patient. If he or she is accompanied by a family member and allows that person to remain in the room, I ask the patient and the family member if they have any questions and inquire whether the patient remembers the risks, possible complications, and length of recovery. It's not unusual for patients at the last minute in the preoperative area to ask whether we could take off skin lesions, add an extra area for liposuction, or even add a completely new procedure. For that reason, and to avoid any postoperative misunderstandings, I confirm with the patient that we have neither left out any procedures nor added anything. I explain that if the patient wishes to add extra procedures and operative time is available, there will be an extra charge, and the patient will be billed for it. If he or she requests excision of a skin lesion or two or a small additional area for liposuction or fat injection, I often as a courtesy include that without extra charge. However, I mention that the pathologist will send a bill for examining the excised lesions.

We then proceed to the operating room. There is a special waiting area for family members if they choose to wait; if not, I ask for a phone number so that I can personally call when the operation is finished and the patient is in the recovery room.

I also inform the patient and the family that if the operation is completed in less time than I had allotted, it does not mean that I rushed through it, and conversely, if it takes longer, it does not mean that either the patient or I encountered a problem.

After the operation, patients either go home with a responsible adult or stay in our recovery suites. If the patient goes home, I call that evening to inquire whether the patient is comfortable and whether there are any questions. If I am greeted by the answering machine, I leave a message that I called to make sure that the patient is home and comfortable. I ask the patient to call if there are questions or problems. If the patient remains in our suites, either I visit or someone on the team visits the patient. Two days postoperatively, all patients receive a follow-up phone call from our surgicenter asking them how they are doing and inquiring about their experience with the center.

Postoperative Visits

Follow-up visits are as important as the initial consultation. Most patients are concerned that the red carpet and VIP treatment will be rolled out preoperatively so that they will sign up for an operation, and that their postoperative care will be less attentive, relegated to the nurses. It is important for them to have a favorable experience in their postoperative visits. We make every effort to usher postoperative facial patients straight into a private waiting room or examination room to minimize their time in our public places, such as the general waiting room. I go in and sit and greet the patient, ask how he or she has been, and how the recovery is progressing. I explain that the nurses will clean the wounds, remove sutures, and change tapes, and that our aesthetician will take care of the areas that may have been resurfaced. I inquire whether the patient needs more medication and explain that I will return for a more thorough examination once the nurses have removed sutures and cleaned the wounds. As with preoperative examinations, a nurse is present during the postoperative examination of a breast augmentation or body-contouring patient, to put the patient at ease and for my protection. It is important to close the door, sit down, make eye contact, and talk to the patient. I do not flip through the chart, read through it, or write in it. Leaving the door open, standing, reading, and writing in the chart leaves the patient with the impression that you breezed in for a few seconds, wrote in the chart, and left without examining him or her. When I return to see the patient, I examine every suture line and express my own opinion about the early results and stage of recovery. I then answer questions. If the patient is at the stage in a facial procedure where camouflage makeup can be applied, our aesthetician applies makeup, and I see the patient after this application. For patients who have undergone breast augmentation or body-contouring procedures and have recovered sufficiently, I go back in and see them when they are fully dressed to make certain they are happy with their appearance in their clothes.

Occasionally, despite my best efforts, a patient complains to the nurse that I have not been attentive enough or spent enough time after the operation. This is an important line of communication between the patient and me, and I listen to the nurse and make every effort to resolve the situation. Very often a patient who is concerned about the result may discuss it first with the nurse or patient coordinator for fear of offending the surgeon: “I don’t want to hurt his feelings.” These communications are important and are dealt with in a kind and understanding fashion. I explain to my patients that I want them to be comfortable and open with me and discuss their concerns. My feelings will not be hurt if I am told that a patient is less than satisfied with the result. I tell patients that my feelings would be hurt if they felt that they couldn’t communicate with me and chose to go elsewhere.

I rely heavily on the impressions of our nurse and patient coordinator. It is crucially important to surround yourself with good people and to listen to them. I have turned down patients based on recommendations from these professionals and have been able to diffuse potentially unpleasant situations based on their input.

Management of Complications and Problems

No one wants complications. I take all complications personally and replay the entire procedure in my mind, wondering how and why they occurred. Despite my explanations to my patients that complications do occur, even in the best of hands, it is difficult for me to accept that my patient has developed a complication. Regardless of these personal feelings and the sense of disappointment, it is necessary to deal with these problems, and more important with the patient’s anxieties, concerns, and possible resentment. Most patients feel that something went wrong, something was not done properly—otherwise they would have sailed through the operation as smoothly as their friend did, on whom your partner, your colleague, or even you operated. I usually explain the nature of the complication to the patient. If I have any idea why it happened, I explain that and outline our plan to take care of it. I usually tell the patient, “I am sorry this happened; it isn’t anything you did; it isn’t anything I did. Despite our best efforts, we have a problem. It is not the first time I have seen it, and we know how to take care of it.” I then explain exactly what has to be done and how long it will take.

In cases of postoperative hematoma in a face lift, I reoperate usually with the patient under local anesthesia, but I use general anesthesia if needed, and I explain to the patient that this will take care of the problem. It will not affect the results, but it will leave more bruising than expected, and the affected side of the face (if unilateral) will lag behind the other side in recovery.

Devastating complications, such as skin slough following a face lift, exposed breast implants, and nipple-areola loss require a more prolonged plan for recovery. Fortunately, these complications are extremely rare and are often associated with predisposing factors such as smoking. These patients require a great deal of attention. We naturally have an instinct to avoid unpleasant situations and circumstances, but these are times when our patients need us to be there for them. These patients must be seen on an almost daily basis. If a strong bond already exists between the patient and the surgeon before the complication develops, this will have a positive influence on the outcome. However, if the surgeon's relationship with the patient was already less than ideal, these complications will serve to further undermine the relationship and result in an unhappy situation for both the patient and the physician. This is when people become angry and seek legal advice, especially if the complication adds an additional financial burden to the patient. It may be tempting to abandon such a patient and to blame him or her for the complication, but it would be unwise. If you absolutely cannot continue with the patient, have a partner or trusted colleague assume the care at your expense.

When I have been able to explain the reason for the complication, I have found that patients have not only been surprised by this explanation but also have appreciated my candor. This communication has further improved our physician-patient relationship and the patient's confidence in me. To do anything less will confirm the impression that "the medical profession covers up errors."

There is no question that by offering to continue working with the patient to correct a complication, you send a reassuring message. I comfort patients by telling them that I have seen these complications and know how to take care of them, and I will not stop until we are both happy with the outcome.

The Dissatisfied Patient

Dissatisfied patients come in two varieties—your own and those of your colleagues. Despite our best efforts in preparing and evaluating our own patients, screening them, and discussing risks and complications and realistic expectations, we still have patients who are not satisfied with their outcomes. Even though these patients may have an average or good result, they are just not happy. This dissatisfaction may be the result of inadequate or even poor communication between the surgeon and patient or patient expectations that were not met. Such patients are extremely difficult to deal with and may never be satisfied. They will exhaust you and test your patience and that of everyone in your office. They also have access to the Internet and the numerous websites that grade or evaluate doctors. They have the freedom to say anything they want about you, your staff, and their result. There are no checks and balances, and it is difficult, if not impossible, to respond to these allegations or comments

once they have been posted. Although most of the time these comments are posted anonymously, most surgeons have a good idea who the patient may be, but are bound by privacy rules from commenting. The best way to deal with these patients is not to operate on them, and with maturity and experience, one should be able to identify them.

One of the most challenging problems in clinical practice is dealing with a colleague's dissatisfied patient. If the patient has an identifiable problem that is correctable and the colleague has referred the patient to you for that purpose, this represents a relatively straightforward situation, since all three parties are involved. However, most of the time the patient is self-referred and would prefer that you not contact the original surgeon.

I evaluate these patients in the same manner that I evaluate any patient. I then explain to them that the problem is correctable and how I would do it. I also explain to them that I am flattered and honored that they have chosen to consult with me, and I take that as an indication of their confidence in me as a surgeon. If the problem is a recognized and not uncommon complication or sequela of the procedure, such as implant malposition or even lid retraction, I explain that I have seen similar complications in my own patients. If I am familiar with the other surgeon and believe that he or she could just as easily correct the problem, I encourage the patient to return to the original surgeon, who may do the revision or correction at no charge or at a discount. I explain that I would not charge my own patients for a similar revision. If the patient does not wish to return to the other surgeon, he or she will usually respond, "He doesn't think there is a problem," "I can't communicate with him," or "He says there is nothing else he can do." I then tell the individual that I would have to charge my full fee for the revision and that it may take more than one procedure. I do ask all patients to have copies of their records forwarded to me, and I ask their permission to communicate with the other surgeon. If the patient does not grant permission, then it would be a breach of his or her privacy to obtain the files, complicating the situation and putting me in an awkward position with my colleagues. These are extremely delicate situations, often involving litigation. It is paramount that the patient's best interests be considered first and that everything possible be done to correct the problem, even at the risk of affecting a collegial relationship. It is important to emphasize that complications do not necessarily indicate a deviation from the standard of care and to refrain from inflammatory comments such as "This is the worst I have ever seen," or "Who did this to you?"

We are physicians and well-trained surgeons, highly skilled in the procedures we perform. Communication skills, however, were never part of our medical school or residency curriculum; we were not taught bedside manner. Yet communication and bedside manner are as important as our skills in the operating room. Our patients expect more than good results; they like to be listened to and cared for. They want a sur-

geon who is responsive and makes them feel valued and respected. Good results and satisfied patients will do far more than any advertising program to promote and grow a practice.

Concluding Thoughts

The practice of cosmetic medicine and aesthetic surgery is satisfying and rewarding for the surgeon. I am excited that it continues to evolve, and it is imperative that we adapt to these changes so that we can provide the best for our patients. To our patients, aesthetic treatments are not a necessity but the fulfillment of a personal goal; therefore their experience must be satisfying and rewarding as well. This is a partnership that at its best works smoothly and effectively for all involved.

In this chapter I have shared my approach, but in truth it is *our* approach—my partners and staff are all intimately involved in making the experience for our patients a positive one. Time spent with the patient by the surgeon and the staff is time well invested. This is especially true today, when our patients have access to all kinds of information on the Internet. Our goal is to establish a long-term and trusting relationship with our patients. We nurture an environment in which our patients can feel that they are among friends when they visit us in our office. Patient satisfaction is the best form of marketing available to us. Such patients are our best source of referrals and will themselves return if the initial experience was one worth repeating.

Clinical Caveats

A well-informed patient is a happy patient.

A well-motivated patient is a happy patient.

Eliminate postoperative financial surprises, or at least warn the patient about them.

Listen to your patients.

Learn to say “no.”

Spend time with your patients.

Respect the patient’s privacy.

First impressions last.

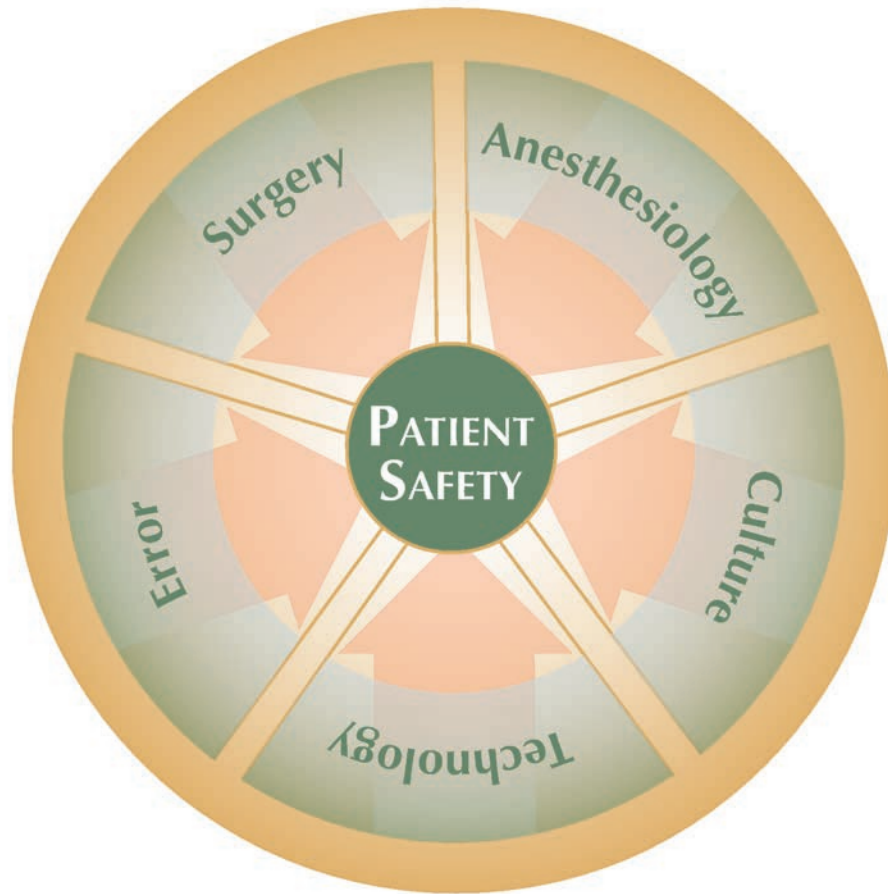
Your website is the face of your practice to the world.

The Internet can be a friend or foe.

Suggested Readings

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CHAPTER 2



Patient Safety in Aesthetic Surgery

V. LEROY YOUNG

New concepts and advances in technology accumulate so quickly these days that much of what plastic surgeons now need to know was probably not covered in their days of medical school or residency. This applies particularly to patient safety, which is becoming a medical discipline all to itself. Evidence is collected from multiple specialties—including anesthesiology, cardiology, pulmonology, endocrinology, psychology, hematology, and infectious disease—and guidelines or recommendations are developed based on that evidence.

If we plastic surgeons cannot keep up with reading our own specialty journals, when are we supposed to delve into those from other disciplines? Yet that is what we must do to keep our patients safe during what are typically elective procedures. Failure to protect our patients from medical harm may lead to consequences ranging from relatively minor postoperative vomiting or a small infection to a deep venous thrombosis (DVT) that produces lasting disability to the worst outcome of all—death.

The movement to improve patient safety began in 1999, when the Institute of Medicine issued its report, *To Err Is Human: Building a Safer Health System*. The report, which focused on the types and frequency of errors associated with the delivery of health care, defined a medical error as “the failure to complete a planned action as intended or the use of a wrong plan to achieve an aim.” An adverse event was described as “an injury caused by medical management rather than by the underlying disease or condition of the patient.” The public, medical professionals, and government agencies were shocked by some of the IOM’s findings, including the fact that more than half of surgical adverse events are preventable.

Some preventable surgical errors arise from policies and others from personnel who deliver the care. Whatever the root cause, the surgeon is ultimately responsible. Consider the example of a patient undergoing an abdominoplasty who does not receive chemoprophylaxis to prevent a blood clot and dies of a pulmonary embolism (PE) several days after she is sent home. If the surgeon had followed regularly updated expert recommendations for the use of chemoprophylaxis, this PE might have been averted. Surgeons who claim ignorance of a safety practice that would have prevented a complication are not in a defensible position, nor are those who choose to ignore evidence-based recommendations because they think they know better.

After the IOM report, the professional societies of physicians, nurses, technologists, and other groups began to disseminate patient safety information to their members. Federal agencies and associated groups also make important contributions to the patient safety movement, and their websites contain valuable resources. Some of the partners for improving the quality and safety of health care include the following:

The Agency for Healthcare Research and Quality (AHRQ), part of the U.S. Department of Health and Human Services that takes the lead in evaluating patient safety and health care outcomes (www.ahrq.gov)

The Centers for Disease Control and Prevention (CDC) (www.cdc.gov)

The Centers for Medicare and Medicaid Services (CMS) (www.cms.gov)
The Joint Commission (www.jointcommission.org)
The American Association for Accreditation of Ambulatory Surgery Facilities (AAAASF) (www.aaaasf.org)
The National Surgical Quality Improvement Program of the American College of Surgeons (www.acsnsqip.org)
The Institute for Healthcare Improvement (IHI) (www.ihl.org)
The World Health Organization (WHO) (www.who.int)
The National Patient Safety Foundation (NPSF) (www.npsf.org)

Some of these groups have developed and continually revise evidence-based measures that help streamline and standardize processes, decrease the variability of delivering health care, and improve patient outcomes. More and more, those organizations responsible for the accreditation of hospitals as well as outpatient and office-based surgery centers follow the evidence-based safety recommendations when measuring facility compliance.

One example of an approach to guideline development is the Surgical Care Improvement Project (SCIP), which was formed as a collaborative effort between CMS and the Joint Commission in 2003 with the goal of reducing preventable surgical complications that have a high frequency and cost. The work of groups like this makes issues such as prevention of surgical site infections and venous thromboembolism (VTE) important measures of quality care, facility performance, and patient outcomes in the surgical setting.

Improving Patient Safety in Plastic Surgery

The amount of information available to make our patients safer during encounters with health care is almost overwhelming. Although plastic surgeons are responsible for knowing at least the most basic recommendations for keeping patients safe during surgery, these recommendations are continually evolving and changing as evidence accumulates about safety issues. For example, at least some of the information in this chapter will likely be outdated by the time this volume is published. However, we are still responsible for knowing current safety standards not only for the facilities where we work but also for our states and the national credentialing organizations. We are helped in this by the national plastic surgery professional associations—the American Society for Aesthetic Plastic Surgery (ASAPS) and the American Society of Plastic Surgeons (ASPS). Recently they have developed requirements for earning safety-related CME credits to retain board certification, which should have the effect of forcing plastic surgeons to keep current with changes. Some of the most important patient safety concerns related to plastic surgery are briefly described in this chapter.

Prevention of Surgical Site Infections

Infection prevention efforts must be directed in multiple directions. Although surgical site infections (SSI) are a serious problem, so are infections spread by simple contact with a health care facility. Health care–associated infections have become such a problem that in 2008 Medicare began refusing to pay for many hospital-acquired infections. Relatively simple measures can make a real impact, such as instituting contact precautions, disinfecting the patient care environment and equipment, and complying with hand hygiene guidelines established by the CDC or WHO.

Special attention must be directed to the prevention of infections caused by multi-drug-resistant organisms (MDRO), including methicillin-resistant *Staphylococcus aureus* (MRSA), *Clostridium difficile* (CDI), vancomycin-resistant enterococci (VRE), and multidrug-resistant gram-negative bacteria. Although MRSA is perhaps the best-known problem, other organisms pose greater threats, especially resistant gram-negative bacteria and *C. difficile*, which recently overtook MRSA as the leading cause of hospital-associated infections. *C. difficile* infections occur primarily in individuals taking antibiotics. Because bringing a new drug to market takes 8 to 10 years, the introduction of new antibiotics will not come soon, and the pipeline is empty.

Practices and processes for reducing the risk of health care–associated infections, including those related to surgical procedures, must address a spectrum of preventive actions, because a variety of factors are known to contribute to SSIs. Some of the risk factors for infection most likely to be encountered by plastic surgeons are shown in the box.

Risk Factors for Infection	
<i>Patient-Related Factors</i>	<i>Treatment-Related Factors</i>
Diabetes mellitus	Abdominal or emergency surgery
Obesity	Operation of 2 hours or more
Recent or current smoking	Inappropriate antimicrobial prophylaxis
Poor nutritional status	Hypothermia in the perioperative period
Older age	Inadequate surgical scrub or skin antisepsis
Previous site radiation	Preoperative shaving
Postoperative anemia	Poor operating room ventilation
Immunosuppression	
	<i>Surgical Technique–Related Factors</i>
	Poor hemostasis
	Failure to obliterate dead space
	Tissue trauma

Antibiotic Use

The overuse of antibiotics is largely responsible for the problem of resistant organisms. It is the responsibility of all physicians to reduce the use of antibiotics in contexts in which they are of dubious value. In fact, many experts believe that antibiotics are unnecessary for clean surgeries without implants, which encompasses most procedures that plastic surgeons perform, but this issue is still being debated. All plastic surgeons should follow the evidence-based guidelines for administering antibiotics in the surgical setting. For many, this will require changing long-standing behaviors, which is never easy. However, the organizations that evaluate the clinical evidence and establish recommendations for reducing the rate of SSIs all agree on antibiotic delivery and timing.

USE THE CORRECT ANTIBIOTIC Surgical patients should receive antimicrobials that target the pathogens most likely to contaminate the wound. The most commonly recommended antibiotic is a first-generation cephalosporin given intravenously in a dose of 1 g (2 g if the patient's weight is more than 73 kg [160 pounds]). Another dose should be given after 3 to 5 hours if the wound has not yet been closed or the patient has lost a large amount of blood. The drugs of choice for patients with a beta-lactam allergy are clindamycin (600 to 900 mg intravenously, repeated at 6 to 12 hours) or vancomycin (1 to 1.5 g intravenously, repeated at 6 to 12 hours).

DELIVER THE ANTIBIOTIC AT THE CORRECT TIME A full dose of cefazolin or a similar antibiotic should be delivered no less than 30 minutes and no longer than 60 minutes before an incision is made. Clinical trials have shown that drug delivery outside this window (too early, at the time of incision, or after the incision) is much less effective in reducing the rate of SSIs than using the appropriate timing. If a tourniquet will be used, the antibiotic must be completely infused before tourniquet application. Vancomycin and clindamycin must be administered slowly, over the course of 1 hour; thus its administration should begin approximately 120 minutes before incision.

ADMINISTER THE ANTIBIOTIC FOR THE CORRECT DURATION Antibiotics should be administered for the shortest effective period possible; a single preoperative dose is usually all that is needed. Most studies have determined that administration of an antibiotic is unnecessary after wound closure. Unless there is a specific reason, antibiotics should be discontinued within 24 hours after the surgical incision. The exception is in cardiac surgery, after which antibiotics may be given for up to 48 hours. Some plastic surgeons typically overuse antibiotics and discharge patients with a 7- to 10-day prescription for antibiotics. This has not been found effective for reducing the risk of SSI; it does, however, contribute to drug resistance. Furthermore, there is no evidence to suggest that antibiotics should be given as long as drains are in place.

In addition to the guidelines for using the right drug at the right time, some other measures for reducing the risk of SSIs relate to proper hair removal, glucose monitoring, hypothermia prevention, and smoking cessation.

Hair Removal

Hair removal is unnecessary for most surgeries. If it is required, all infection prevention guidelines agree that shaving should be avoided, because it significantly increases the risk of SSI, with some studies reporting almost a tenfold increase. A razor makes microscopic cuts in the skin that invite bacterial growth. Many experts recommend that all razors be removed from surgical areas. When necessary, hair should be removed with electric clippers or a depilatory immediately before surgery. Patients should be instructed not to shave during the 2 weeks before a surgery.

Glucose Control

Plastic surgeons do encounter patients with type 1 and type 2 diabetes in their practices, and they should therefore understand the importance of preventing hypoglycemia and hyperglycemia in the perioperative period. Maintaining tight glycemic control may shorten recovery time and the time spent in the postanesthesia care unit (PACU). More importantly, for patients with and without diabetes, hyperglycemia before, during, and after surgery is significantly associated with an increased rate of SSIs and wound healing complications, more than a fourfold increase in some studies.

As part of the process for obtaining preoperative medical clearance for surgery, patients with diabetes should have their hemoglobin A1c level measured. The HbA1c test indicates glucose status for the previous 3 months and, according to the American Diabetes Association, the level should be less than 7%. Recent studies, however, suggest a level below 8% has some advantages, but as yet there is no consensus sufficient to change the recommendations. A higher-value HbA1c suggests a need to adjust medications before surgery with the aim of achieving tighter glucose control. The physician who manages the patient's diabetes should be consulted about perioperative management, and, if warranted, should devise a plan to adjust the timing and dosing of antihyperglycemic medication—insulin or oral—starting the day before surgery.

Preoperative staff must be aware when diabetic patients are expected, especially since they will have been NPO for several hours. These patients should be scheduled for the first surgical slot of the day. As soon as a patient with diabetes arrives at the surgical facility, the blood glucose level should be measured and insulin administered if the glucose level is 180 mg/dl or higher. Patients with insulin pumps may be encouraged to manage their pumps when conscious. Intraoperative hyperglycemia is common and blood glucose must be monitored throughout the perioperative period and treated with insulin. The common recommendation is for type 1 diabetics to be given insulin if blood glucose exceeds 140 mg/dl. Patients with type 2 diabetes can tolerate higher glucose levels, up to 200 mg/dl.

Plastic surgery can be safely performed in patients with diabetes, but surgeons are advised to seek guidance from physicians who know much more about diabetes management in the perioperative period.

Hypothermia Prevention

Since at least the mid-1990s, unplanned perioperative hypothermia has been viewed as a major risk factor for surgical site infections and other wound healing complications in patients undergoing colorectal surgery. In 2010, groups that develop and apply standards for improving patient safety and tracking outcomes (including SCIP, the Joint Commission, CMS, and IHI) expanded the recommendation for preventing hypothermia to include all surgical patients receiving general or neuraxial anesthesia for a procedure lasting 1 hour or longer. Most guidelines suggest that normothermia be maintained with active warming methods, which consist of forced-air warming systems, circulating warm water garments, and polymer-based conductive fabric blankets. Regardless of the method used, its effectiveness cannot be measured unless the core temperature is being monitored, preferably from the pulmonary artery, distal esophagus, tympanic membrane, or nasopharynx. The skin, axilla, and mouth are the least accurate measurement sites.

Hypothermia, which is defined as a core body temperature lower than 36° C (96.8° F), has serious consequences, including a threefold increase in wound infections, delayed wound healing, a higher risk for bleeding and transfusion need, cardiac events, altered drug metabolism, more difficulty obtaining hemostasis, coagulopathy disorders, and longer times in the PACU. Some studies also show that hypothermia contributes to postoperative nausea and vomiting. Surgical patients who are not actively warmed during the perioperative period almost always become hypothermic. The three stages of hypothermia development help explain why:

1. The body starts redistributing heat from the core to the periphery during the first hour of general or regional anesthesia. After 1 hour the patient is hypothermic.
2. The linear core temperature steadily declines.
3. The core temperature reaches a plateau between hours 2 and 4 of surgery with general anesthesia. This plateau does not develop with regional anesthesia and the core temperature continues to decline.

When hypothermia is allowed to develop, returning to core normothermia may require 4 or more hours. Furthermore, waiting until a patient's temperature begins to fall before initiating active warming measures is too late.

Unless preventive measures are instituted, several plastic surgery procedures place patients at high risk for developing hypothermia and all its harmful effects, especially procedures that require exposure of large body surface areas (for example, liposuction, abdominoplasty, and lower body lift). Postanesthetic shivering is common in hypothermic patients and carries its own consequences. Shivering seems to

magnify postoperative pain and may play a role in postoperative nausea and vomiting. Bruising and/or hematoma may occur more often with shivering, which could compromise the results of facial procedures such as face lift or blepharoplasty. Hypothermia definitely complicates perfusion of any type of flap, and the addition of shivering is likely to impair blood supply even more. For these reasons, postoperative shivering should be treated aggressively with an active preventive measure.

Multiple techniques are available for preventing hypothermia in the perioperative period. All clinical trials agree that *active warming* is necessary (using forced-air, circulating water, or conductive fabric blankets). Moreover, prospective, randomized, and controlled studies indicate that the key to maintaining normothermia is prewarming with an active method for about 1 hour before surgery begins. Surgeons should use the evidence-based interventions that are proven to be most protective of patients by extending active warming during and after surgery. *Passive warming* methods may be used to supplement the active ones, especially when procedures place patients at increased risk, as long as one understands that none of these can add much heat content to a patient. Frequently used passive techniques include insulation of patients with standard or even heated blankets or drapes, raising the ambient temperature of the operating room, and warming irrigation, intravenous, or infiltration fluids. Warmed fluids should be delivered at core temperature (37° C [98.6° F]). A temperature higher than 43° C (109.4° F) carries a risk of burns.

Recommended Practices for Hypothermia Prevention During General or Neuraxial Anesthesia

1. Actively prewarm patients in the preoperative area for approximately 1 hour with forced-air heating, a resistive-heating blanket, or circulating water garment.
2. Keep the ambient temperature of the operating room at approximately 22.8° C (73° F).
3. Monitor the core temperature throughout general and neuraxial anesthesia, and respond to temperature drops with active warming methods.
4. Cover as much body surface area as possible with blankets or drapes to reduce radiant and convective heat loss through the skin.
5. Actively warm patients intraoperatively with forced-air or other technology to prevent heat loss and add heat content. Rearrange the cover or covers if patients are repositioned so as much surface area is warmed.
6. Minimize repositioning time as much as possible so an active warming method can be quickly continued.
7. Warm intravenous fluids and/or infiltration fluids, especially if large volumes are used, so that they are 37° C (98.6° F) when they enter the body. This may require a warming setting of 40° C to 42° C (104° F to 107.6° F), depending on the length and diameter of the tubing/cannula. For large incisions, consider warming the irrigation fluids.
8. Aggressively treat postanesthetic shivering with a forced-air heater or resistive-heating blanket and consider pharmacologic intervention.

Achieving the goal of always maintaining normothermia will require a change in habits. Fortunately, keeping patients warm is relatively simple and can easily be incorporated into the perioperative routine.

Smoking Cessation

Today most plastic surgeons ask patients who smoke or use tobacco in another form to stop before surgery. The majority of prospective studies conducted on this issue indicate that smokers have a statistically significant increased risk of surgical complications, especially infection and delayed wound healing, than nonsmokers and former smokers. This may be a result of the fact that multiple agents contained in smoke decrease the amount of oxygen available to tissues. Nicotine, for example, is vasoactive and induces endothelial injury, inhibits capillary flow, and decreases epithelialization. Carbon monoxide causes tissue hypoxia. Some debate exists about whether heavy smoking is more risky than light smoking, and whether a former smoker has a complication rate more like a current smoker or one who has never smoked. However, just about everyone agrees that procedures involving flaps or extensive undermining are much riskier for smokers. Aesthetic results are also more likely to be compromised.

Most studies that compare complications in smokers and nonsmokers do not verify smoking status, which is unfortunate, because patient self-reporting is unreliable. Patients either say they are not smoking when they are, or they underreport the amount they smoke. The safest way to address this problem is for surgeons to test for recent smoking before and after surgery. The most common and inexpensive method for verifying smoking status is to measure the levels of cotinine in the urine, saliva, or blood. Cotinine persists in urine for up to 4 days and test results are available within about 10 minutes, at a cost of approximately \$10 per test.

Plastic surgeons have every right to refuse to perform surgery on patients who smoke, especially since not smoking makes surgery safer. A good approach to make certain someone is not smoking is to test for cotinine a few weeks before surgery and again on the morning of surgery. If a test is positive, the procedure should be delayed. Another test a few weeks after surgery proves whether someone has smoked recently. If that test is positive, the documented result might prove valuable if postoperative complications develop. The amount of time a smoker should abstain from smoking is currently unclear, but the CDC recommends 4 weeks before surgery; 2 months would be even better. By 30 days after surgery, fibroblast proliferation, collagen production and deposition, and reepithelialization have reached their peak. Postoperative abstinence is especially important if a smoker had little or no warning before surgery, as is often the case with procedures such as breast reconstruction, traumatic injury repair, or cancer resection.

Prevention of Venous Thromboembolism

In 2008, the Surgeon General's office issued a report identifying deep venous thrombosis and pulmonary embolism as among our most serious public health problems that demand attention, concerted action, and research to reduce their prevalence. According to the Surgeon General, approximately 20% of people with a PE die almost immediately, and a fatal PE is often the first symptom of DVT. The period of highest risk for a fatal PE in surgical patients is within 3 to 7 postoperative days, a point at which many surgical patients are at home, but the risk for postoperative VTE remains elevated for 3 months.

VTEs that occur in association with health care—and especially surgery—should be the easiest to prevent, yet they continue to occur at alarming rates. The Million Women Study recently reported its analysis of health records for 947,454 middle-aged women in the United Kingdom regarding the incidence of VTE during the first 12 weeks after surgery and compared it to matched middle-aged women who did not have surgery. The study determined that 1 in 140 women who had inpatient surgery was hospitalized for or died from VTE, and 1 out of 815 women who had outpatient surgery was hospitalized or died because of a VTE in the 12-week postoperative period. For women who did not undergo surgery, the incidence of VTE was 1 out of 6200. These rates seem even more disturbing when we consider that this epidemiologic study could follow only women who were hospitalized with a diagnosed VTE. The number of diagnosed DVTs is believed to represent only about a third (or less) of events, and not all people with diagnosed DVT are hospitalized.

To address the need for information about VTE development, the last several years have seen the publication of educational articles in plastic surgery journals. Although growing numbers of plastic surgeons report using VTE prophylaxis methods, the majority employ only mechanical devices such as graduated compression stockings (GCS) or intermittent pneumatic compression (IPC) applied to the calves or feet. The value of GCS is highly questionable, because they are completely passive devices and are unlikely to be fitted properly. In 2008, the eighth edition practice guidelines developed by the American College of Chest Physicians (ACCP) departed from its previous recommendations and determined that mechanical prophylaxis used alone is appropriate *only* for surgeries lasting less than 1 hour or for patients who are at very high risk for bleeding, as would be the case for a patient with an inherited or acquired thrombophilia. For other surgical patients, mechanical prophylaxis may be used in conjunction with an anticoagulant but is not recommended as the primary means of VTE prevention. According to the ACCP, the efficacy of mechanical prophylaxis methods has not been demonstrated in well-designed clinical trials; the variations in device sizes and pressures make IPCs difficult to study, and determining

whether the devices are used properly and consistently is difficult to establish. Because IPCs work primarily in the calves, they also may be unable to prevent the most dangerous clots, which propagate proximally and may be fatal if they reach the lungs. Despite these problems, IPCs are not likely to cause harm, although they are contraindicated in patients with peripheral vascular disease. If ordered, IPCs should be started in the preoperative area and worn until the patient is fully ambulatory.

Before 2008, the ACCP based its recommendations for VTE prevention on individual risk factors, an approach that has been presented in most of the plastic surgery literature related to VTE. A surgical patient's risk for VTE is determined by assigning points for every risk factor a patient has; the total number of points indicates the level of risk (low, moderate, or high) and therefore the type of VTE prophylaxis. The 2008 guidelines departed from this model and instead based recommendations according to type of surgical procedure rather than individual risk factors.

The change was made because randomized clinical trials of VTE prevention that provide the evidence for recommendations are based on group risk assignment, such as VTE incidence in patients undergoing total hip replacement, abdominal procedures, bariatric surgery, etc. Even though the new guidelines discuss a variety of surgical disciplines, the conclusions of the guidelines are similar for all procedures: *Surgery patients should receive either low-molecular-weight heparin (LMWH), low-dose unfractionated heparin (LDUH), or fondaparinux for VTE prophylaxis unless they are undergoing a minor procedure or have a high risk of bleeding.*

Even though evidence from other surgical specialties indicates that postoperative anticoagulants significantly reduce the incidence of VTE, have a positive benefit-to-risk ratio, and improve patient outcomes, chemoprophylaxis remains underused in plastic surgery. However, many plastic surgery patients tend to have multiple risk factors that place them at moderate to high risk for VTE. Some of the most common risk factors encountered are these:

- Major surgery that lasts longer than 1 hour (the risk rises with each hour)
- Age 40 years or older (the risk rises as age rises)
- General anesthesia
- Use of oral contraceptives, hormone replacement therapy, or selective estrogen receptor modulators (used for treatment of breast cancer and osteoporosis)
- Obesity
- Malignancy (active or in patient history)
- Abdominal surgery (carries higher risk than most other types of surgery)
- Varicose veins
- Smoking

Many plastic surgeons are reluctant to use anticoagulants for fear of causing bleeding complications that may compromise results. However, most meta-analyses and placebo-controlled randomized clinical trials from other surgical specialties have found that the risk of clinically important bleeding does not increase if drug instructions are followed correctly. According to the Joint Commission and the Surgical Care Improvement Project (SCIP), a bleeding risk that is considered normal for surgery is not an acceptable reason for not administering anticoagulants.

As a general rule, anticoagulants should be started at least 6 to 8 hours after surgery. One common approach is to use a drug that can be subcutaneously injected by the patient once a day beginning the morning after surgery. For the purpose of VTE prevention (not treatment) enoxaparin is packaged in a 40 mg dose, and fondaparinux syringes come in a 2.5 mg dose. The recommended duration of anticoagulant use is between 7 to 10 days to ensure that patients are protected when the risk of VTE is highest, during the first postoperative week.

The need for anticoagulants seems highest in procedures that involve the lower trunk because patient positioning invites venous stasis of the lower extremities, and increased intraabdominal pressure decreases blood flow in the femoral vein. In an analysis of 2.4 million outpatient surgeries, the American Association for Accreditation of Ambulatory Surgery Facilities (AAAASF) determined that the risk of death is 10 times higher in outpatient abdominoplasty patients than for any other outpatient procedure. Although plastic surgeons have not yet conducted the types of prospective randomized clinical trials needed to evaluate the effectiveness of chemoprophylaxis in plastic surgery patients, some surgeons have begun to report data on this question, particularly with respect to lower body–contouring procedures. In comparisons of patients receiving anticoagulants with those receiving mechanical prophylaxis only, most recent studies (but not all) have found statistically significant lower rates of VTE in patients receiving chemoprophylaxis.

With respect to bleeding, some studies have seen increased postoperative bleeding in patients who received LMWH compared to mechanical prophylaxis. Among lower body contouring patients, the incidence of hematoma and need for transfusion were significantly higher when anticoagulants were used. However, other studies have found no significant differences in bleeding complications when patients receiving LMWH were compared with controls (no treatment).

Patients with cancer are also known to be at increased risk for VTE. When compared to surgical patients without cancer, those with cancer have at least twice the risk of developing a DVT in the postoperative period and three times the risk of a fatal PE. Patients receiving chemotherapy have a risk for VTE that is 6 times higher than patients without cancer. Other treatment modalities (selective estrogen receptor mod-

ulators like tamoxifen, angiogenesis inhibitors, and aromatase inhibitors) are also associated with increased VTE risks. Plastic surgeons often treat cancer patients and must consider the use of chemoprophylaxis in this patient population, especially when performing reconstruction with flaps. One study of TRAM flap patients who received D-dimer tests and lung scans to look for VTE found that 17% who received no chemoprophylaxis had asymptomatic PEs, compared with no patients who received LMWH.

The debate about using chemoprophylaxis in plastic surgery will likely continue for the foreseeable future. Growing numbers of plastic surgeons seem to be adopting the use of anticoagulants for patients undergoing lower body contouring procedures such as abdominoplasty (with or without additional procedures), circumferential body lift, panniculectomy, and large-volume liposuction in the lower trunk or thighs. No studies have yet reported serious bleeding complications that were difficult to manage in these patients. Thus, unless a patient is at high risk of excessive bleeding, chemoprophylaxis currently seems to possess greater benefits than risks for many plastic surgery patients. The issue may ultimately be resolved by groups such as the Joint Commission, which has recently adopted guidelines regarding the timing of chemoprophylaxis for VTE prevention among inpatient surgical patients as one of its performance measures for determining a facility's quality of care during the accreditation process.

Prevention of Postoperative Nausea and Vomiting

Postoperative nausea and vomiting (PONV) is thought to affect up to 70% of surgical patients unless preventive measures are instituted. Although a postoperative complication itself, nausea and vomiting may contribute to additional complications such as hematoma and wound dehiscence following procedures such as face lift, blepharoplasty, breast surgery, or abdominoplasty. PONV may also delay discharge from the surgical facility or lead to unplanned hospital admission. Postoperative nausea and vomiting is often rated higher than pain as a source of discomfort associated with surgery and can erode patient satisfaction.

Of all the patient safety concerns, PONV is perhaps the easiest to prevent in most patients. Important risk factors for developing PONV are female gender, a history of PONV or motion sickness, not smoking, and perioperative opioid treatment. None of these risk factors is unusual in plastic surgery patients, but the risk for PONV rises 20% with each additional factor; for example, a 40% increased risk in patients with two risk factors and 80% when four risk factors are present. The key to prevention and treatment is the use of pharmacologic agents to block neurotransmitters that stimulate emesis. Some of the important receptors implicated in PONV are serotonin (5-HT₃), dopamine, histamine (H-1), neurokinin-1, cholinergic, and inflammatory receptors.

No single receptor antagonist seems to be successful in blocking PONV in patients who have two or more risk factors, but combinations of at least two drugs that target different receptors are known to be effective. When three or more receptors are blocked, PONV can be prevented in up to 90% of patients. As a general rule, the more risk factors a patient has, the more prophylactic antagonists will be needed. Commonly used antagonists include combinations of a serotonin blocker (ondansetron), an antiinflammatory (dexamethasone), a dopamine antagonist (droperidol), and/or an antihistamine (diphenhydramine) delivered intravenously, with some given preoperatively and others near the end of surgery. A neurokinin-1 receptor antagonist called aprepitant (Emend, Merck & Co., Whitehouse Station, NJ) is a newer alternative that continues to act for 48 hours and is taken in pill form before surgery.

If a patient develops PONV despite preventive efforts, the rescue should be approached using a different class of drug than was used as a prophylactic antiemetic so that a different receptor is targeted. If PONV continues beyond 6 hours after surgery, many drugs could be repeated, except for those that are long-acting, such as dexamethasone, aprepitant, and scopolamine.

Obstructive Sleep Apnea

Elective surgery can be safely performed on patients with obstructive sleep apnea (OSA), which is characterized by intermittent closure or narrowing of the upper airway during sleep that results in a 30% reduction in airflow for at least 10 seconds and reduces oxygen saturation by at least 4%. To plan for potential complications that may arise in OSA patients, the surgeon must first know the condition is present. Unfortunately, estimates suggest that OSA is undiagnosed in at least 80% of individuals who have the disorder. The plastic surgeon must therefore be aware of OSA risk factors, which include obesity (especially with a BMI greater than 35), men older than 40 and women who are perimenopausal or postmenopausal, a neck circumference larger than 17 inches in men and 16 inches in women, a positive family history, and hypertension. Experts speculate that 50% of hypertensive patients have OSA; in addition, 60% to 90% of OSA patients are obese.

Because so many people are unaware they suffer from sleep apnea and deny its symptoms, the best source for identifying patients with OSA is the spouse or another person who lives in the home. A simple screening tool called STOP has been developed to assist with identifying OSA. Sleep apnea should be suspected in a patient who has two of these four symptoms:

1. Snoring loud enough to be heard through a closed door
2. Tiredness or daytime hypersomnolence (falling asleep easily in a nonstimulating environment, such as watching television or riding in a car)
3. Observed pauses in breathing during sleep
4. Pressure reading or history of hypertension

Diagnosis is confirmed with multiple-channel polysomnography performed in a sleep laboratory. The most important OSA treatments are weight loss, elevating the head of the bed to 30 degrees to 60 degrees, using an oral appliance, and wearing a continuous positive airway pressure (CPAP) device.

Anesthesia Management

Patients with OSA typically require special anesthesia management. If OSA has been diagnosed or is suspected, the anesthesiologist should evaluate the patient before surgery because the airway may be difficult and require fiberoptic intubation. Surgery in an outpatient setting with local or regional anesthetic should be safe, but the facility should have the equipment and expertise to carefully monitor patients and deliver advanced respiratory care if needed. Longer surgeries, especially those which cannot be done with regional blocks or light sedation, should be performed in a hospital.

Extubation should not be done until the patient is fully awake. Postoperative monitoring and attentive staff are essential for recognizing respiratory depression and abnormal heart rhythms. Monitoring should be continued for at least 3 hours longer than patients without apnea would receive, and an overnight stay would be preferable. Patients who used a CPAP before surgery should bring the device to the surgical facility so it can be used in the postoperative period. If possible, the supine position should be avoided; instead, the head of the bed should be elevated to a 30- to 45-degree angle. Patients with OSA are very sensitive to sedatives and opioids, which should be sparingly used or avoided altogether. Supplemental oxygen can help maintain SpO₂ higher than 90%.

Perioperative Beta-blockers and Other Cardiac Issues

It is not unusual to encounter patients with some degree of cardiovascular disease, especially hypertension, in plastic surgery practices. Individuals seeking body contouring after weight loss, obese patients inquiring about liposuction, and women who want to undergo breast reconstruction are among those more likely to be taking beta-blockers. The withdrawal of beta-blockers for surgery has been found to carry a much higher risk of mortality than continuation of the drug. Consequently, the American College of Cardiology/American Heart Association (ACC/AHA) and SCIP recommend that surgical patients who take daily beta-blockers continue the therapy throughout the perioperative period to reduce the risk of cardiovascular complications during and after surgery. If beta-blocker therapy is not continued perioperatively, the surgeon should document the reason (or reasons).

The ACC/AHA also recommends that surgeons *not* order perioperative beta-blockers for all patients in an effort to reduce perioperative cardiac risks. Starting a patient on beta-blockers requires monitoring by a cardiologist, internist, or other specialist. Plastic surgeons are not trained to diagnose and/or treat cardiovascular disease and

should consult with cardiac specialists about patients who have risk factors for major cardiac complications associated with surgery:

- A high-risk operation (intraperitoneal, intrathoracic, vascular)
- A history of ischemic heart disease or heart failure
- A history of cerebrovascular disease
- Diabetes requiring insulin
- A preoperative serum creatinine level above 20 mg/dl

If a patient is taking antiplatelet drugs, such as clopidogrel bisulphate (Plavix) or aspirin, the plastic surgeon needs to know why. Surgery increases the risk of coronary stent thrombosis, especially early after stent placement. Stopping an antiplatelet drug should not be recommended by a plastic surgeon if a stent is present unless the patient's cardiologist approves.

Office-Based Surgery

All board-certified plastic surgeons who perform surgery in their offices have a responsibility to make sure their facilities are accredited by AAAASF, the Joint Commission, or some other recognized credentialing organization. Gaining certification requires meeting certain safety practices and tracking all surgical complications and adverse events. Whenever a surgical patient is on the premises, someone trained in advanced cardiac life support must be present, and all personnel who work in the surgical area should be trained in basic cardiopulmonary resuscitation. The types of routine monitoring and emergency equipment and supplies needed at the facility are usually mandated by accrediting agencies.

In a review that compared surgical outcomes in offices and ambulatory surgery centers in Florida, the risk of adverse incidents and death was 10 times higher in offices than surgery centers. Thirteen deaths occurred in office facilities, only 15% of which had an anesthesiologist present, with only 38% of offices accredited for surgery. This study highlights the fact that a surgeon is not an anesthesiologist. The AAAASF requires that general anesthesia be administered by an anesthesiologist or certified registered nurse anesthetist (CRNA). A surgeon may give intravenous sedation but may not deliver Propofol because it requires careful monitoring.

Evidence-based initiatives such as those that call for changes in infection prevention protocols tend to arise in hospitals first, but they eventually spread to office settings and outpatient surgery centers. Ultimately, quality and performance reporting related to complications will be required by agencies such as AAAASF during a facility's accreditation process. Every site at which surgery is performed should have documented policies and procedures that directly address patient safety concerns. Moreover, those policies should be routinely reviewed and, if needed, modified to

reflect the best evidence available at the time. Sometimes the adoption of guidelines requires changing long-standing habits.

Building a Culture of Safety

In recent years, the value and applications of checklists in medicine, especially surgery, have been proved worthwhile. The measures contained in national guidelines are reviewed and revised as evidence warrants in an effort to reflect the state of the science. Ultimately, such guidelines are used as a way to measure facility quality and patient outcomes.

Another method of improving patient safety is growing in popularity, especially in larger facilities: opting out of safety recommendations. Instead of writing orders to have something done, “opt-out” requires physicians to explain why a safety practice is not being followed. For example, an order does not need to be written for an antibiotic to be administered, but if it was not given—and at the recommended time—the reason must be documented. Some newer recommendations from the Joint Commission pertaining to VTE prophylaxis (both mechanical and pharmacologic) require the surgeon to specify why preventive measures were not ordered; likewise, a bleeding risk considered normal for surgery is not an acceptable reason for not using anticoagulants.

The Surgical Safety Checklist developed by the WHO presents a list of actions that should always be performed by the surgical staff (see p. 52). This protocol, or a variation of it, may be posted in operating rooms around the country, yet it is ignored daily. Although surgeons and other members of the perioperative team know their responsibilities without having to be reminded, preventable errors still occur. Thus reminders are crucial to keeping patients safe.

The Surgical Safety Checklist has been prospectively examined in eight countries at different stages of development before and after the checklist intervention was introduced. The preintervention group consisted of 3733 patients undergoing non-cardiac surgery, and the intervention group had 3955 patients. When the checklist was used, the patient rate of death significantly declined ($p = 0.003$), as did the number of inpatient complications ($p < 0.001$). The reasons for the improvement in patient outcomes may go beyond use of a checklist. In several of the hospitals, adhering to the checklist required changing some systems (for example, when antibiotics are administered before surgery) and behaviors (operating room staff must communicate about the patient during the surgical time-out and again at the debriefing). Designed as a sequence of tasks to perform, the checklist resulted in better team communication and awareness of safety practices.



SURGICAL SAFETY CHECKLIST (FIRST EDITION)

Before induction of anaesthesia

Before skin incision

Before patient leaves operating room

SIGN IN	TIME OUT	SIGN OUT
☐ PATIENT HAS CONFIRMED • IDENTITY • SITE • PROCEDURE • CONSENT	☐ CONFIRM ALL TEAM MEMBERS HAVE INTRODUCED THEMSELVES BY NAME AND ROLE	NURSE VERBALLY CONFIRMS WITH THE TEAM:
☐ SITE MARKED/NOT APPLICABLE	☐ SURGEON, ANAESTHESIA PROFESSIONAL AND NURSE VERBALLY CONFIRM • PATIENT • SITE • PROCEDURE	☐ THE NAME OF THE PROCEDURE RECORDED
☐ ANAESTHESIA SAFETY CHECK COMPLETED	ANTICIPATED CRITICAL EVENTS	☐ THAT INSTRUMENT, SPONGE AND NEEDLE COUNTS ARE CORRECT (OR NOT APPLICABLE)
☐ PULSE OXIMETER ON PATIENT AND FUNCTIONING	☐ SURGEON REVIEWS: WHAT ARE THE CRITICAL OR UNEXPECTED STEPS, OPERATIVE DURATION, ANTICIPATED BLOOD LOSS?	☐ HOW THE SPECIMEN IS LABELLED (INCLUDING PATIENT NAME)
DOES PATIENT HAVE A:	☐ ANAESTHESIA TEAM REVIEWS: ARE THERE ANY PATIENT-SPECIFIC CONCERNS?	☐ WHETHER THERE ARE ANY EQUIPMENT PROBLEMS TO BE ADDRESSED
KNOWN ALLERGY?	☐ NURSING TEAM REVIEWS: HAS STERILITY (INCLUDING INDICATOR RESULTS) BEEN CONFIRMED? ARE THERE EQUIPMENT ISSUES OR ANY CONCERNS?	☐ SURGEON, ANAESTHESIA PROFESSIONAL AND NURSE REVIEW THE KEY CONCERNS FOR RECOVERY AND MANAGEMENT OF THIS PATIENT
☐ NO	HAS ANTIBIOTIC PROPHYLAXIS BEEN GIVEN WITHIN THE LAST 60 MINUTES?	
☐ YES	☐ YES	
DIFFICULT AIRWAY/ASPIRATION RISK?	☐ NOT APPLICABLE	
☐ NO	IS ESSENTIAL IMAGING DISPLAYED?	
☐ YES, AND EQUIPMENT/ASSISTANCE AVAILABLE	☐ YES	
RISK OF >500ML BLOOD LOSS (7ML/KG IN CHILDREN)?	☐ NOT APPLICABLE	
☐ NO		
☐ YES, AND ADEQUATE INTRAVENOUS ACCESS AND FLUIDS PLANNED		

THIS CHECKLIST IS NOT INTENDED TO BE COMPREHENSIVE. ADDITIONS AND MODIFICATIONS TO FIT LOCAL PRACTICE ARE ENCOURAGED.

An analysis of closed malpractice claims determined that failures in communication can lead to injury in surgical patients. In addition, root cause analysis has revealed that communication errors played a role in 80% of wrong-site surgeries reported to the Joint Commission. The factors most commonly associated with a breakdown in communication are ambiguity about responsibilities in 73% of cases and “status asymmetry” in 74% (the surgeon has the highest status in the operating room). A good opportunity for soliciting input from all team members is a preoperative briefing, the surgical time-out, or a debriefing at the end of a procedure. A surgical time-out that uses a checklist is known to reduce failures in team communication. For example, before a time-out intervention was introduced in one study, 3.95 communication failures per procedure were documented by trained observers; after instituting the intervention, the failures declined to 1.31 per procedure ($p < 0.001$).

Many elements of an effective preoperative briefing (as staff gather in the operating room) or time-out (just before making the incision) have been identified. The obvious elements are staff introductions and identification of the patient, the procedure, and the laterality (if applicable). This pause should also outline the surgical plan and its critical steps, as well as potential patient safety risks or hazards and equipment problems. Identification of issues that might arise in advance can prevent or minimize adverse events. In addition, any medical concerns, such as a comorbid condition, should be specified and patient positioning explained.

Checklists and Guidelines

Anesthesiology used to have one of the highest rates of error in medicine, estimated to be 25 to 50 per million. Development of standardized protocols and equipment has reduced the error rate in anesthesiology to 5.4 per million. Anesthesiologists took their cue from the written protocols and checklists used by such high-risk professions as aviation, the military, and nuclear power engineering. Checklists—concise lists of action items—are essential for ensuring that patient safety procedures are followed. Some may think that going through a checklist and written protocol multiple times a week is boring, repetitive, and a waste of time and effort. Do we want airline pilots to have similar complacent attitudes, or do we want all checklists to be completed before take-off and landing? Checklists can have great value when tasks become so automatic that nobody pays attention.

Just as each patient is an individual, every surgery is a unique and complex process, even if the procedure is simple. At any point a crisis can arise, and a life can be lost or damaged. Every person in an operating room has his/her individual responsibilities, and all are focused on different tasks that must be completed at the same time. Staff must also remain aware of the “big picture” and know what everybody else in the room is doing. The surgeon has the greatest responsibility in this process because he or she will ultimately receive the praise or the blame.

Despite their limitations, several guidelines that span the time between initial screening and postoperative follow-up are presented below. Although more extensive than the WHO Surgical Safety Checklist, these guidelines do not pretend to be all inclusive. It is hoped that these guidelines may serve as prompts for important issues plastic surgeons should think about.

Getting Patients Ready for Surgery

An emphasis on ensuring a patient's safety should begin with the initial consultation, when the surgeon first meets a patient and begins to establish a relationship. The surgeon and his/her staff must explain that a patient's own safety may depend on the extensiveness and truthfulness of answers to questions about medical and surgical history. For example, patients rarely give you their actual weight, and some smokers will not tell you they smoke. One reason that patients are sometimes less than truthful is because they do not want to give the surgeon a reason to refuse to perform a desired procedure.

Patients may be more accurate with health and medication history if they complete medical/surgical questionnaires at home rather than in the waiting room. Once you have the health history questionnaire, the physician must not glance through it and assume that this provides all that is necessary of a patient's medical history. Probing questions should be asked about everything checked "yes" on the form, and why all of a patient's medications were prescribed. It is important to determine whether other medications have been prescribed but not taken or were taken in the past but are no longer needed. Listening closely to what the patient says and asking follow-up questions when necessary are essential. For example, if a patient mentions that a parent or sibling once had a problem with general anesthesia, the physician should ask for an explanation. If patients can recall only sketchy details, they should be asked to provide the information when they learn more. Such information could prevent the development of a potentially fatal episode of malignant hyperthermia.

The items listed in the box are essential to preparing patients for surgery.

Text continued on p. 59

Suggested Guidelines for Preparing Patients for Surgery

Obtain a complete medical and surgical history. Consider asking what, where, when, and why questions.

Record all medications currently taken or taken in the recent past. Include over-the-counter drugs and supplements (some of which can affect blood-clotting). Ask whether any medications have changed every time a patient is seen in the preoperative period.

Stop estrogen-containing drugs (birth control and hormone replacement therapy) 4 weeks before major surgical procedures because they raise the risk for DVT.

Stop all selective estrogen-receptor modulators (used for breast cancer or osteoporosis prevention and treatment) at the time recommended by the manufacturer of the specific drug. This may vary from a few days to a few weeks.

Some patients who take clopidogrel, daily aspirin, or other antiplatelet drugs may need to stop these medications 1 to 2 weeks before surgery. Others should continue them throughout the perioperative period. Consult with the prescribing physician to determine the wisest option. Antiinflammatory drugs also elevate the risk of bleeding and ideally should be stopped 2 weeks before surgery.

Patients who are 50 years of age or older should obtain an electrocardiogram and the following laboratory tests: complete blood cell count, basic metabolic panel, prothrombin time, and partial thromboplastin time. Test results from within the past year may be acceptable if there have been no health changes.

Order blood tests needed to evaluate the nutritional status of patients who have had bariatric surgery.

Consult with specialists if a patient has any chronic condition to determine how surgery might impact the disease or how their conditions might influence perioperative care. This is especially important for cardiovascular and pulmonary disorders, including hypertension and asthma.

Determine whether a patient with a chronic condition should have surgery in an office setting versus ambulatory center versus hospital operating room.

Have patients with chronic illnesses, massive weight loss, or any medical issues you are not comfortable with obtain medical clearance for surgery from the primary care physician.

Determine whether a patient's expectations are realistic. Get psychiatric clearance if the patient has a history of serious pathology. For those suffering from depression (now or in the past), make sure the disease is well controlled (contact the mental health professional or ask for a letter of clearance).

Have patients with diabetes get a hemoglobin A1c test, which measures glucose status for the past 3 months. Consult with the physician who manages the diabetes to determine what modifications in the insulin or other medication regimen might be needed the night before and day of surgery.

Explain the need for abstinence from smoking for 1 month before and after surgery and tell patients they will have a urine cotinine test at least 2 weeks before surgery, the morning of surgery, and at some point after surgery to verify that they are not smoking.

Be attentive to indications that a patient may (knowingly or unknowingly) have obstructive sleep apnea. Patients diagnosed with OSA should have a preoperative consult with an anesthesiologist.

Tell patients who use a continuous positive airway pressure (CPAP) device for OSA at home to bring the unit to the surgical facility for use after the procedure.

Instruct patients not to shave the surgical area for 2 weeks before surgery as a way to lower risk of infection.

Check for bacterial and yeast infections in the skin folds of massive-weight-loss patients and treat such infections before surgery with fluconazole or nystatin.

Make certain that all consent documents have been fully discussed and are properly signed.

Suggested Preoperative Preparation Guidelines

Patients should shower with a 4% chlorhexidine gluconate (CHG) product on the morning of surgery to reduce microbial colony counts. Those with skin folds should additionally shower the evening before surgery. A second cleansing of the operative site should be performed in the preoperative area using cleansing wipes that contain 2% CHG.

Verify the patient's current medications and identify patients with allergies.

Mark the patient while he or she is awake to confirm the correct operative site.

Perform urine cotinine testing or some other reliable test to ensure the patient has not smoked if appropriate to the surgical procedure.

Attach the patient's pulse oximeter and other vital signs monitors and make sure they function properly.

Begin hypothermia prevention 45 to 60 minutes before surgery by prewarming the patient with a forced-air heating blanket or some other active warming device. (Warmed cotton blankets are not sufficient.)

Begin DVT/PE prophylaxis with intermittent pneumatic compression (IPC) or sequential compression devices (SCD) at least 30 minutes before surgery.

When indicated, administer cephalosporin or another appropriate parenteral antibiotic no sooner than 30 minutes or longer than 60 minutes before the incision. Adjust the dosage according to patient weight. Clindamycin is usually preferred for patients allergic to penicillin. If clindamycin or vancomycin is used, its administration should begin 2 hours before incision. Timing of the dose may depend on whether a surgical delay is possible.

Begin the drug protocol for prevention of postoperative nausea and vomiting (PONV) in patients with two or more risk factors. High-risk patients may benefit from a prescription for aprepitant, a 40 mg pill taken the morning of surgery that provides 48 hours of protection.

All patients with diabetes, especially those who have been without oral medication or insulin since the evening before, must have their glucose checked on arrival in the preoperative area. Tight glucose control (80 to 120 mg/dl) should be maintained with insulin titrated to blood sugar levels throughout the perioperative period or according to his/her physician's advice.

If hair removal is necessary, have the nurse use clippers rather than a razor.

Suggested Intraoperative Guidelines

Set the operating room temperature to approximately 23° C (73.4° F) to help maintain normothermia.

Continue IPCs or SCDs for DVT prophylaxis.

Place the patient beneath a forced-air warming blanket to actively warm nonsurgical areas and maintain a body temperature of 36.1° C (97° F) or higher throughout surgery. Consider warming the irrigation, tumescent, and intravenous fluids so they are delivered at approximately 37° to 41° C (98.6° to 105.8° F). If the patient is repositioned during surgery, continue active warming methods after each position change. Use proper padding and gel heel protectors to prevent traction, pressure, or nerve injury. Recheck with every change in patient position.

Have preoperative photographs and/or imaging results posted for reference.

Reinforce the patient's markings.

Place a Foley catheter if needed (large-volume liposuction, or major body contouring such as a lower body lift).

Take the surgical time-out as close as possible to making the incision, when all staff are present and are not distracted by other matters. Use a standard time-out routine and make certain all operating room staff are involved and all equipment and supplies are available and functional.

Continue glucose monitoring at least every 60 minutes and treat to prevent hyperglycemia.

Consider supplying increased oxygen (80% FiO₂) to reduce the incidence of wound infections and possibly PONV.

Administer ondansetron (4 mg intravenously) less than 2 hours before the end of surgery for patients at highest risk of PONV.

Use a standard sign-out routine to make certain all counts are correct and all specimens are properly labeled. Also summarize any issues or concerns pertinent to the specific patient's postoperative care. This may include the need for extended postoperative monitoring if any cardiac or respiratory events occurred during the procedure.

Remove the Foley catheter at the end of the procedure (if applicable).

Suggested Postoperative Guidelines

Recovery Area or Postanesthesia Care Unit

Continue patient warming with forced air in the recovery area or PACU if the patient is hypothermic. If shivering develops, intensify warming efforts and consider medication with meperidine or other drug.

Consider continuing 80% FiO₂ for 2 hours with a non-rebreather mask.

Continue IPCs or SCDs for DVT prophylaxis until discharge.

Do not extubate OSA patients until they are fully awake. Transfer them to a unit where their vital signs can be frequently monitored. Continue supplemental oxygen throughout hospitalization to maintain SpO₂ above 90%. Use a continuous positive airway pressure (CPAP) device in the hospital if a patient uses one at home. A 45-degree modified sitting position will improve ventilation. Use sedatives and pain medicine judiciously in OSA patients.

Continue close glucose monitoring in patients with diabetes and have insulin available for injection or infusion. Determine when and how patients should resume self-monitoring.

Manage fluids to maintain a urine output of 50 to 100 ml/hr.

Discontinue antibiotics within 24 hours unless there is a specific reason to continue.

Use a patient-controlled analgesia (PCA) pump for pain control with inpatients unless analgesia was provided with an epidural or nerve block.

If a patient develops PONV despite preventive efforts, do not repeat the same drug or drugs; order a drug that blocks a different receptor.

Begin ambulation on the evening of surgery.

Order incentive spirometry for all inpatients.

Make certain that printed postoperative instructions are given to the patient or a family member.

When indicated, begin chemoprophylaxis on the first postoperative day after checking the patient for any bleeding complications. Have the patient trained in the use of self-administered enoxaparin or fondaparinux, which should be continued for 7 to 10 days, especially with lower body procedures.

Postdischarge Recommendations

Remove drains when output drops below 30 ml/24 hr.

Minimize the use of liposuction compression garments to prevent permanent horizontal creases in the skin.

Instruct patients not to exercise or have sex for at least 3 weeks following major procedures.

Reinforce the idea that patients should avoid cigarette smoke. Repeat cotinine testing within 2 to 4 weeks when appropriate and document the results in the medical records.

Crisis Situations

Beyond the information presented in this chapter, plastic surgeons need to know how to manage life-threatening complications that may occur suddenly during surgery—malignant hyperthermia (MH) and local anesthetic systemic toxicity (LAST). These situations are quite rare but can develop in any surgical setting: the hospital, outpatient center, or office. The drugs, supplies, and treatment protocol needed to prevent death are discussed next. Successful recovery from MH or LAST requires rapid recognition of the problem, knowledge of what to do in the crisis, immediate action, and the availability of the treatment and monitoring equipment necessary. Neither condition can be studied with the types of clinical trials that underlie the safety recommendations described throughout this chapter, because treatment cannot ethically be withheld. Consequently, the treatment protocols described represent the current state of knowledge.

Malignant Hyperthermia

MH is a life-threatening, pharmacogenetic disorder of skeletal muscle metabolism triggered by volatile inhalation (gas) anesthetics and/or the depolarizing muscle relaxant succinylcholine. MH occurs only in people with a genetic trait that makes them susceptible, yet few people planning surgery would know they carry the trait for this inherited myopathy, which is detected by genetic testing or muscle biopsy. Consequently, every surgical patient should be presumed to be susceptible to MH. An episode of MH begins when a triggering agent disturbs calcium homeostasis. If not quickly diagnosed and treated, MH may lead to sudden cardiac arrest and death during or after general anesthesia with any of these agents:

- Succinylcholine
- Halothane
- Sevoflurane
- Desflurane
- Isoflurane
- Enflurane
- Methoxyflurane

A surgeon may not intend to use any of these agents, but plans may change, regardless of the type of facility where surgery is performed. For example, the use of succinylcholine may be needed in an emergency situation to establish an airway. Consequently, all procedures that require more than local anesthesia should be performed in an accredited facility with staff who know what to do if MH develops.

The incidence of MH is unknown, but the Malignant Hyperthermia Association of the United States (MHAUS) estimates that 1000 cases occur each year. This would mean that two or three MH episodes happen every day in the United States. In an MH episode, intracellular free calcium is released in striated skeletal muscle and sustained muscle contraction is activated. The rapid escalation of muscle metabolism increases oxygen consumption, produces excess carbon dioxide, and breaks down ATP (adenosine triphosphate), which stores the energy of muscle cells. As more energy is expended, more heat is produced. The cell membranes eventually collapse and high levels of potassium (K) and creatine kinase (CK) are released into the bloodstream.

MH develops without warning. Unfortunately, its signs and symptoms are inconsistent, may appear in a different order, and are not all present in every patient in crisis. Important signs of MH include unexplained tachycardia, a rise in expired carbon dioxide, hypercarbia, hypoxemia, generalized or masseter muscle rigidity, cardiac arrhythmias, metabolic acidosis, and hyperkalemia. A rise in body temperature often occurs late in the episode, as does rhabdomyolysis, which is usually identified by high serum levels of creatine kinase, excretion of myoglobin in the urine (myoglobinuria), and renal failure.

Because MH may escalate into a life-threatening crisis within minutes, all operating room personnel must be quick to recognize it and initiate treatment with dantrolene sodium, which directly relaxes skeletal muscle and reduces the release of calcium within muscle cells. MHAUS is the best single source of information on MH, its development, symptoms, diagnosis, and treatment, and surgeons should familiarize themselves with its excellent website at www.mhaus.org. MHAUS also maintains a hotline that is staffed 24 hours a day, 365 days a year to help with diagnosis and treatment of MH. The hotline will put callers in touch with an on-call anesthesiologist who specializes in MH crises and can advise operating room staff throughout the treatment process. A call to the hotline should be one of the first actions taken if MH is suspected.

MH Hotline: 1-800-644-9737
(1-800-MH-HYPER)
Outside the US: 001-315-464-7079

Surgeons should download the treatment instructions for MH from the MHAUS website (see p. 61) and also order these guidelines in larger format wall posters.

Effective May 2008

MH Hotline
1-800-644-9737

Outside the US:
001-315-464-7079

EMERGENCY THERAPY FOR MALIGNANT HYPERTHERMIA

DIAGNOSIS vs. ASSOCIATED PROBLEMS

Signs of MH:

- Increasing ETCO₂
- Trunk or total body rigidity
- Masseter spasm or trismus
- Tachycardia/tachypnea
- Mixed Respiratory and Metabolic Acidosis
- Increased temperature (may be late sign)
- Myoglobinuria

Sudden/Unexpected Cardiac

Arrest in Young Patients:

- Presume hyperkalemia and initiate treatment (see #6)
- Measure CK, myoglobin, ABGs, until normalized
- Consider dantrolene
- Usually secondary to occult myopathy (e.g., muscular dystrophy)
- Resuscitation may be difficult and prolonged

Trismus or Masseter Spasm with Succinylcholine

- Early sign of MH in many patients
- If limb muscle rigidity, begin treatment with dantrolene
- For emergent procedures, continue with non-triggering agents, evaluate and monitor the patient, and consider dantrolene treatment
- Follow CK and urine myoglobin for 36 hours.
- Check CK immediately and at 6 hour intervals until returning to normal. Observe for dark or cola colored urine. If present, liberalize fluid intake and test for myoglobin
- Observe in PACU or ICU for at least 12 hours

ACUTE PHASE TREATMENT

1 GET HELP. GET DANTROLENE – Notify Surgeon

- Discontinue volatile agents and succinylcholine.
- Hyperventilate with 100% oxygen at flows of 10 L/min. or more.
- Halt the procedure as soon as possible; if emergent, continue with non-triggering anesthetic technique.
- Don't waste time changing the circle system and CO₂ absorbant.

2 Dantrolene 2.5 mg/kg rapidly IV through large-bore IV, if possible

To convert kg to lbs for amount of dantrolene, give patients 1 mg/lb (2.5 mg/kg approximates 1 mg/lb).

- Dissolve the 20 mg in each vial with at least 60 ml sterile, preservative-free water for injection. Prewarming (not to exceed 39° C.) the sterile water may expedite solubilization of dantrolene. However, to date, there is no evidence that such warming improves clinical outcome.
- Repeat until signs of MH are reversed.
- Sometimes more than 10 mg/kg (up to 30 mg/kg) is necessary.

- Each 20 mg bottle has 3 gm mannitol for isotonicity. The pH of the solution is 9.

3 Bicarbonate for metabolic acidosis

- 1-2 mEq/kg if blood gas values are not yet available.

- **4 Cool** the patient with core temperature >39°C. Lavage open body cavities, stomach, bladder, or rectum. Apply ice to surface. Infuse cold saline intravenously. Stop cooling if temp. <38°C and falling to prevent drift < 36°C.

5 Dysrhythmias usually respond to treatment of acidosis and hyperkalemia.

- Use standard drug therapy except calcium channel blockers, which may cause hyperkalemia or cardiac arrest in the presence of dantrolene.

6 Hyperkalemia – Treat with hyperventilation, bicarbonate, glucose/insulin, calcium.

- Bicarbonate 1-2 mEq/kg IV.
- For **pediatric**, 0.1 units insulin/kg and 1 ml/kg 50% glucose or for **adult**, 10 units regular insulin IV and 50 ml 50% glucose.
- Calcium chloride 10 mg/kg or calcium gluconate 10-50 mg/kg for life-threatening hyperkalemia.
- Check glucose levels hourly.

7 Follow ETCO₂, electrolytes, blood gases, CK, core temperature, urine output and color, coagulation studies. If CK and/or K⁺ rise more than transiently or urine output falls to less than 0.5 ml/kg/hr, induce diuresis to >1 ml/kg/hr and give bicarbonate to alkalinize urine to prevent myoglobinuria-induced renal failure. (See D below)

- Venous blood gas (e.g., femoral vein) values may document hypermetabolism better than arterial values.
- Central venous or PA monitoring as needed and record minute ventilation.
- Place Foley catheter and monitor urine output.

POST ACUTE PHASE

- **1** Observe the patient in an ICU for at least 24 hours, due to the risk of recurrence.

- **2** Dantrolene 1 mg/kg q 4-6 hours or 0.25 mg/kg/hr by infusion for at least 24 hours. Further doses may be indicated.

- **3** Follow vitals and labs as above (see #7)

- Frequent ABG as per clinical signs
- CK every 8-12 hours; less often as the values trend downward

- **1** Follow urine myoglobin and institute therapy to prevent myoglobin precipitation in renal tubules and the subsequent development of Acute Renal Failure. CK levels above 10,000 IU/L is a presumptive sign of rhabdomyolysis and myoglobinuria. Follow standard intensive care therapy for acute rhabdomyolysis and myoglobinuria (urine output >2 ml/kg/hr by hydration and diuretics along with alkalization of urine with Na-bicarbonate infusion with careful attention to both urine and serum pH values).

- **2** Counsel the patient and family regarding MH and further precautions; refer them to MHAUS. Fill out and send in the Adverse Metabolic Reaction to Anesthesia (AMRA) form (www.mhreg.org) and send a letter to the patient and her/his physician. Refer patient to the nearest Biopsy Center for follow-up.

CAUTION:

This protocol may not apply to all patients; alter for specific needs.

Non-Emergency Information

MHAUS
 PO Box 1069 (11 East State Street)
 Sherburne, NY 13460-1069

Phone
 1-800-986-4287
 (607-674-7901)

Fax
 607-674-7910

Email
info@mhaus.org

Website
www.mhaus.org



Another valuable resource available from the MHAUS website is the description of the supplies needed for stocking the MH cart or kit that should be readily available at every surgical facility. The most important drugs needed for an MH kit are shown below.

Important Drugs for the MH Kit*

Dantrolene sodium for injection—at least 36 vials* (each to be diluted with 60 ml sterile water at time of use).

If surgery is performed on obese patients, 36 vials will be insufficient. For example, if a patient weighs 100 kg (220 pounds), 1000 mg of dantrolene may be needed (50 vials). The amount of sterile water for reconstitution and all other drug ingredients will also require adjustment.

Sterile water for injection USP (without a bacteriostatic agent) for reconstitution of dantrolene: Two 1000 ml bags.

Five sodium bicarbonate (8.4%): 50 ml syringes.

Two dextrose 50%: 50 ml vials.

Two calcium chloride (10%): 10 ml vials.

Four furosemide 40 mg ampules.

One regular insulin: 100 units/ml (refrigerated).

Lidocaine for injection: 100 mg/5 ml or 100 mg/10 ml in preloaded syringes.

*A complete list of required drugs, general equipment, monitoring equipment, nursing supplies, laboratory testing supplies, and forms required for an MH kit is available at <http://medical.mhaus.org/index.cfm/fuseaction/OnlineBrochures.Display/BrochurePK/B5DBDF12-20C3-4537-948C098DAB0777E3.cfm>.

Supplies for rapid patient cooling should also be readily available, such as a minimum of 3000 ml refrigerated saline solution and large and small plastic bags that can be filled with ice.

MH is rare, but all surgeons and anesthesiologists should be prepared to manage an MH crisis. Rescue from MH may take hours and requires the efforts of a large team. As an example, 3 or 4 people are needed to reconstitute Dantrolene for infusion. Early recognition and preparation is the key to successful treatment of MH. Having a protocol in place and all the many supplies available may make the difference in saving a patient's life or reducing the chance of long-term morbidity.

Local Anesthetic Systemic Toxicity (LAST) and Lipid Infusion

The use of local anesthetics and regional blocks is common among plastic surgeons, but knowledge of what to do if toxicity develops and leads to cardiovascular collapse is not. Although all types of local anesthetics are capable of reaching toxic lev-

els, the aminoamides, which are metabolized in the liver, seem to be more often implicated in toxicity of brain and heart tissue. The aminoamides include bupivacaine, ropivacaine, lidocaine, levobupivacaine, mepivacaine, prilocaine, and etidocaine. There are some indications that levobupivacaine and ropivacaine may be less likely to cause cardiac toxicity.

Detection of LAST

Successful treatment of LAST greatly depends on its prompt diagnosis. Toxicity is not always immediately evident after anesthetic injection and may take up to 60 minutes to manifest, especially if tumescent solutions are used. Intoxication may develop at any time when local anesthetic is delivered through a catheter. Signs of minor systemic toxicity are usually neurologic and may include perioral numbness, facial tingling, restlessness, confusion, muscle twitching, drowsiness, tinnitus, metallic taste, dizziness, and slurred speech. Major toxicity is accompanied by sudden loss of consciousness, tonic-clonic seizures, hypertension followed by progressive hypotension, tachycardia, ventricular arrhythmias, bradycardia or asystole, ventricular fibrillation, and cardiac arrest. The cardiovascular signs are not always preceded by neurologic signs, and cardiac arrest may be the first indication of LAST.

Treatment of LAST

Evidence indicates that the infusion of lipid emulsion (20% Intralipid) can effectively reverse anesthetic toxicity, whether the anesthetic is delivered locally or regionally. Every facility where local anesthetic is used in large doses should have a stocked Lipid Rescue Kit immediately available if a crisis arises. The same applies for cardiac monitors and supplies needed for Advanced Cardiac Life Support (ACLS), which should begin as soon as the need is recognized, before lipid rescue is attempted. Arrhythmias may be refractory to treatment and resuscitation measures will likely be needed for a prolonged period, perhaps 1 hour or more.

A Lipid Rescue Kit should be clearly marked and contain these supplies:

- 1000 ml of 20% Intralipid
- Intravenous tubing (for lipid infusion)
- 60 ml syringes and needles (for lipid bolus doses)
- A printed protocol

The protocol on pp. 64-65 was developed by the Association of Anaesthetists of Great Britain and Ireland (AAGBI) and is available at http://www.aagbi.org/publications/guidelines/docs/la_toxicity_2010.pdf.^{*} The American Society of Regional Anesthesia and Pain Medicine has a similar, though less detailed, protocol (www.rapm.org).

^{*}The British use a superscript negative number (ml.kg^{-1}) to denote what North Americans would refer to as “per” (ml/kg).

AAGBI Safety Guideline

Management of Severe Local Anaesthetic Toxicity

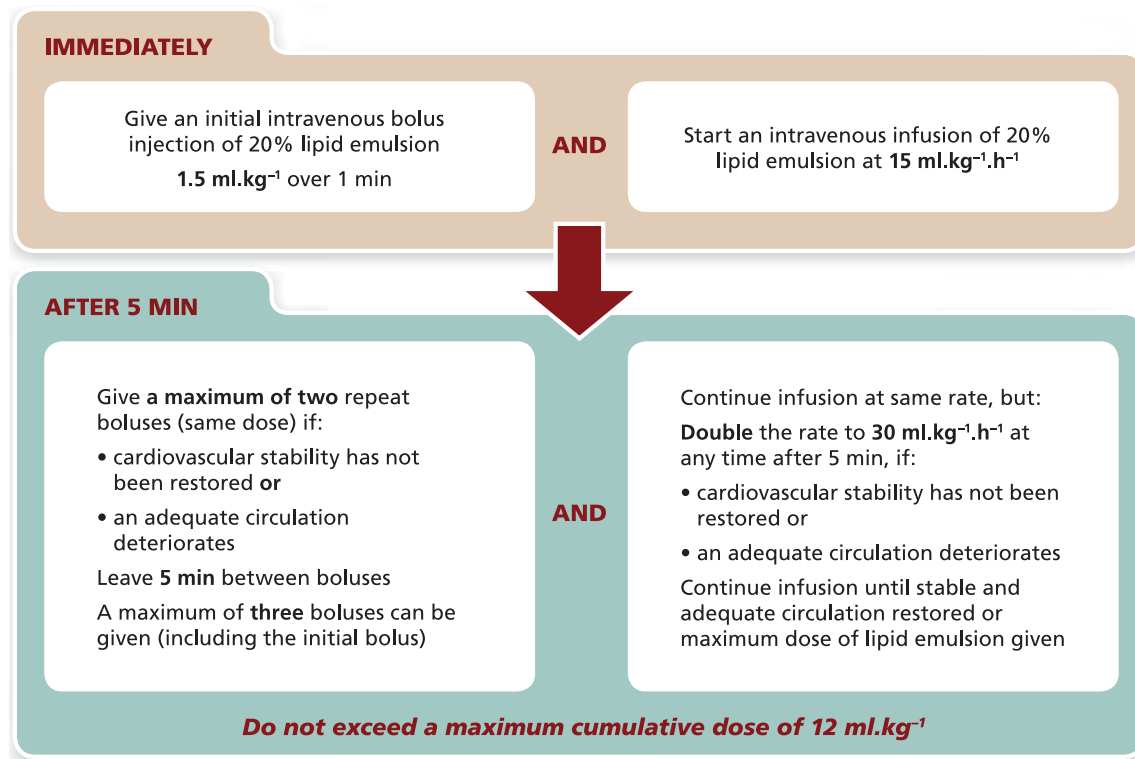


1 Recognition	Signs of severe toxicity: • Sudden alteration in mental status, severe agitation or loss of consciousness, with or without tonic-clonic convulsions • Cardiovascular collapse: sinus bradycardia, conduction blocks, asystole and ventricular tachyarrhythmias may all occur • Local anaesthetic (LA) toxicity may occur some time after an initial injection		
2 Immediate management	• Stop injecting the LA • Call for help • Maintain the airway and, if necessary, secure it with a tracheal tube • Give 100% oxygen and ensure adequate lung ventilation (hyperventilation may help by increasing plasma pH in the presence of metabolic acidosis) • Confirm or establish intravenous access • Control seizures: give a benzodiazepine, thiopental or propofol in small incremental doses • Assess cardiovascular status throughout • Consider drawing blood for analysis, but do not delay definitive treatment to do this		
3 Treatment	<table border="1"> <tr> <td> IN CIRCULATORY ARREST • Start cardiopulmonary resuscitation (CPR) using standard protocols • Manage arrhythmias using the same protocols, recognising that arrhythmias may be very refractory to treatment • Consider the use of cardiopulmonary bypass if available GIVE INTRAVENOUS LIPID EMULSION (following the regimen overleaf) • Continue CPR throughout treatment with lipid emulsion • Recovery from LA-induced cardiac arrest may take >1 h • Propofol is not a suitable substitute for lipid emulsion • Lidocaine should not be used as an anti-arrhythmic therapy </td><td> WITHOUT CIRCULATORY ARREST Use conventional therapies to treat: • hypotension, • bradycardia, • tachyarrhythmia CONSIDER INTRAVENOUS LIPID EMULSION (following the regimen overleaf) • Propofol is not a suitable substitute for lipid emulsion • Lidocaine should not be used as an anti-arrhythmic therapy </td></tr> </table>	IN CIRCULATORY ARREST • Start cardiopulmonary resuscitation (CPR) using standard protocols • Manage arrhythmias using the same protocols, recognising that arrhythmias may be very refractory to treatment • Consider the use of cardiopulmonary bypass if available GIVE INTRAVENOUS LIPID EMULSION (following the regimen overleaf) • Continue CPR throughout treatment with lipid emulsion • Recovery from LA-induced cardiac arrest may take >1 h • Propofol is not a suitable substitute for lipid emulsion • Lidocaine should not be used as an anti-arrhythmic therapy	WITHOUT CIRCULATORY ARREST Use conventional therapies to treat: • hypotension, • bradycardia, • tachyarrhythmia CONSIDER INTRAVENOUS LIPID EMULSION (following the regimen overleaf) • Propofol is not a suitable substitute for lipid emulsion • Lidocaine should not be used as an anti-arrhythmic therapy
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4 Follow-up	• Arrange safe transfer to a clinical area with appropriate equipment and suitable staff until sustained recovery is achieved • Exclude pancreatitis by regular clinical review, including daily amylase or lipase assays for two days • Report cases as follows: - in the United Kingdom to the National Patient Safety Agency (via www.npsa.nhs.uk) - in the Republic of Ireland to the Irish Medicines Board (via www.imb.ie) If Lipid has been given, please also report its use to the international registry at www.lipidregistry.org. Details may also be posted at www.lipidrescue.org		

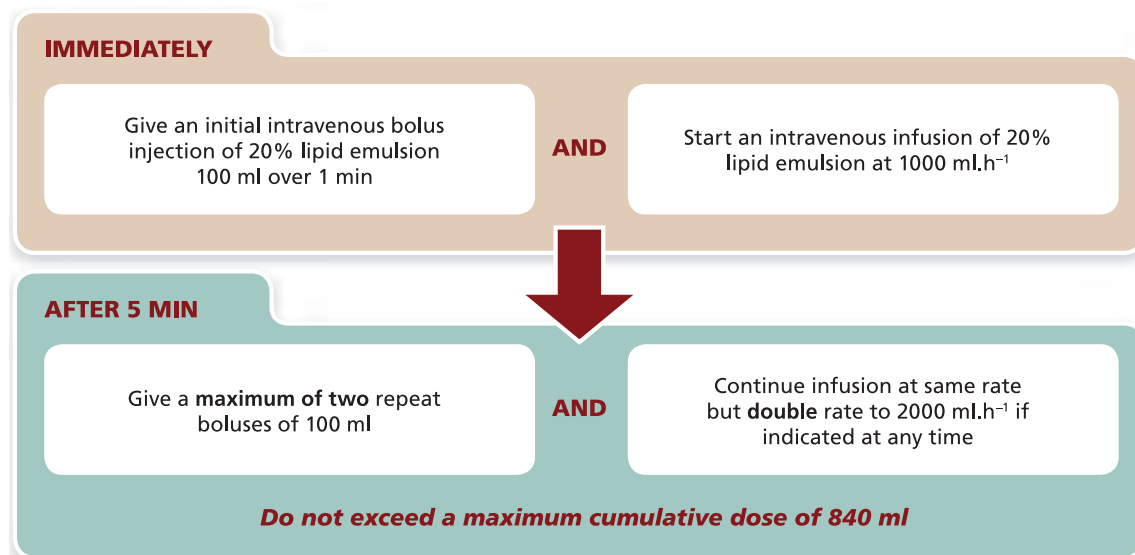
Your nearest bag of Lipid Emulsion is kept

This guideline is not a standard of medical care. The ultimate judgement with regard to a particular clinical procedure or treatment plan must be made by the clinician in the light of the clinical data presented and the diagnostic and treatment options available.

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An approximate dose regimen for a 70-kg patient would be as follows:



This AAGBI Safety Guideline was produced by a Working Party that comprised:
Grant Cave, Will Harrop-Griffiths (Chair), Martyn Harvey, Tim Meek, John Picard, Tim Short and Guy Weinberg.

This Safety Guideline is endorsed by the Australian and New Zealand College of Anaesthetists (ANZCA).

The timing of lipid infusion delivery is still being debated. It is probably unwise to wait until ACLS has been determined ineffective, because early treatment of LAST with lipid infusion can prevent cardiovascular collapse. However, only a small portion of patients will advance to life-threatening toxicity. The midpoint between the two extremes may be to start lipid rescue when LAST seems clinically severe and is progressing rapidly. Cardiac life support should continue throughout the lipid rescue treatment.

Additional Points to Remember

High doses of epinephrine can impede the effectiveness of lipid rescue. Low doses in the range of 1 $\mu\text{g}/\text{kg}$ can be safely used for hypotension.

Continue to monitor patients who had indicators of cardiac toxicity for at least 12 hours after they are stable. Cardiac depression can return after successful treatment.

Report LAST events and treatment at www.lipidrescue.org. If lipid emulsion is used, register the event at www.lipidregistry.org.

Concluding Thoughts

A culture of safety cannot emerge as long as there is a culture of blame and unwillingness to change behaviors and processes. Part of building a successful team requires overcoming cultural barriers that impede some members of the surgical team from speaking up because they are intimidated, are afraid of seeming foolish, or do not think the surgeon values their opinions. Every staff member in an operating room probably has something important to say about how safety practices could be improved, but nothing will change unless these ideas are shared among surgical team members.

According to AHRQ, the main component needed to improve patient safety is someone who will champion necessary changes. If a single surgeon seriously commits to the need for change in safety practices, others will follow this leadership when properly educated about the evidence behind the change. Thus frequent in-service training, effective reminder systems, and prominent, well-designed checklists are essential. Progress should be recognized. In addition, plastic surgeons must perform more thoughtful research to identify potential problems and solutions that will improve our safety processes and practices. We also need to do a better job of tracking outcomes.

Surgical patients have every reason to assume their safety will be protected and they will not be harmed. Adverse events are almost always a surprise to everyone involved in a procedure. The best way to prepare for them is to be proactive and take the ac-

tions necessary to prevent the error in the first place. Keeping up with the latest literature related to patient safety could be practically a full-time job, and most plastic surgeons are so busy that they rarely sample the literature of other medical specialties, such as anesthesiology, where much of the patient safety research is published. Even so, we have a responsibility to keep pace with evidence-based patient safety guidelines and protocols and turn them into actual practice.

Suggested Readings

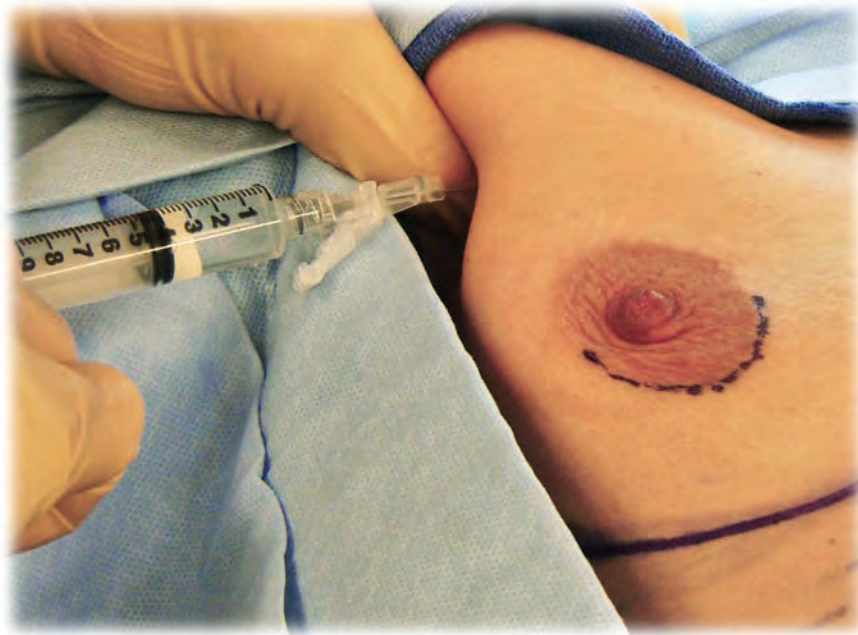
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CHAPTER 3



Sedation and Anesthesia for Aesthetic Surgery

DONALD W. BUCK II, THOMAS A. MUSTOE

According to the American Society of Plastic Surgeons (ASPS), more than 80% of all aesthetic surgery procedures are performed outside the hospital setting. As the number of office-based surgical procedures continues to rise exponentially, plastic surgeons have begun to embrace a less-invasive means for providing effective anesthesia: local anesthesia with sedation. There are two major states of sedation used for procedural anesthesia: (1) deep sedation (DS), or monitored anesthesia care (MAC), and (2) conscious sedation (CS). The success of both techniques has been well described in the literature, spanning numerous surgical and nonsurgical specialties, including plastic surgery, oral and maxillofacial surgery, otolaryngology, cardiology, gastroenterology, pulmonology, interventional radiology, and dermatology. A critical component of successful sedation is achieving effective local anesthesia, which we will emphasize in this chapter.

Conscious sedation is defined as an altered state of consciousness leading to a comfortable state of relaxation while maintaining airway patency and respiratory drive. During CS, the patient is capable of responding to verbal and physical stimuli. This is the hallmark difference between CS and DS techniques. During DS, the patient maintains airway patency and respiratory drive but is often unresponsive to stimuli.

Sedation techniques have many proven advantages over traditional general anesthetic techniques. In contradistinction to general anesthesia, patients under CS and DS are capable of generating respiratory drive and protecting their airway, thereby obviating the need for intubation. This fact alone prevents the development of airway complications such as pain, edema, injury, and pneumonia that are often associated with mechanical ventilation. In addition, although patients under general anesthesia are immobile and lack lower extremity muscle tone, patients under CS and DS maintain the ability to contract lower extremity musculature, thereby eliminating the venous stasis that can lead to deep venous thrombosis (DVT) and pulmonary embolus. This is especially true in CS patients, who are in a much lighter state of sedation, which allows them to shift their position throughout the procedure. It has been reported in the literature that the risk of DVT is up to threefold greater in patients undergoing general anesthesia compared with those receiving conscious sedation.

Other important advantages of sedation techniques include a lower incidence of postoperative nausea and vomiting and fewer unplanned hospital admissions, because inhalational anesthetics and/or high-dose narcotics are not used. In addition, post-procedure recovery is more rapid as a result of the short half-life of most sedative medications used in CS and DS techniques.

Although sedation techniques offer many advantages over general anesthesia, they are not without a few important disadvantages. Because patients are not entirely asleep, there is the risk that they will recall the procedure and the experience of pain

during the operation. Both can be avoided by carefully selecting and administering the appropriate balance of sedative medications and analgesics.

Deep Sedation/MAC Anesthesia

The mainstay of most deep sedation protocols is propofol. Propofol is an intravenous nonbarbiturate sedative that is most widely used as an induction agent for general anesthesia. Although the elimination half-life is 30 to 60 minutes, the observed duration of action is much shorter because of its rapid distribution into peripheral tissues such as muscle and fat. Therefore the clinical effects of propofol last approximately 2 to 3 minutes. This rapid onset and recovery make propofol an ideal medication for intravenous deep sedation. In DS techniques, propofol is often continuously infused at the lowest possible dose to maintain appropriate sedation depth.

Despite its rapid pharmacokinetic profile and the lower incidence of nausea and vomiting, patients under deep sedation with propofol can experience procedural recall if the level of sedation varies during surgery. Of even greater importance, patients can show great variability in their clinical response to administration of propofol, at times showing profound sedation even with the smallest doses, with a very rapid effect. This variability, coupled with its lack of reversibility, restricts propofol's utility in most *conscious sedation* protocols. In some states, propofol can only be administered by an anesthesiologist who maintains appropriate CME credits on its use. Because there is no reversal agent for propofol and the potential exists for respiratory depression, the person administering propofol must be trained in airway control and assisted ventilation. For these reasons, most advocate the assistance of an anesthesiologist or certified nurse anesthetist (CRNA) if DS is employed in the office setting. Hypotension related to systemic vasodilation is also a side effect but is not difficult to manage.

Conscious Sedation

The American Society of Anesthesiologists (ASA) advocates treating CS techniques as a combination of anesthesia and analgesia. In their consensus statement for nonanesthesiologists, they recommend targeting these factors individually with an appropriate combination of sedatives and narcotics. Commonly used sedatives include midazolam, diazepam, and ketamine. Commonly used narcotics include fentanyl and its derivatives. There have been numerous reports in the literature describing various combinations of these agents. Although ketamine has been used safely, and some practitioners have had extensive experience without problems, because of

its lack of reversibility and potential for respiratory depression, it is unclear whether its use should expand to office-based settings without the assistance of an anesthesiologist. By far the most common combination, and the one used exclusively at our institution is midazolam and fentanyl.

Midazolam is a benzodiazepine agonist with a rapid onset and recovery and causes very few cardiopulmonary effects. It is water soluble, resulting in very little venous irritation, and intravenous injection is painless. In addition, midazolam administration causes retrograde amnesia in a dose-responsive fashion, thereby limiting patient recall. Midazolam is also reversible; in the event of an overdose, flumazenil can be administered to reverse the benzodiazepine effects. However, benzodiazepines affect respiration much less than narcotics do, and the dose response is very graded, so reversibility has in practice never been required in our experience. Midazolam has been used successfully for CS in continuous and bolus dose fashion. The only absolute contraindication for the use of midazolam is in patients with benzodiazepine hypersensitivity or acute angle-closure glaucoma. Relative contraindications include pregnancy and the presence of significant cardiac and pulmonary diseases.

Fentanyl is a synthetic mu opioid receptor agonist. It is one of the strongest opioids available, with a potency 80-fold greater than morphine and 100-fold greater than heroin. It has a rapid onset and recovery, an acceptable side effect profile, and is reversible, making it the ideal analgesic for CS. There are many fentanyl analogs on the market today, including alfentanil (ultra-short acting: 5 to 10 minutes), sufentanil (5 to 10 times more potent than fentanyl), and remifentanil (shortest acting), but because of their very short action and their potency, they have not found wide usage in aesthetic surgery. Common side effects with all narcotics include constipation, somnolence, dizziness, anxiety, cardiopulmonary depression, and nausea and vomiting. These side effects can be reduced by limiting the total administered narcotic dose. Respiratory depression is the major side effect in practice, and it is important to note that benzodiazepines potentiate this effect. The peak onset is 6 to 12 minutes, so it is critically important to space the dosing with small increments to avoid overshoot in clinical effect. In the event of an overdose, naloxone can be administered, but in the cumulative clinical experience at Northwestern University, naloxone reversal has been necessary in less than 1 in 1000 cases. With increased attention to limiting the dose (usually 25 to 50 μg for local anesthetic injection, with cumulative doses for an entire procedure not to exceed 250 μg), and the short effective clinical half-life, the potential need for a reversing agent is reduced even more. The half-life of naloxone is much shorter than that of fentanyl. If a patient has received a significant dose of fentanyl, it may be necessary to readminister naloxone.

It cannot be overemphasized that the key to the CS technique and maintenance of the CS state is through the use of the described medications in small, incremental

doses that are properly spaced (every 5 minutes for benzodiazepines; slightly longer for fentanyl, depending on patient alertness and the level of sedation/analgesia). This allows appropriate titration of medications to limit or reduce the risk of side effects and maximize efficacy of sedation and patient comfort. Titration of medications is guided by close observation of the patient's vital signs, including respiratory rate, oxygen saturation, and overall state of alertness. An example of this technique is discussed next.

The Conscious Sedation Technique

After obtaining informed consent, and before the operation begins, patients receive three premedications: an antibiotic, an antiemetic, and an anxiolytic. As with most aesthetic surgery cases, patients receive an antistaphylococcal antibiotic as prophylaxis. At our institution we typically use 1 or 2 g of cefazolin in penicillin-sensitive patients and 900 mg of clindamycin in penicillin-allergic patients. Administration of an antibiotic is followed by an antiemetic; at our institution we administer 4 mg of ondansetron (Zofran) intravenously. Finally, patients are given intravenous diazepam (Valium) for anxiolysis. Diazepam is generally injected in incremental doses of 5 to 10 mg until adequate preoperative subjective relaxation is achieved. The appropriate state of preoperative relaxation is confirmed by slurred speech, a tendency to speak softly, and nystagmus. The observation of even slight nystagmus allows the physician to objectively monitor when an effective sedating dose of diazepam has been achieved. The most common dosing of diazepam is between 10 and 50 mg, but in patients with a history of diazepam usage or other neuroleptic drug use, much higher doses are occasionally used. The major problem with higher dose diazepam administration is the potential for prolonged postoperative drowsiness, which may extend the time to discharge. Most patients also receive between 0.1 and 0.2 mg of clonidine. Clonidine has been shown to improve sedation, stabilize vital signs, and decrease the amount of narcotic analgesic required as a result of its intrinsic analgesic and anxiolytic properties.

Once the patient is in the operating room, cardiac monitors, a pulse oximeter, and blood pressure cuffs are applied. One nurse or assistant is responsible for continuously monitoring patient status through these methods. This individual must have appropriate experience and background in continuous patient monitoring. In many cases this is a CRNA trained in airway management. The patient's status is reported to the surgeon in 5-minute increments. Any change among the measured parameters (vital signs, oxygen saturation, level of alertness, or blood pressure) is communicated to the surgeon. On the basis of these parameters, the patient receives 0.5 to 3 mg of incremental bolus midazolam for sedation and/or fentanyl in increments of 12.5 to 25 μg .

Local Anesthesia: A Critical Component of Sedation Anesthesia

As a result of the increasing number of office-based procedures and the subsequent increase in the use of sedation anesthesia, local anesthesia has become a critical adjunct to office-based surgical practice. We think that effective sedation and anesthesia in aesthetic surgery begins and ends with adequate local anesthesia. Thus we will discuss local anesthesia techniques in detail.

Commonly Used Local Anesthetic Agents

Agent	Class	Duration of Action (min)	Recommended Dosage Guidelines (mg/kg)	Maximum Total Dosage (mg)
Procaine (Novocain)	Ester	15-60	7.0	350-600
Lidocaine (Xylocaine)	Amide	30-60 120-360	Without epinephrine: 4.5 With epinephrine: 7.0	300
Mepivacaine (Carbocaine)	Amide	45-90	7.0	400
Bupivacaine (Marcaine)	Amide	120-240 180-420	Without epinephrine: 2.5 With epinephrine: 2.5-4.0	175 225-400

Plastic surgeons are extremely familiar with the available local anesthetics and basic infiltration techniques. The most commonly used compounds include the esters procaine, tetracaine, and chlorprocaine and the amides lidocaine, mepivacaine, bupivacaine, etidocaine, and prilocaine. A thorough knowledge of the pharmacokinetics of the commonly used agents is imperative to optimize anesthesia, analgesia, and patient comfort, while minimizing the risks associated with these agents.

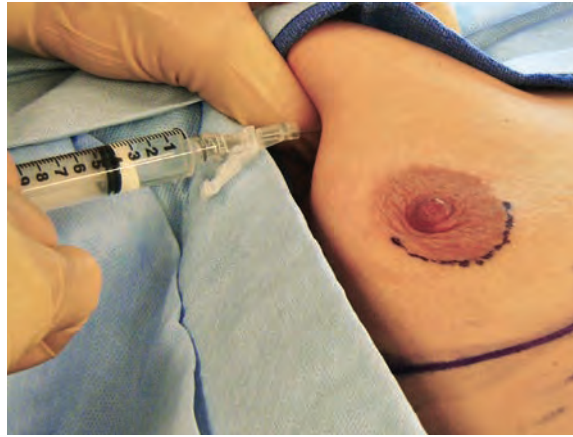
Allergic reactions are rare and are more likely to occur with an ester compound. Toxicity usually results from an overdose. Systemic manifestations can include headaches, tinnitus, perioral paresthesias, restlessness, seizures, apnea, and cardiac depression. Surgeons should follow recommended guidelines regarding safe maximum dosages to reduce the risk of toxicity. The maximum dosage can often be extended by adding epinephrine to the anesthetic agent.

In 1987 Klein first described the tumescent technique, which involved infiltration of large volumes of dilute lidocaine with epinephrine into the local subcutaneous tissues to assist with suction lipectomy. During his seminal work, he discovered an important concept—the maximum dosage of lidocaine with epinephrine that could be safely injected extended well beyond the recommended guidelines of 7 mg/kg. In fact, he had safely used doses as high as 35 mg/kg without reaching toxic plasma levels. Since that report, a similar study by Ostad et al found that doses as high as 55 mg/kg can be used. Over the next several years it became increasingly clear that the tumescent technique offered significant perioperative advantages, including a reduction in surgical time, less potential for postoperative edema and hematoma, and improved postoperative pain control; furthermore, it eliminated the need for general anesthesia when paired with CS techniques.

This concept gained significant popularity over the following decade and has revolutionized local anesthesia technique. At this point the cumulative experience is in the millions of patients. In our practice we routinely approach the 35 mg/kg level of lidocaine, and in thousands of cases we have never encountered a hint of toxicity. One very useful safety feature of this CS protocol is that the antidote for early lidocaine toxicity (which is first manifested neurologically) is the administration of benzodiazepines, which have already been administered.

We employ the tumescent technique (or more accurately, flooding of the tissues with dilute local anesthetic, whether in the face, nose, breast, abdomen, or fat) in most of our aesthetic surgery cases using sedation anesthesia. Our goal is not to achieve turgidity of the tissues, but rather to achieve vasoconstriction, providing a bloodless field and truly effective local anesthesia.

Our dilute local anesthetic solution consists of lidocaine with epinephrine mixed in normal saline solution, which is sufficient to achieve anesthesia of fat. In our experience, 0.3% lidocaine is a sufficient concentration to achieve anesthesia for skin incisions, and approximately 0.1% lidocaine is sufficient to achieve anesthesia of breast tissue or muscle in sufficient volumes. Therefore our standard mix for skin incisions of the breast, abdomen, or face is 100 ml of 1% lidocaine, 1:100,000 epinephrine in 250 ml of normal saline solution, with 0.05% lidocaine for infiltration along abdominal fascia or in fat for liposuction. For breast reduction procedures under conscious sedation, 0.1% lidocaine is sufficient; however, to avoid skin complications, we limit the epinephrine concentration to 1:2,000,000. Depending on the specific procedure and anatomic location, an appropriate volume of solution is injected along the incision lines and into the regional soft tissues.



For example, during a breast augmentation procedure, after all incision lines have been adequately infiltrated, approximately 30 ml of dilute local solution is infiltrated directly into the subpectoral plane in the axillary portion of the breast to achieve effective regional breast anesthesia.

The table of injection techniques gives dilute anesthetic solutions for various aesthetic procedures.

Local Anesthetic Injection Techniques for Various Plastic Surgery Procedures

Procedure	Dilute Local Injection Technique
Face lift/brow lift	100 ml per side, along incision lines; 50-150 ml for submental region
Breast augmentation	100-150 ml for each breast, with dedicated 30 ml injected into subpectoral plane in axillary tail region
Mastopexy	250-500 ml for each breast, depending on breast size
Abdominoplasty	75-100 ml along all incision lines; 50-100 ml for abdominal fascia; remainder of solution for liposuction assistance where necessary

Outcomes and Safety

Our ability to provide less-invasive anesthesia and optimize patient comfort has advanced rapidly over the past 20 years. Despite these advances, we must maintain good clinical judgment and uphold superior standards in technical skills, surgical facilities, and patient safety. Office-based surgery can be performed safely and offers patients the highest degree of privacy and convenience, but surgeons must realize that the risk of serious injury or death exists. In fact, some published reports indicate that the risk of serious injury or death is tenfold higher for office-based procedures.

There is no doubt that the appeal of enhanced privacy, convenience, and comfort has substantially contributed to the number of patients seeking aesthetic surgery in the office setting. As with the truest of economic fundamentals, with this increase in demand, we have seen an unparalleled rise in the number of office-based procedures that are performed yearly.

To deliver optimal results in the safest environment, it is imperative that aesthetic surgeons adhere to strict guidelines set forth by governing bodies. For instance, the ASPS has published a series of guidelines to advise surgeons on appropriate safety measures for office-based practices. In addition to these specific guidelines, basic principles of ethical patient care should become the foundation of every aesthetic surgeon's practice. These include (1) performing office-based procedures in an accredited facility in accordance with policies set forth by the appropriate governing bodies, (2) only performing procedures for which one has been trained and is qualified to perform, (3) maintaining up-to-date, functioning equipment and appropriate facilities, and (4) applying the protocols necessary to create an environment in which the foremost concern is patient safety. All staff and personnel should be trained and certified to perform advanced cardiac life support (ACLS), efficiently manage emergencies, effectively stabilize patients, and appropriately transfer patients when necessary.

We have seen firsthand in our own practice the rising demand for sedation-based anesthesia and aesthetic surgery over the years. The well-publicized deaths from pulmonary embolus and respiratory complications have increased public awareness of the risks of general anesthesia. Over the past 15 years we have performed more than 4000 procedures employing the sedation and anesthesia techniques described in this chapter. The techniques have been widely used in our resident aesthetic clinic and by other plastic surgeons at Northwestern University.

As with all aspects of aesthetic surgery, achieving the optimal patient outcome and experience requires appropriate patient selection, operative planning, and realistic expectations. The delivery of appropriate sedation coupled with effective local anes-

thetia is a learned skill that requires the ability to pay significant attention to the level of sedation, stable vital signs, and oxygenation while focusing on the operation at hand. In practice, this means being alerted to changes in the patient's status by the monitoring nurse through 5-minute reports and maintaining a steady state of sedation by continued small increments of benzodiazepine administration.

We have used CS anesthesia for a wide range of aesthetic procedures, including suction lipectomy, abdominoplasty, breast surgery, rhytidectomy, blepharoplasty, and rhinoplasty. We have never had a patient develop deep venous thrombosis or a pulmonary embolism as a result of these techniques. Additionally, the risk of developing postoperative nausea and vomiting has nearly been eliminated with an effective balance of sedation, narcotic, and antiemetic prophylaxis. As a result, the incidence of unplanned hospital admission is extremely rare.

Key Observations

During our experience with CS, we have made several key observations that are important for surgeons employing CS techniques.

Patient Selection

1. The use of CS should be avoided in patients who are extremely anxious and have an absolute desire to be "out," with a stated very low pain tolerance. These patients may require large amounts of sedation, which prolongs the recovery and increases the risk for nausea and vomiting. However, with experience, and for easier procedures (such as rhinoplasty), some of these patients can still do very well with sedation.
2. For patients with any significant history of coronary artery disease, arrhythmias, or significant pulmonary problems, their procedure should be performed under MAC or DS with the assistance of an anesthesiologist to optimize patient safety.
3. Patients with a significant history of depression, bipolar disorder, or other mental illness may have unpredictable responses to sedation and should be considered for MAC.
4. Patients who take several neuroleptic drugs may be difficult to sedate, and caution should be used.

Procedural Considerations

1. Essentially any aesthetic procedure is applicable (including harvesting costal cartilage) if good local anesthesia can be achieved.
2. Patients can get restless after 4 hours; therefore we avoid using CS in procedures that last longer than 4½ to 5 hours.
3. For long procedures with significant fluid infiltration, insertion of a Foley catheter after the patient is sedated can be very useful.
4. Local infiltration, for liposuction for instance, with very dilute (0.05% xylocaine) can take 15 to 30 minutes for maximal effect.

5. Planning a procedure to minimize the number of separate times that local anesthetic is infiltrated eases the procedure. For instance, when doing a combination breast augmentation and abdominoplasty, we infiltrate both surgical fields completely at the beginning of the procedure when the patient is usually most deeply sedated. This enables the local anesthetic sufficient time to take full effect in both fields, while subjecting the patient to only one period of injections, significantly easing the procedure, and speeding it up.

Concluding Thoughts

As the number of office-based procedures and the demand for more convenient and safer anesthesia continue to rise exponentially, plastic surgeons must become comfortable with the techniques of sedation anesthesia to stay competitive with their colleagues. Sedation techniques can be applied for the majority of aesthetic procedures, so long as these procedures are performed in an accredited facility, with strict adherence to the appropriate standards and guidelines, with a particular focus on maintaining maximal patient safety.

Clinical Caveats

Sedation anesthesia results in less risk for deep venous thrombosis, pulmonary embolism, and postoperative nausea and vomiting.

The major distinction between deep sedation and conscious sedation is the patient's ability to respond to external stimuli.

Sedation anesthesia should be performed in accredited facilities by surgeons and personnel who are trained in medication administration and able to provide airway assistance if necessary.

The conscious sedation state can be maintained by careful titration of medications and administration in small, incremental bolus doses.

Appropriate local anesthesia is paramount to effective conscious sedation.

Office-based surgery can be performed safely, so long as surgeons adhere to the standards and guidelines set forth by appropriate governing bodies, with the primary focus on patient safety.

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CHAPTER 4



Facial Aesthetic Surgery in Skin of Color

JULIUS W. FEW

According to 2008 statistics from the American Society for Aesthetic Plastic Surgery (ASAPS), persons of color represent the fastest-growing group of consumers in elective aesthetic medicine. With the increasing availability of information and awareness of the latest innovations, patients' expectations are high, and the need is clear for interventions that are individualized to the specific needs of ethnic patients.

Skin of color has more advantages than disadvantages when it comes to the aging process because of its inherent protection against actinic damage and its sebaceous nature and suppleness. Thus the types of interventions requested and the specific indications differ from those of patients with lighter skin. In addition, patients of color tend to present later in life than those with light skin.

In general, darker-pigmented skin has an increased epidermal melanin content and large, singly dispersed melanosomes within melanocytes. Melanosomes are distributed throughout the epidermis in darker skin, whereas in lighter skin they are limited to the basal and lower malpighian layer of the epidermis. Black/brown skin is thicker and the dermis more compact than white skin. Fibroblasts are large and numerous, and thus there is a significant turnover of collagen in dark skin. These findings may help to explain why skin of color is at an increased risk of adverse scarring with epidermal or dermal trauma.

Treatment Considerations for Skin of Color

The primary focus in treating skin of color relies on several major considerations. When treating the skin of ethnic patients, the surgeon must consider the presence and/or prevention of postinflammatory hyperpigmentation and hypertrophic/keloid scar tendencies. In general, there are a variety of surgical and nonsurgical options to help avoid these unwanted events. Excess tension, inflammation, and a genetic predisposition appear to play the major part in hypertrophic or keloid scar formation. As with any approach, surgical or nonsurgical, it is vital to neutralize all possible variables in an effort to avoid complications.

In some instances, the very nature of the treatment is keloidogenic. Face lifts and skin resurfacing are by their very nature keloid promoting in at-risk patients because of skin tension and inflammation, respectively. I have found that nonabsorbable su-

ture material is less reactive in at-risk skin types, thereby limiting local tissue inflammation. Nonabsorbable suture material can be removed subsequently, eliminating the potential offending agent. The surgeon must understand the fine balance between allowing the suture to control tension and the need to limit a reactive substrate.

If hyperpigmentation exists in an area in which cosmetic enhancement is planned, one should consider treating this before a procedure is performed. This is particularly applicable preceding injections of fillers or *botulinum* toxin. Regardless of skin tone, sunscreen protection is vital, especially with preexisting postinflammatory hyperpigmentation. For existing hyperpigmentation, I typically begin with a solution of 4% hydroquinone, 0.05% tretinoin, and 0.01% fluocinolone, which the patient applies nightly for 2 to 6 weeks before a planned surgery. Skin-bleaching therapy is resumed 1 week after the procedure. As with all forms of medicine, prevention is the key to a successful outcome.

INDICATIONS AND TREATMENT MODALITIES

The following discussion provides a general framework for the treatment of patients of color but is by no means an exhaustive list of treatment options for these patients.

Periorbital Rejuvenation

Most of the literature on facial aesthetics reflects white ideals, which runs the risk, if taken too literally, of conflicting with the desires of patients with other cultural ideals. However, there are goals that remain consistent, regardless of the patient's race, ethnicity, or sex.

The surgeon must strive for an approach that will restore and enhance appearance in the most natural way possible, without distortion of function. Most elective patients are not trying to assume the appearance of another person, but rather to feel that their outward aspect conveys a message consistent with their inner feelings. The most common comments heard in consultation for eyelid rejuvenation are a desire to “not look tired,” or “not look sad.” The endpoint sought by most patients is: “I want to look refreshed.”

Pertinent Anatomy



According to our study published in 2006, approximately 40% of African American women fear losing their ethnic identity if they undergo blepharoplasty, which emphasizes the importance of sensitivity to this issue. In studying the faces of patients of African descent, I have found a strong association with Asian features, especially with regard to the lateral canthus of the eye. When questioned, patients of color felt their eyes shared canthal and upper eyelid characteristics with those of Asian ancestry, although they clearly did not want to change their own ethnic character. In general, when questioned, patients in this group are not pursuing a younger look, or a change in ethnic characteristics, but rather a less-tired look.

The split-face image above demonstrates the composite nature of facial aging in an African American woman: the left side shows the patient 17 years before and the right side just before rejuvenation surgery. As Flowers and others taught us, the periorbital aging process begins at the forehead/brow region. The process begins with forehead redundancy and flattening of the brow apex. Crowding of the lateral and central upper eyelid occurs as the brow migrates inferiorly. The upper lid often loses its septal support, leading to brow prolapse and an exacerbation of upper eyelid fullness and congestion. The lateral canthal complex then migrates inferiorly, loosening the lower eyelid sling. The lower lid then takes on an elongated appearance, and tear troughs and nasojugal sulci develop. This is followed by ptosis of the midface and deepening of the nasolabial sulcus. Finally, jowls form. Reviewing the patient's more youthful photos is vital in planning periorbital surgery.

Preoperative Planning

A successful outcome depends on a successful surgical plan. When selecting the overall approach, surgeons must realize that patients of color are looking for significant improvement but fear overcorrection more than white patients do, according to our research. Past photos are reviewed primarily to assess normal canthal and periorbital landmarks for surgical planning. In general, I prefer to perform canthopexy liberally to restore canthal tilt, preserve the majority of the upper eyelid orbicularis as

an autologous graft, and place the upper blepharoplasty closer to the ciliary margin than in a typical white eyelid (taking care to measure the exact height of the tarsal cartilage). If supratarsal malposition is found in the upper eyelid, the surgeon and patient discuss ptosis correction versus three-point fixation of the supratarsal crease. Ptosis surgery is recommended in patients adversely affected by the condition and/or those desiring restoration to a more youthful appearance. Regardless of race or ethnicity, it is vital to beware of patients with dry-eye syndrome, because ptosis correction will exacerbate these symptoms.

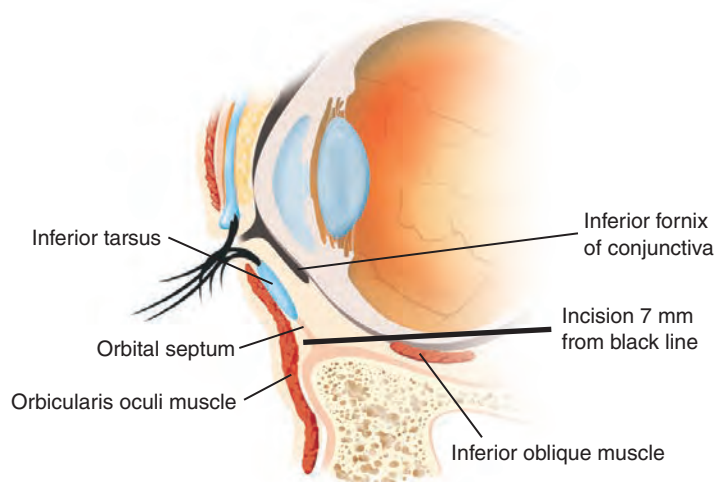
For patients of African heritage, I find that canthal ptosis with aging occurs at a faster rate than in white patients. This finding is based on controlled photo files analyzed with high-resolution photography and computer evaluation of the canthal angle in more than 500 subjects. Although the lateral canthus starts higher than the medial canthus in a youthful patient of color, the drop over time is relatively dramatic. The surgeon may be deceived to find the medial and lateral canthal points equal, a common finding in the white population, and mistakenly leave this malposition untreated while other periorbital concerns are addressed. This omission leaves the patient with an incomplete correction and subjective dissatisfaction.

Brow ptosis in persons of color occurs to a lesser extent and at a much later age than in white patients. Despite great advances with light-based treatments, laser therapy to the lower eyelid in skin of color remains a challenge. Given the rare finding of excessive lower eyelid skin after treatment of redundant deeper tissue, immediate sub-ciliary skin-pinch excision is preferred. The removal of skin in this location is very effective and safe, typically leaving no signs of surgical intervention.

I have found that 6-0 Prolene suture in skin of color leaves no identifiable marks. This approach has even been used in patients with a known history of keloid formation in other parts of the body.

Once the surgical plan has been defined, there are techniques that are common to patients of all ethnic backgrounds. In particular, this involves (1) supporting the brow-forehead aesthetic unit to provide the scaffold for successful periorbital rejuvenation and (2) assessing risk factors in the rejuvenation plan.

There are considerations unique to patients of color, and these require a modified approach to achieve the desired outcome. Because most of these patients do not have significant signs of aging in the forehead region until much later in life, the focus is typically set on balancing the brow position and providing support for the planned eyelid repositioning. I have found that internal browpexy is ideal for these patients, limiting the scar to the supratarsal area. The upper eyelid becomes deflated over time, making preservation and restoration the most important variables. Fat excision is often limited to the nasal upper eyelid fat compartment. One must be very conservative with fat excision in the more lateral compartments. The upper eyelid is an ideal access point for lateral reticular release and lateral canthopexy.



Given the unique challenges of pigmented skin and visible scarring, I have found it ideal to attempt to keep visible scars within the confines of the lateral canthal point. For this reason, I developed the *transconjunctival deep plane midface lift*. This is a technique that provides primary access to the lower lid and midface through the transconjunctival approach and eliminates the need for traditional skin muscle flap surgery and the accompanying scar. In addition, the approach leaves the orbicularis muscle undisturbed, minimizing the risk of eyelid malposition from muscle contracture or paralysis. With the orbitomalar ligament divided, the midface is readily available and amenable to suture fixation after elevation. This technique can often replace or eliminate the need for more traditional face-lift approaches.

Because there are often few rhytids visible on the skin of patients of color, deep autologous fat injection and/or grafting is ideal for malar restoration and tear-trough augmentation. I prefer the lateral ala and oral commissure as access points for fat injection. The ideal fat graft for skin of color is the dermal or septal fat graft for tear-trough and direct malar augmentation. Patients are advised that the implanted autologous tissue will initially feel hard to the touch and undergo maturation and softening over 6 to 12 weeks. Although a patient of African descent may wish to preserve a natural appearance, it is important to slightly overcorrect, anticipating the post-operative relapse and “settling” of the surgical manipulation. I always use nonabsorbable suture to limit the risk of hyperpigmentation and/or the suture reaction seen with absorbable material. The sutures are removed at 4 to 7 days, thus limiting the potential for a suture reaction.

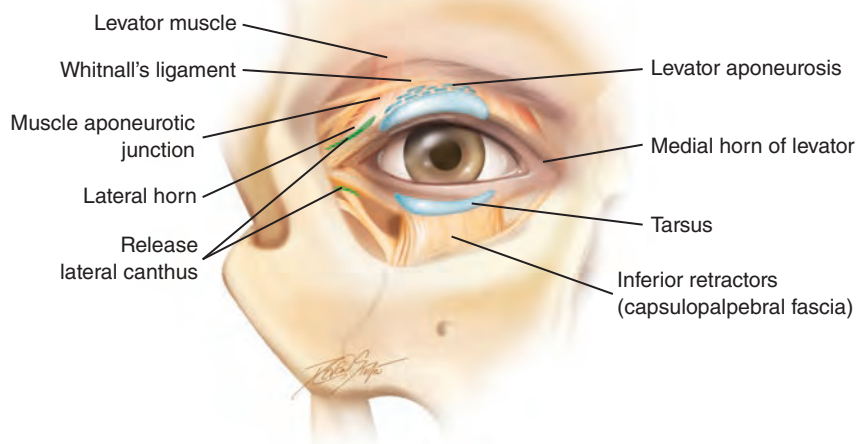
It is not possible to cover every nuance of periorbital rejuvenation in patients of color, but I will provide some illustrative examples of technical approaches to the area. I will describe the treatment approach and rationale in two African American women to demonstrate the algorithm for both primary and secondary rejuvenation.



Preoperative

Long-term postoperative result

This woman presented in her late fifties wanting to look “less tired.” The split image emphasizes the changes that have occurred; the appropriate location for her lateral canthus relative to the medial canthus can be seen. It is important to recognize her asymmetry before the procedure. In particular, her right brow is lower and flatter than the contralateral side, creating a more hooded appearance to the right upper eyelid. She has forehead rhytids, but they are largely reactive and dynamic, involuntarily responding to brow and eyelid ptosis. With transpalpebral brow correction, the forehead assumes a more aesthetic position, making direct forehead rhytidectomy unnecessary. With these findings, I prefer to approach this indication with peri-orbital access only.



In addition, I address upper eyelid excess while preserving the underlying orbicularis and conservative resection of the nasal fat pad. Because her lower lid distraction is less than 6 mm, a canthopexy is planned with a lateral retinacular release. Because the patient has significant tear-trough deformity, septal fat prolapse, and submalar depression exacerbating midface ptosis, a transconjunctival deep plane midface lift will be done. A tear-trough fat graft will soften the sulcus. The procedure can be done under monitored anesthesia care (MAC) or general anesthesia, depending on surgeon and patient preference.

Markings

The supratarsal crease is marked with the patient awake and in the upright position. The desired apex of the brow is marked at the level of the lateral limbus of the iris, marking preoperative asymmetry. The redundant skin of the upper eyelid is marked, with the brow in the desired corrected position. Care is taken to not take the cephalic limb of the upper lid excision beyond the midpoint of the area between the supratarsal crease and inferior edge of the natural brow.

Operative Technique

The procedure begins with the patient supine. After the appropriate marks have been made, tetracaine ophthalmic drops are placed, followed by lubrication and protective, evaginated corneal shields. A solution of 1% lidocaine with epinephrine 1:100,000 is injected in the field, regardless of the level of anesthesia. The surgical incision begins with an upper blepharoplasty; excess upper eyelid skin is removed while preserving the underlying muscle.

The muscle is then divided at the level of the supratarsal crease, preserving the underlying septal extension. The muscle is elevated in a cephalad direction, using insulated needle tip cautery. Care is taken to identify and preserve the supraorbital neurovascular bundle. Dissection on the supraorbital rim is done deep to the subor-

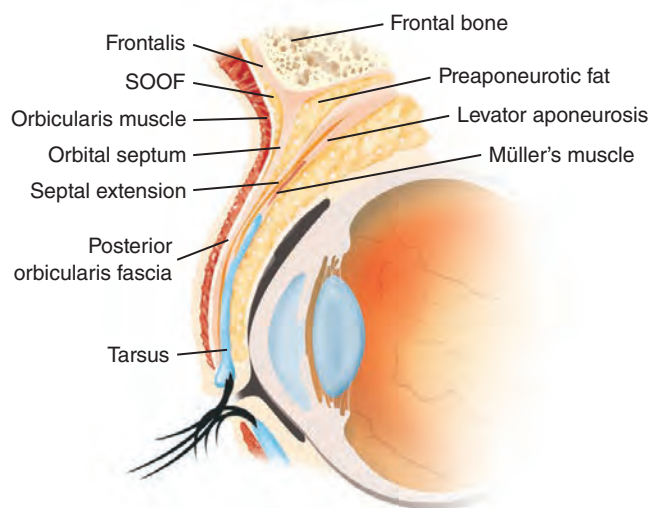
bicularis fat pad but superficial to the periosteum. The lateral brow retaining ligaments are separated, allowing release of the caudal 3 cm of the forehead from the brow. The surgeon then conservatively resects nasal fat excess using the needle tip cautery. Release of the lateral retinaculum, as described by Jelks (see p. 94), is done through the upper lateral eyelid exposure. The lateral 1.5 to 2 cm of periorbital orbicularis is elevated off the periosteum, allowing exposure of the lateral retinaculum and upper and lower lateral septal fat compartments. Selective release of the retinaculum without lysing the canthal tendon can be done through this approach under direct vision.

The surgeon then turns to the transconjunctival approach (see p. 92). A conjunctival 5-0 silk traction suture is placed 8 to 10 mm from the inferior ciliary margin. The transconjunctival incision is made above the traction suture and a preseptal exposure is developed deep to the orbicularis muscle. The arcus marginalis and orbitomalar ligament are identified and preserved. The orbital malar ligament is divided with needle tip cautery, preserving the arcus marginalis and periosteum. A preperiosteal dissection is carried down to the desired level of correction, keeping all fat and soft tissue off the periosteum. One can readily reach the level of the ala while carefully identifying and protecting the infraorbital neurovascular bundle. Using the deep orbicularis to arcus marginalis, one- or two-point fixation can be performed through the transconjunctival exposure with a 4-0 Vicryl or PDS suture on a small tapered needle. Care must be taken to avoid incorporating capsulopalpebral fascia or conjunctiva in the closure, since this could lead to lid malposition. One- or two-point suture fixation, deep orbicularis to periosteum, is performed through the lateral aspect of the upper blepharoplasty exposure.

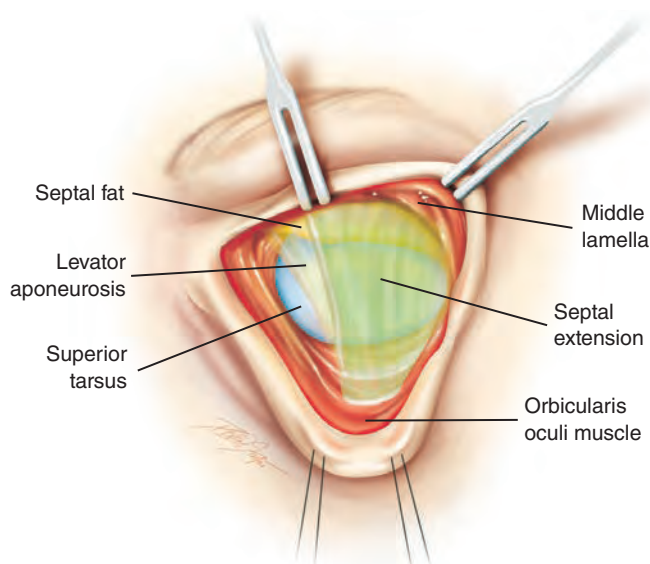


Suture fixation of the lateral canthus to the interior of the lateral orbit periosteum

After securing the lateral aspect of the midface while taking care to preserve the zygomaticofacial nerve located at the malar eminence, the surgeon performs the lateral canthopexy. I prefer 4-0 Mersilene or braided ophthalmic nylon, double-armed, to plicate the lateral canthal tendon to the interior aspect of the superolateral periosteum. The knot is carefully buried. Attention is then turned to the browpexy.



Sagittal view: Layers of the upper eyelid



Layers of the upper eyelid to gain access to the brow for internal browpexy

The apex is identified and the inferiormost aspect of the brow margin is transposed to the deep surface of the orbicularis. The deep orbicularis is then anchored to the periosteum of the frontal process, typically 1.5 to 2 cm above the supraorbital rim using a 5-0 Vicryl suture. The surgeon must be careful not to overcorrect, because the brow tends to migrate superiorly over time with thorough brow release.

Finally, the upper blepharoplasty incision is closed with a running 6-0 Prolene suture. Any redundant lower eyelid skin can be removed using a skin-pinch excision, preserving the underlying orbicularis.

Postoperative Care

A Steri-Strip bolster dressing is placed to support and reinforce the superolateral lift of the midface-cheek unit. The conjunctival incision is not closed. Ophthalmic lubrication is not instilled for the first 48 hours after surgery to avoid a granulomatous reaction. The patient can place cool compresses over the eyes for the first 36 to 48 hours and liberal applications of an ophthalmic steroidal agent if significant chemosis appears (a rare finding).

Results



This patient illustrates the importance of having a well-laid plan and understanding what the patient really desires. This woman had undergone a four-lid blepharoplasty at another clinic more than a year earlier and was not pleased with her result, which she felt made her look “tired” and “unhappy.” She had objective signs of uncorrected canthal ptosis and lower lateral eyelid retraction, creating a gapping at the lateral aspect of the eye and increased scleral show. Had the previous surgeon looked at her more youthful photos, he or she would have appreciated the significance of her canthal ptosis and subsequent loosening of the lower eyelid mechanism. The inferior lateral cant of the eye makes her look angry. Given these findings, I felt that revision upper and lower blepharoplasties would be appropriate, with a transconjunctival deep plane midface lift. The midface lift is intended to recruit skin and soft tissue to the correct lower lid retraction and preserve an appropriate correction to the lateral canthus. In addition, the patient required a lateral reticular release with canthopexy, as previously described, to achieve harmony in the periorbital region. As the 3-year follow-up images show, this patient was able to achieve significant, persistent correction. Note the paucity of visible scar formation despite the revisionary nature of the intervention.

Patients of color are particularly well suited for autologous fat injection to the midface and tear trough, primarily because of the robust nature of the overlying skin and soft tissue. There are a variety of techniques for preparing and injecting the fat, but I have found tumescent aspiration with concentrated injection to work well. I do not advocate centrifugation; I simply use a sterile nonstick gauze pad or simple gravity filtration. The fat is then injected through concealed injection ports, such as the oral commissure or nasal ala. Slight overcorrection is done to offset the average take of 75%. I do not place sutures at the injection sites for closure because of the increased risk of prolonged or chronic suture tract marks.

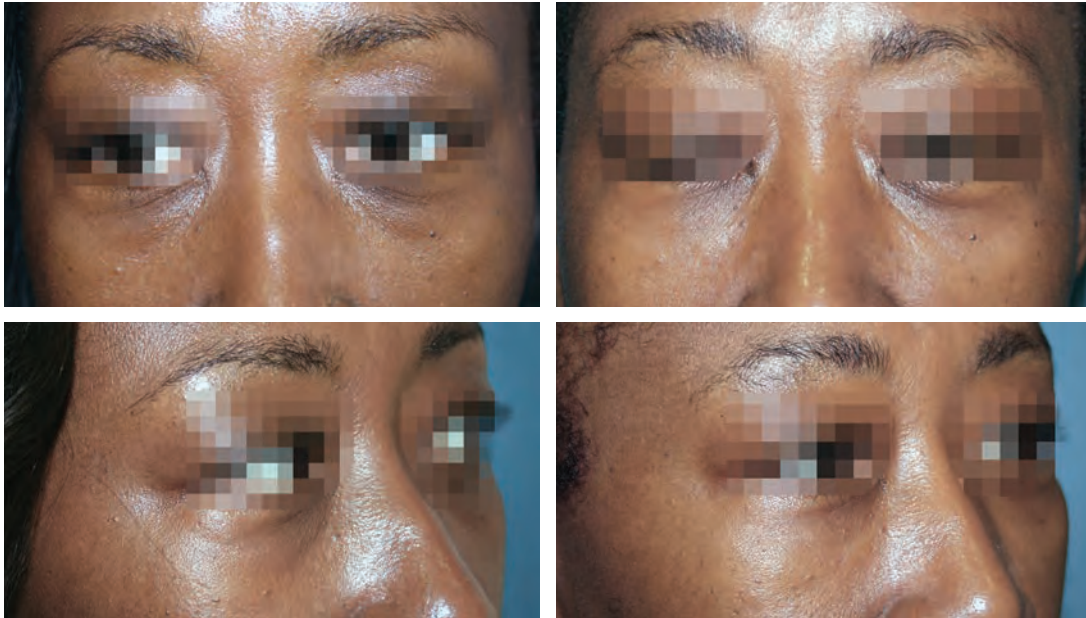
Nonsurgical Periorbital Rejuvenation

In previous publications I have shown the safety and efficacy of using hyaluronic acid filler in facial soft tissue and skin restoration in skin of color. There has been no reported difference in adverse effects or complications with such synthetic fillers. I find that it is better to inject the filler in the deeper dermis, with as few points of injection trauma as possible. In addition, neurotoxin injection enhances the benefit. With injection of a neurotoxin initially, one can simulate a brow lift and correction of lateral brow hooding and crow's-feet. In patients with prolapse of the lower eyelid septal fat and a prominent tear trough, hyaluronic acid can be injected to correct the defect and deemphasize the prominence of the prolapsed fat. In addition, significant harmony can be achieved in the lid-cheek junction. The overlying skin tends to be thicker and is more forgiving of contour irregularities. I prefer to inject the glabella and forehead, preserving the caudal 1.5 cm of the frontalis overlying the brow apex, and injecting the crow's-feet area 1 cm away from the orbit. The exact dose varies, but I often supplement the above with 2 to 3 units injected directly into the superior border of the brow apex.

In a secondary procedure, the brow and tear trough can be injected with hyaluronic acid filler; this is an off-label indication. There are a variety of hyaluronic products that can achieve similar results, and it is ultimately up to the user to find the most appropriate option. I recommend using serial injection, placing the product on the periosteum laterally. As one progresses medially on the tear trough, the injections become more superficial while remaining submuscular. The nasojugal fold is the most superficial and requires great caution to prevent hematoma and/or a Tyndall effect. Care must be exercised so that the product is not deposited in the septum or the malar fat pad, because this can cause prolonged edema and will be counterproductive. A useful strategy is to inject 2 to 3 mm below the obvious tear trough and massage the area to mold the end result, thus almost guaranteeing that the product is not placed into or under the orbital septum. Linear threading is placed more nasally to avoid visible lumps and bumps.

Care is taken to not overcorrect. Patients are made aware of the option to do a secondary injection 2 weeks later, if needed. This is much better than having to use hyaluronidase to break down too much product. Secondly, hyaluronic acid filler can be injected to restore and lift the lateral brow and reinforce the brow apex. This injection technique requires deep injection and care to avoid the supraorbital neurovascular junction. Typically, I do not exceed 0.2 to 0.3 ml of product. I have found that filler in this area will consistently last more than 12 or more months, and I have seen patients with persistence beyond 24 months. This provides a great "trial run"

for a patient who is uncertain about the degree of correction desired or who wishes to avoid surgery at all costs. These options can also be used in a patient wanting only segmental correction, such as limiting the correction to just the brow and upper eyelids and using filler and *botulinum* toxin for the lower eyelid and cheek. Fillers provide an amazing option for correction in patients of color, providing a great deal of forgiveness and user friendliness for the surgeon.



Although the result is not surgical, one can see this patient's enhanced appearance following hyaluronic acid injection to the tear trough. The longevity of this filler is typically more than 12 months and in some cases more than 2 years because of the relative lack of tissue movement in the tear trough and brow. In addition, the injections involve minimal downtime.

Avoiding Problems

There are several advantages to treating the skin of patients of color. The overlying skin is often more robust and shows fewer rhytids over time. This means that surgical intervention will focus on deeper tissue changes, in particular restoration of ptotic tissue and lost soft tissue volume. As already noted, a common and avoidable omission is failure to use past patient photos, which can provide a roadmap to success. Youthful photos also aid in appropriate planning for positioning of the lateral canthal mechanism. Failure to reposition the lateral canthus will not only result in a poor cosmetic outcome, but will also place the patient at increased risk for lid malposition. It is important to plan the use of soft tissue fillers in these patients, either nonpermanent products or autologous fat.

The transconjunctival deep plane midface lift allows preservation of the orbicularis function while providing direct access to the ptotic cheek tissue and a mechanism for restoration of a visible tear trough. To avoid difficulty with this procedure, I recommend using an insulated surgical system made up of insulated retractors and an insulated needle tip cautery. In addition, the use of a fine, double-armed skin hook facilitates holding the deep midfacial tissue for suture placement. I recommend working from medial/nasal to lateral for suture fixation. The canthopexy should follow the midfacial suspension, but the canthopexy should not be expected to support the midface alone. Conservative skin removal is recommended to avoid widened scars or visible extensions.

Perception is reality. This is extremely important in aesthetic surgery, but it is especially so in patients of African heritage, given their culturally specific ideals of beauty. I prefer to meet with the patient at least twice; the focus of our discussion is on the patient's desired outcome. I make the patient aware that I will undercorrect rather than overcorrect, allowing for later modification as needed. This places the patient in the copilot seat and limits the potential for a later perception of failure. When there is doubt about the patient's long-range outcome goals, a temporary option such as fillers and neurotoxins may be used.

Rhinoplasty

Nasal aesthetic surgery in people of color is very clinically and culturally specific. Despite past attempts to compare the noses of white patients and patients of color, the aesthetic goals are very different for each. In addition, the underlying structures differ from those of white patients. Defining points such as alar width, tip fullness, and radix height are inherently distinct in different racial/ethnic groups. If one looks at individuals who personify beauty in the African, Latin, or Asian cultures, the norms for whites do not fit. Adding to the complexity, there is no one universal African, Latin, or Asian nose; there are multiple ideals within ethnic groups and multiple cultures. There have been unfortunate examples in the popular media demonstrating how inappropriate attempts at changing one's ethnic character to another can be; the results are always obvious and unnatural.

Although much can be gleaned from past teachings, there are limitations and pitfalls to the unswerving use of past approaches. In particular, I am not trying to "correct" or "gentrify" a patient's nose, but rather to enhance the appearance and bring it closer to a given ethnic/familial definition of beauty and balance. The following discussion represents my personal approach to ethnic rhinoplasty and will focus on useful concepts that can be molded to an individual practice.

Preoperative Planning

In general, I use the patient's family photos as a useful guide to the individual's aesthetic goals. This is extremely useful in patient consultation and in defining the desired end result. Unfortunately, present-day virtual simulation is not accurate enough to predict an ethnic patient's end result because of the intrinsic variability of defining points. Of the patients referred to my practice who have undergone surgery elsewhere, more than 50% of the cases involved the use of morphing software that the patients perceived as an implied guarantee. Occasionally I see patients who wish to completely change their ethnic identity—to assume the characteristics of another racial identity. I advise surgeons to employ extreme caution in this very small and dangerous subset of patients, because ultimately they will be extremely difficult to satisfy.

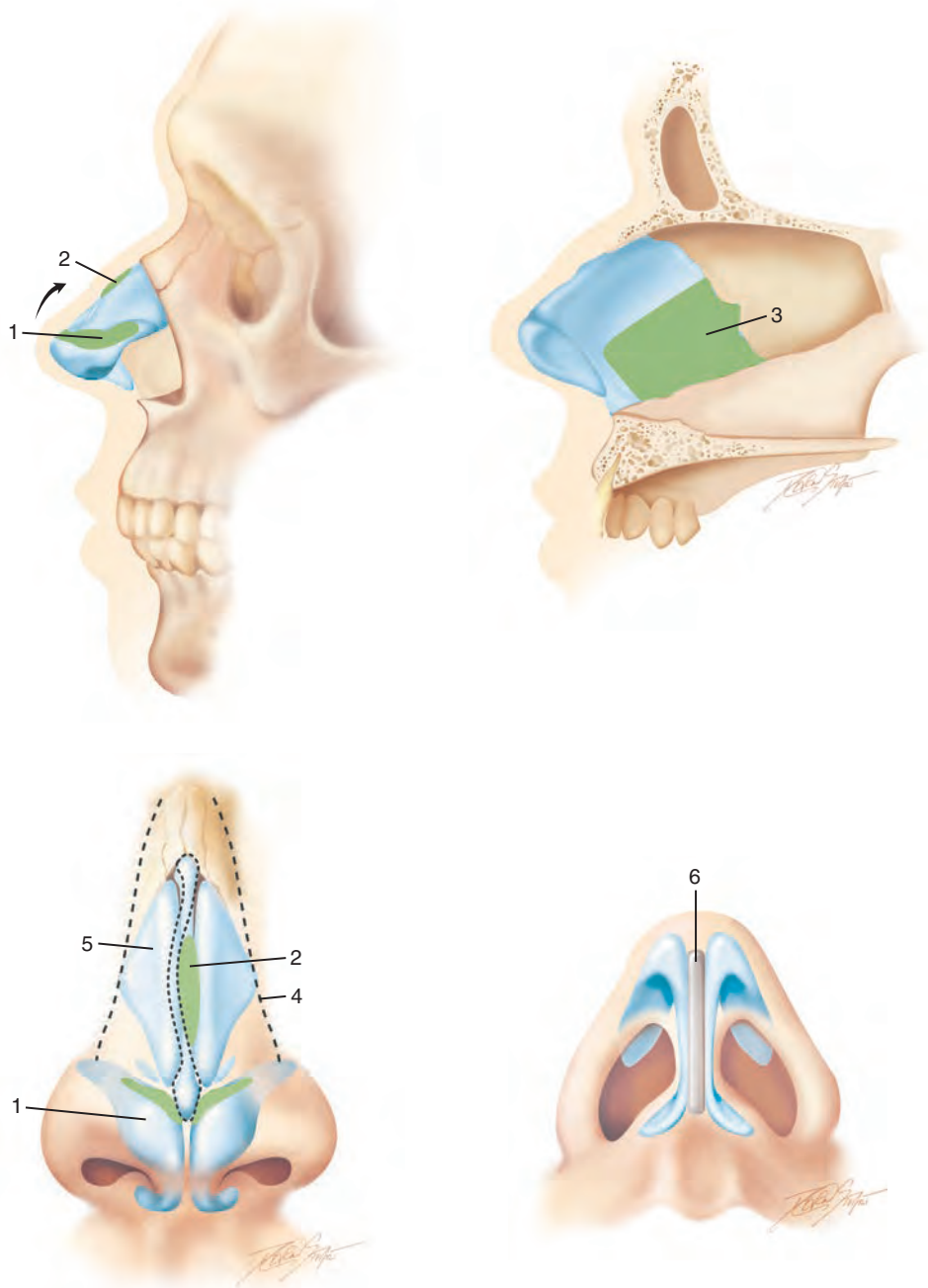


Preoperative

1 week postoperatively

2 years postoperatively

Although I prefer to produce a slightly undercorrected result, at the time of surgery the result must look slightly overdone to make up for the tendency of the skin envelope to swell significantly and the loss of tip support during the recovery period. This woman presented with severe lack of nasal tip support, to the point of complete collapse when she smiled. She did not want a drastic change, but to have a nose that looked more like her mother's.



An open-tip primary rhinoplasty was planned, beginning with a cephalic trim leaving 7 mm of lower lateral cartilage. The dorsal hump was reduced under direct vision, with a formal septoplasty for correction of an obstructing septal deviation to the left and harvest of donor cartilage. The nasal tip was then augmented with a columellar strut and placement of dome sutures. The alar flaring was managed with an internal diamond excision, as shown. Finally, the proximal nasal base was narrowed with a low-to-low nasal sidewall fracture. The progressive change in the preoperative and postoperative photos is shown on p. 101.

I prefer autologous tissue to alloplastic material in every case, but there are instances in which the donor supply is limited and/or the patient does not accept the risk of donor harvest. In these cases, it is vital to get complete soft tissue, beyond skin alone, to allow for long-term tissue integration and limitation of extrusion. Unfortunately, septal donor material is often limited if an extensive augmentation is planned. In general, I prefer to use auricular and costal cartilage, respectively, if available. If a patient is keloid prone, I will preferentially use alloplastic material rather than risk the development of ear or chest keloids. In patients with poorly controlled acne, I defer alloplastic implantation until the acne is under control and appropriate prophylactic treatment has been done.

In a patient of color who is uncertain about the idea of surgery or the end result, hyaluronic acid filler injection, used with caution as an off-label indication, can be a powerful tool. This is useful not only for demonstration purposes but also offers a reasonably long-term solution, typically more than 12 months, and favors the thicker skin envelope found in patients of color. This is an advanced application that requires significant understanding of the vascular anatomy to avoid inadvertent intravascular injection. A prime advantage is the ability to use hyaluronidase injection in patients who wish to remove the enhancement, typically providing complete resolution in 24 hours or less.

Before surgery, patients are made aware of the typical use of steroid injections during postoperative recovery. Patients are typically considered for their first injection of triamcinolone at 6 weeks after surgery. The injection is always placed deep to the dermis with a microdroplet injection technique in the tip. A 27-gauge or smaller needle is used and a concentration of 40 mg/ml is used so that the medication can be diluted 50%, with 1% lidocaine. A typical injection for my African American patients is 5 to 10 mg; I do not defat the dermis at the time of surgery. I then consider an additional injection of a steroidal agent at 3, 6, and 12 months after surgery.

At all costs, I avoid visible scar placement. The use of Weir alar excisions can typically be avoided by using the internal alar excision, completely hiding the future scar, as demonstrated on p. 101. Most primary cases are done via an open approach, using the natural recess located in the slightly hyperpigmented area at the columellar-labial angle. This scar is very forgiving, and I have used it with good results in patients with a history of keloids.



4-1 African American rhinoplasty

The most common approach performed for a primary African, Asian, or Latin rhinoplasty patient consists of an open tip with use of a septal strut, lower lateral cephalic trim, and removal of the fibrofatty pad collection at the crural dome. Lateral nasal infracture is used to blend the width between the tip and radix. Typically, the dorsum is left at its native height or is augmented with a cartilage or dermal fat graft onlay, depending on the patient's desired aesthetic endpoint.

Face Lift and Soft Tissue Restoration With Autologous Fat Grafting

Darker-skinned individuals have a tendency to age prematurely in some areas and late in others as a result of adipose tissue atrophy, bone remodeling, and gravitational soft tissue changes. Individuals of African heritage tend to manifest signs of aging in the deeper muscular layers of the face, with sagging of the malar fat pads toward the nasolabial folds. The folds become prominent and cheek ptosis is noted. Given the thicker dermis and subcutaneous tissue of some darker racial/ethnic groups, combined with infraorbital hypoplasia, midface aging can occur at an earlier age. For all the reasons mentioned earlier, rhytidectomy in skin of color can often be deferred or even avoided, given the availability of minimally invasive technology. However, there are appropriate indications for soft tissue repositioning and correction of facial rhytids in darker skin. The challenge I face is the nature of the procedure and the increased risk for adverse events. In particular, I know that hypertrophic and/or keloid scar formation may be exacerbated by increased skin closure tension, foreign body reactions or inflammation, and the patient's genetic factors. Therefore a simple skin-tightening procedure can be the start of disfiguring scars, as you can see on p. 105.

I have found that the use of progressive-tension sutures in this patient group helps to diffuse the ultimate resting tension on the periauricular skin closure. In addition, focusing on deep tissue repositioning helps to decrease the reliance on "tight" skin closure. In addition, I prefer to use nonabsorbable suture for the middermal to superficial dermal closure, which I remove within the first 7 to 10 days. Finally, I remove significantly less redundant skin than in a white patient to minimize skin tension.



This woman illustrates the result of a “lunchtime” skin lift. One can see how skin tension can lead to devastating complications. She is seen less than a month after surgery.



The patient is shown 6 months after a secondary face lift using a SMAS plication with conservative skin excision and internal progressive skin tension sutures. It is important to note the limited skin undermining, exposing only the lateral aspect of the midface–malar fat for suture plication.

My preferred facial rejuvenation procedure is the SMASectomy or SMAS plication procedure, especially in skin of color, allowing composite preservation and repositioning of soft tissue, but a variety of other approaches can achieve good results as well. The key is to reduce the provoking factors for poor scar in skin of color—primarily unrestricted tension. If I am ever in doubt or the patient has a questionable history of keloid formation, especially on the earlobe, I will either defer a face lift or consider an isolated postauricular approach, because the scar is easier to camouflage and/or treat with an intralesional steroid injection.



This second face-lift example is a woman who presented more than 2 years after a SMASectomy face lift, with autologous fat injection to the nasolabial folds and marionette grooves. The patient has a natural, well-maintained result that avoids the scar issues seen in the patient on p. 105. This case illustrates the importance of not placing the skin under excessive tension.

Fat Grafting

Autologous fat grafting can be performed alone or in combination with other procedures, using a variety of anesthesia options, including a local anesthetic only. I prefer to use the lower abdomen or flank as the primary donor site. Injection of tumescent local anesthesia, 60 ml 1% lidocaine with epinephrine 1:100,000 diluted into 250 ml normal saline solution plus 10% bicarbonate. Accordingly, the recipient site

is anesthetized using 1% lidocaine with epinephrine. Fat is aspirated using the Byron instrumentation (Byron Medical, Tucson, AZ), which offers graded cannulas. The harvest is then concentrated using a Telfa pad, strainer, or centrifuge, depending on the setting. Typically, 25% more volume than needed is injected. Care is taken to avoid bolus injection, and a microdroplet technique is used. The fat is injected into the subcutaneous layer accordingly. The puncture sites on the skin are not sewn but rather closed with Steri-Strips or a simple gauze covering to prevent suture marks that could hyperpigment during the healing process.

It is vital to use some form of silicone sheeting and/or scar massage during the acute healing phase, usually for the first 4 to 6 weeks or more. I typically see these patients two or three times during the first 6 weeks to assess for any evidence of scar hypertrophy or keloid formation. If there is evidence of such a scar process, intralesional steroid injections are very effective.

Adjunctive Nonsurgical Procedures

Laser

Skin resurfacing in skin of color can be very challenging, but the delayed nature of aging makes some of the light-based technologies an attractive option. In addition, the use of less-invasive technology can be coupled with minimally invasive surgical and nonsurgical technologies to provide the best of all worlds for this specific patient group. Although traditional ablative technologies such as CO₂ laser resurfacing may pose challenges to the treatment of darker skin, the newer wave of fractional and nonablative modalities offers significant benefits. Skin of color features the unique paradox of offering inherent protection from actinic damage, dense sebaceous support to lubricate the skin, and relative thickness, making it very nice to work with in all forms of handling. Yet it is much more prone to postinflammatory hyperpigmentation and adverse scar formation with resurfacing.

The primary indications for laser therapy in skin of color include hair reduction and treatment of dyschromia, texture irregularities, and scars. There are several critical considerations when considering laser treatment in these patients. The basics must be followed, such as shaving hair before laser hair reduction to avoid excessive energy uptake in surface hairs that can cause severe burns. In addition, many cases benefit from a patch test treatment before undertaking the definitive first treatment. Dermabrasion is really the benchmark for skin resurfacing in skin of color; it has been used for more than a century.



This patient is seen before and after two sessions of dermabrasion to treat severe forehead dyschromias. The technique is relatively low technology and offers the technician depth control and accuracy in uneven pigmentation cases, as this case demonstrates. I often use dermabrasion for treatment of active or chronic acne. This technique can be employed as a pretreatment before laser resurfacing or hair removal.

Before any resurfacing, it is vital to have patients use strict sunscreen protection of at least SPF 20 for 2 to 4 weeks before the treatment. In addition, although hydroquinone and retinoic acid use is beneficial for preparation of the skin and control of pigmentation after the treatment, patients typically defer retinoic and hydroquinone treatments for 1 week before and after resurfacing. During the treatment, two-phase cooling is vital to prevent thermal postinflammatory hyperpigmentation. To prevent complications, it is vital to respond quickly to a patient complaint of pain; a disproportionate complaint of pain is an automatic indication to halt treatment and reconsider the approach. Before the procedure, the need for realistic expectations is discussed with patients so they will understand that the treatment process will likely require a full year or more to achieve the greatest level of correction or enhancement.

The concept of selective photothermolysis is a concept developed in 1983 by Anderson and Parrish. The concept is vital to the understanding of skin of color. Fractional laser technology and nonablative capabilities are very attractive, given the tendency for energy to focus on melanin. With the gridlike effect seen with fractional laser treatment, there is less absolute injury and areas that are spared to aid in dermal recovery.



This woman with Fitzpatrick type IV skin requested treatment of active acne and related scars. Her acne scars were initially treated with three rounds of dermabrasion. Once the acne was brought under control, a combination of nonablative and ablative laser resurfacing was performed with the use of the Palomar fractional erbium laser system. The wavelengths used were 1540 nm for nonablative treatment, two sessions, and 2940 nm for ablative treatment, one session. The 6-month post-operative results are shown. Her regimen following skin resurfacing consisted of applications of silver sulfadiazine during the 5 days of reepithelialization, sunscreen protection at all times, and generalized cleansing of the skin. After 2 weeks, the patient used skin bleach (fluocinolone/hydroquinone/tretinoin [Tri-Luma] was preferred) for 4 to 6 weeks.

Fillers

The use of fillers in skin of color has many advantages and enjoys the same safety and efficacy profile seen in white patients. Because of the increased thickness of patients' skin and the darker pigment, the injection of product into the dermis tends to blend very well. In addition, longevity of effect appears to be at least the same if not greater in skin of color.

Based on my research with Dr. Grimes, I have found that several points should be considered regarding injectable fillers. In particular, the primary goal of any injection in skin of color is to minimize the number of needle perforations to the epidermis to reduce the risk of postinflammatory hyperpigmentation. In addition, it is important to inject the material into the deeper dermis to minimize the risk of dermal-epidermal separation, which can lead to epidermolysis and postinflammatory hyperpigmentation. Therefore our preferred technique, when possible, is linear threading with a 1- or 1.5-inch needle. To our knowledge, and based on a review of the current literature, there have been no reported cases of keloid or hypertrophic scar formation after the injection of hyaluronic, hydroxyapatite, or collagen fillers. Synthetic fillers are extremely advantageous in individuals of color who do not want to undergo surgical intervention. In particular, volume restoration to the midface can be readily achieved with a combination of deep injection to the submalar and tear-trough regions. In addition, the nasolabial folds and marionette grooves are further filled and corrected. Finally, with mild jowl formation, the prejowl sulcus can be filled, giving an appearance of a “liquid face lift.”



In patients with few rhytids, significant results can be achieved by injecting hyaluronic acid into the nasolabial folds, prejowls, and marionette grooves.

Concluding Thoughts

The use of expanded techniques in persons of color can lead to very safe, predictable outcomes. The material presented can form a framework for both clinical application and scientific investigation.

Clinical Caveats

Rhinoplasty

The surgeon reviews family photos when possible as a guide in planning intervention.

Overprojection and overrotation of the nasal tip should be avoided.

Postoperative deep tissue steroid injections should be planned.

An open incision is placed at the nasal–upper labial junction, in the natural shadow.

The use of morphing software to demonstrate potential results may lead the patient to have false expectations of what is possible, leading to patient dissatisfaction.

Autologous Fat Grafting

Excessive skin resection and/or tight skin closure must be avoided.

Absorbable suture closure on superficial skin should be minimized.

Soft tissue restoration should be seen as a primary tool; face lifting is secondary in skin of color.

Adjunctive Nonsurgical Procedures

A pretreatment patch test for laser patients is advisable.

Laser settings should be conservative.

Dermabrasion is the benchmark procedure for skin resurfacing.

Filler is injected into the deep dermis.

Fillers can serve as a supplement or substitute in facial rejuvenation.

Annotated Bibliography

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CHAPTER 5



Photographic Essentials in Aesthetic Surgery

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Photography and plastic surgery are inextricably intertwined, both in history and in today's practice. The development and popularization of photography in the 1800s gave people a new medium by which to measure, perceive, and evaluate themselves. Even for people of modest means, a photographic portrait was a special event, taken by itinerant photographers who carried their equipment with them. Most small towns had a photographic studio offering portraiture at a moderate cost. Certainly, popular photography had and still has a role in the general public's perception of themselves and can arguably be linked to the development of plastic surgery. Images of youth, beauty, and health pervade our daily lives. Often these photographic images are brought to the plastic surgeon as a representation of a patient's aesthetic goal.

Our patients are keenly aware of our reliance on photography as a diagnostic, documentary, and assistive tool. Photographs serve as records and legal documents. Because so much of plastic surgery is visually driven and amenable to photographic documentation, it is critical that we have a formal understanding of photographic techniques and strive for standardization of methods. We must apply these standard methods when producing photographic documentation in plastic surgery so that we have the means to accurately and adequately record patient outcomes and to compare preoperative and postoperative results. The recent advent of digital photography and its revolutionary effect on image creation has had a significant impact on the field of plastic surgery. This new technology has expanded our capabilities for photographic documentation, storage of and access to photographs, and even patient consultation.

History

In 1839, the process of making photographs, first named the *daguerreotype* after Louis Daguerre, was introduced; the remarkably clear images were called “mirrors with a memory.” It was in that same year that Sir John Herschel coined the term *photography*, which is derived from the Greek words for “light” and “writing.” The popularity of photography grew, and soon physicians of that era were using this new medium to record clinical conditions. In 1845, Gordon Buck, a New York surgeon, was the first to create a clinical photograph, a daguerreotype of a leg fracture. However, the original daguerreotype was only capable of producing a single photograph—in a sense an original piece of art that could not be duplicated. The wet-plate technique, introduced by Frederick Scott Archer in 1851, made photographic prints possible. With this new capability, Dr. Buck was able to take multiple photographs of his cases, including cleft lip repairs.

The next big step forward was the development of the dry-plate technique and celluloid film. George Eastman pioneered the mass production of film that could be stored in a roll. In 1881 he founded his company in Rochester, New York, which later became Eastman-Kodak. The first roll camera, the Kodak, was then introduced by Eastman in 1888 with the slogan “You push the button—we do the rest,” representing the birth of snapshot photography.

Photography Basics

Before addressing the issue of photography in plastic surgery, surgeons must have a basic understanding of how photographs are made and what equipment is needed to produce high quality images. These basics are applicable to both 35 mm film photography and digital photography. Today most plastic surgeons have adopted digital photography. In this introduction we will discuss the camera, the digital sensor, lens, and flash. A discussion of film is included as a historical reference and as a foundation to understanding the common terminology still used in digital photography.

The Camera and Optics

Capturing an image involves exposing the medium onto which the image is recorded (that is, a digital sensor chip or silver-based film) to an appropriate amount of light. The camera or lens contains a shutter that controls the amount of time that light is allowed to strike the medium. Within the lens is a diaphragm that acts much like the iris of the eye; it controls the exposure, or amount of light, that enters the film chamber (or the chip, in a digital camera). The shutter and diaphragm act in concert to control the exposure of the subject onto the recording medium.

Single-lens reflex (SLR) cameras contain a mirror in front of the shutter that projects the exact image seen by the lens to the photographer through a viewfinder. In “point-and-shoot” cameras, separate optics permits the photographer to see what the camera is “seeing.” In today’s digital point-and-shoot cameras, images gathered through the lens are also seen on liquid-crystal display (LCD) monitors.

The characteristics of the lighting environment dictate how much light is exposed to the recording medium (chip or film) and the duration of exposure. A built-in light meter in the camera calculates the best-fit exposure to record that scene. Exposure is controlled by shutter speed and aperture. *Shutter speed* is generally measured in fractions of a second ($\frac{1}{250}$ sec, $\frac{1}{500}$ sec, $\frac{1}{1000}$ sec) and refers to the amount of time that the shutter within the camera is open. *Aperture* refers to the diameter of the

opening of the diaphragm and is commonly referred to as the *f-stop* or *f-number*. The f-stop is typically described in terms of $f/4$, $f/5.6$, $f/8$, $f/11$, and so forth. It is an inverse relationship: the larger the f-number, the smaller the aperture, and therefore the less light that is allowed in. With the many available shutter speeds and f-stops, there are numerous metering combinations that result in the same exposure. This is an important concept to comprehend in understanding how optics and camera settings can affect photographs.

The concept of *depth of field* is critical in clinical photography. It refers to the distance in front of and behind the focal plane, or the subject in focus in the photograph, that remains in focus. A shallow depth of field means there is a small distance about the focal plane that is in focus; as the depth of field increases, so does the area in front of and beyond the focal plane that is in focus. Three factors control depth of field: the aperture, subject distance, and focal length of the lens. Assuming a fixed focal length and subject distance, the aperture may be manipulated to minimize or maximize the depth of field. A large aperture ($f/3$) has a shallow depth of field, thus making anything beyond or in front of the subject blurry. As the aperture increases (for example, to $f/8$), the depth of field lengthens and more objects within a certain range of the focal point will appear in focus.



The three photographs above are good examples of the aperture-setting effect on depth of field. The first photograph was taken at $f/4.5$, the second at $f/8$, and the third at $f/16$. These chess pieces were set 24 inches from the camera and 1 inch from each other. Notice how much more of the photograph is in focus with the larger aperture setting on the right.



This is a clinical example of the same phenomenon. The photograph on the left was taken at $f/2$ and the one on the right at $f/8$. Notice how in both photographs the tip of the nose is in focus, but only in the larger-aperture photograph are the eyes and forehead also in focus. This effect, which is based on aperture setting, must be considered when selecting camera settings in a clinical situation. In general, clinical photographs should be taken with a larger aperture number ($f/8$ or $f/11$) (smaller actual aperture size) to ensure crisp focus throughout.



Barrel distortion is a lens effect that causes images to be *spherized* at their center. This type of distortion typically occurs with wide-angle lenses and at the wide end of zoom lenses. The photographs above show an example of barrel distortion with a wide-angle setting. The photo on the left is taken with an 80 mm lens and the one on the right with an 18 mm lens. One can notice the robust effect a change in focal length alone can have on an image. In the clinical setting, subjects can appear rounded and centrally full or projective when, in fact, they are not.

The three-dimensional opposite of barrel distortion, *pincushion distortion*, is a lens effect that causes images to be pinched in their center. This is associated with the telephoto end of zoom lenses or with the addition of a telephoto adaptor. Because of these types of distortion, wide-angle and zoom lenses are not recommended for clinical use.

Lenses

Lenses are made up of multiple elements, usually individual concave and convex glass lenses, the combination of which gives a lens its operating characteristics. Lenses come in many different sizes, called *focal lengths*, based on the distance in millimeters from the posterior element to a point at which parallel rays of light are focused. The characteristics of a lens are largely based on its focal length.

A “standard” lens (one that does not magnify or diminish the size of an image) for any film or sensor size can be calculated based on the diagonal of the film. For example, the calculated standard lens size for 35 mm film is 35 by 24 mm, making its diagonal 43 mm. (Despite this calculation, 50 mm is the accepted standard.) This is an important concept to understand when using interchangeable lenses on digital SLR cameras, which for the most part have sensor chips that are smaller than the dimensions of 35 mm film. As a result, the standard lens on a digital SLR camera would, in fact, be a shorter focal length. Conversely, the same lens on a digital SLR will be the equivalent of a longer focal length 35 mm lens; for a digital sensor that is two thirds the size of 35 mm film, a 60 mm lens would behave like a 90 mm lens on a digital camera. As digital sensors are developed that increase in dimension and match the size of 35 mm film, this discrepancy will no longer be an issue, and lenses can be freely interchanged without concern for converting focal length (at present such sensors are available but are prohibitively expensive). For point-and-shoot cameras, the range of a lens is usually expressed in “35 mm equivalent” to make comparisons easier.

Lenses less than 50 mm in focal length are considered *wide angle*, and lenses greater than 50 mm in focal length are considered *telephoto*. *Zoom* lenses can traverse a range of focal lengths. Wide-angle lenses are good for panoramic/wide views, and telephoto lenses are good for viewing objects that are far away. Later in this chapter we will discuss how shutter speed, aperture, and lens optics affect the taking of photographs and how these apply to the plastic surgery setting.

Flash

The flash plays an integral role in photography in the plastic surgery setting. Clinical photographs are taken indoors in variable lighting conditions. Therefore it is important to have a reliable light source, comprehend how it works, and understand how flash photography can affect the images produced. The intensity of the flash determines the f-stop that can be used; the f-stop (as discussed earlier) determines the depth of field. Proper use of the flash enables small apertures and more depth of field.

Too much flash and improper aperture settings can result in washed-out photographs that lack definition and exhibit poor color quality.

Flashes on point-and-shoot cameras are typically mounted on one side of the camera at a relatively short distance from the lens. SLR cameras have a mount for the flash, usually above the lens, in addition to connectivity capabilities to operate multiple flashes at a distance from the lens. This is important because multiple flashes eliminate shadows. The “red eye” effect of point-and-shoot flash photography is a symptom of the flash being positioned too close to the lens. Some cameras have features that correct for this problem.



In addition, attention must be paid to flash position relative to the lens because of the shadows that are cast. As demonstrated by these photographs, the shadows projected on the backdrop can have a significant deleterious effect on the composition of the photos, most notably on lateral and oblique views. A projected shadow should not be viewable in clinical photography. A simple rule of thumb is that the flash should be positioned on the same side as the anteriormost part of the patient, placing the shadow behind the patient, as in the figures on the far right.

Equipment for Clinical Photography

Camera

With current trends, a digital SLR camera is the optimal choice for clinical photography. The camera should have manual controls for aperture and shutter speed to maximize versatility and control.

The camera should have manual and autofocus modes and accept interchangeable lenses.

A digital camera should have a minimum of 3 to 4 megapixels; 6 megapixels is preferred for publishing and enlarging photos.

Although a digital SLR camera is best for a studio setting, the point-and-shoot digital cameras with a rotating LCD screen offer an advantage for intraoperative photo taking and awkward camera positions.

Lens and Flash

Quality fixed focal length lenses should be used: a 50 to 60 mm lens for the body and a 90 to 100 mm lens for the face.

The lens should be marked with reproduction ratios.

At least a top-mounted flash with through-the-lens metering should be used, but optimally a studio setup with multiple flash units to eliminate shadows is preferred.

A lens with macro capabilities should be used for closeup photographs.

Ideally, multiple flashes should be used to eliminate shadows. Twin flashes are available that mount on the camera and eliminate the problem of sidedness with single-source flashes. Otherwise, a dedicated space with flashes set up on either side of the subject, or a committed studio, is needed. The setup of a committed studio will be addressed later. Ring flashes, flashes that mount at the end of the lens, are used for macro-photography. These can decrease shadows; however, they tend to make contours difficult to distinguish so they are used principally for intraoral and dental photography.

Film

Although digital photography is the current norm and some major camera companies no longer make film-based cameras (Canon stopped in 2006), film has some advantages over digital images: 35 mm film has excellent resolution, comparable to digital cameras with 6- to 10-megapixel sensors. Having said this, today's digital cameras with resolutions as low as 3 or 4 megapixels offer adequate resolution for clinical use. Film also represents a stable record that cannot be altered or modified, as digital images can; when stored properly, it cannot be lost or erased. Photographs made on quality film (such as Kodak Kodachrome) can last up to 30 years when stored properly.

However, there are significant disadvantages associated with film photography when compared with digital photography:

Buying and processing film is costly.

Storage of prints, slides, and negatives requires significant space.

You cannot immediately determine whether the photographs adequately capture the desired documentation.

Copies are difficult to produce; digital scan copies are an option but are also difficult and time consuming.

Printed images are subject to degradation by dust, fingerprints, and aging.

Clinical photographic prints can be “borrowed,” never to be seen again, leading to permanent loss of a significant part of a patient’s photographic history.

Slides lose color over time, especially when used in bright projectors.

The methods of processing, color balance, and type of film affect the final image.

Digital Photography

Digital photography and imaging are the standard today, with cameras that are capable of excellent resolution, and computers that have increased storage and processing capacity to handle the larger files that result. Today digital cameras outsell film cameras. Yearly advances are being made in digital technology that continue to improve the quality of digital photographs. With the demand for digital photography in the marketplace, resolution has significantly increased and cost has significantly decreased. These two trends have been the driving force that has propelled digital photography into the majority of plastic surgery practices.

The advantages of digital photography to the plastic surgeon are numerous. Most plastic surgeons have adopted the digital method of creating, storing, viewing, manipulating, and presenting clinical photographs. The computers and software needed to view and store digital images are already in most offices. The revolving cost of film and processing is essentially eliminated.

Memory Card

A large-capacity *storage card* such as an SD or compact flash card (in effect, a digital camera’s “film”) can now be purchased for about the same price as purchasing and processing several rolls of film. These memory cards can be reused thousands of times before they need to be replaced. Several investigators have carried out detailed cost analyses of the financial benefit of converting from film to digital photography. As digital photography expands and film usage diminishes, market forces will likely increase the cost differences so that they favor the digital format even more.

Digital images, like any other form of digital data, can be easily copied, stored, displayed, and accessed. These images can readily be shared with colleagues for consultation purposes, either face to face or over the Internet. Images are also easily imported into presentations. Multiple informational tags (such as age, date, and procedure performed) can be stored with images to facilitate archiving, searching, and retrieving in large image databases (for example, for instant access to and display of all blepharoplasty cases). Digital images are easily copied, so all of this can be done without loss of the originals. These images can be easily printed so that pre-operative photographs can be displayed in the operating room and referred to during a procedure. An even more advanced method of having clinical photographs available in the operating room is to establish wireless connectivity between the imaging computer and an LCD monitor, bypassing the need to print photographs.

The advantages of digital photography have also had a significant impact on patient and resident education. With the incorporation of LCD monitors and the playback capabilities of digital cameras, digital photography provides instant feedback on clinical photographs. Any problems with lighting, patient positioning, or composition can be immediately identified and rectified. With digital images and the proper imaging software, one can create simulations of operative results and facilitate patient consultations. These image manipulations can also help the plastic surgeon with operative planning and may reveal certain unwanted aesthetic effects of a surgical procedure before the procedure is performed and perhaps help to avoid undesirable outcomes. In addition, most digital cameras are capable of recording digital video that is easily played and can be used for teaching purposes.

Advantages of the Digital Photography Format

- The ability to store, organize, copy, share, manipulate, and import photographs into presentations, all with unparalleled ease
- No revolving cost of developing film
- Resident teaching and patient education and consultation are facilitated
- Immediate feedback on photographs taken so no loss of opportunity for the perfect shot
- Digital images are stable data that do not take up physical space like prints and slides

The Digital Imaging Setup

The general principles and basics of photography discussed earlier apply to digital photography. There are, however, several key differences between digital and film photography, principally in the creation, storage, manipulation, and production of photographs. We will discuss the differences that are applicable to clinical photography.

Camera Systems

There are two principal types of digital cameras on the market today: point-and-shoot models and digital SLR models. Digital point-and-shoot cameras were the first universally available and affordable type of digital cameras and are currently in common use among plastic surgeons. Myriad models have a zoom lens, autofocus, and an integral flash. These cameras have various levels of programmability and versatility. The composed image is viewed on a small LCD screen and on a viewfinder in most models. In some models the viewfinder tilts and swivels, allowing the photographer to see the image from a different angle than the camera does. This can be particularly helpful for intraoperative photography.

Digital SLR cameras are now universally available and are made by many camera companies. Their prices have decreased considerably, making them more accessible for the casual photographer. As with film SLR cameras, digital SLR cameras use interchangeable lenses, accommodate top-mounted flashes that can perform metering through the lens, can control multiple distant flashes, and permit the user much more versatility. With the SLR camera the photographer can use manual controls and fixed focal length lenses, which are generally of significantly better quality than the lenses of point-and-shoot cameras. These features make the digital SLR camera the optimal device for producing standardized photographs.

Instead of film, digital cameras render images via a sensing chip. Two types of sensors are common, one called a *charge-coupled device* (CCD) and the other a *complementary metal oxide semiconductor* (CMOS). The sensor is made up of a grid of *pixels* (short for “picture elements”); each pixel is a single-unit representation of the light falling on it. By comparison, on film, individual silver ions change with exposure to light. For example, a sensor with a pixel array of 2140 by 1510 would have a total of 3.34 million pixels, which is commonly referred to as 3.34 *megapixels*. As mentioned previously, the size of the sensor in comparison to standard 35 mm film dictates how images from lenses of different focal lengths will be rendered. The image cast by a 100 mm lens onto 35 mm film will be magnified to a degree based on the size difference between the sensor and 35 mm film. A sensor two thirds the size of 35 mm film will record the central two thirds of the image cast by a 100 mm lens and in a sense magnify the image, thus rendering an image comparable to that achieved with a 150 mm lens; $\frac{2}{3} \times 1.5 = 1.0$, hence the conversion for most digital SLR cameras is $1.5 \times \text{focal length}$ to get the 35 mm equivalent.

Digital cameras are categorized by the amount of megapixels they have. The number of effective megapixels in a given camera is directly proportional to the resolution (amount of detail that can be seen in an image). The more megapixels, the greater the resolution and the greater the detail of a given image. However, the final quality of a digital image also depends on the quality of the lens, proper metering, focus, and, if the images are to be printed, the printer and paper being used. In addition, the size of the pixels contributes to perceived resolution or sharpness; a digital SLR and a point-and-shoot may have the same megapixels, but the SLR will generally have a larger sensor with larger pixels, which captures more light and detail. Based on the capability to enlarge photographs and maintain detail adequate to the human eye, 35 mm film is roughly comparable to a 6-megapixel image.

Once the sensor captures an image, it is transferred through an analog to a digital converter for processing, a buffer, and then the storage card. During the course of processing images for storage, the images' raw data are compressed to varying degrees. Multiple compression algorithms exist, the most predominant being the JPEG (Joint Photographic Experts Group) format. Compression reduces an image file by 8 to 10 times with nominal degradation in image quality. The first save of a JPEG image does not cause poor quality at the highest resolution; however, any subsequent resave of the JPEG can degrade quality significantly if the proper settings are not used. Also to be avoided is multiple resizing of the image. Although JPEG format is the default setting on many cameras, for images intended for use in presentations and especially for publication, it is strongly advised that the image be saved in Tagged Image File (TIF) format with LZW compression as an effective, lossless method of maintaining image resolution.



9.5 mb raw

1.2 mb JPEG

380 kb JPEG

In these photographs, one image is in the raw format and the other two are JPEGs compressed to varying degrees. No appreciable difference can be seen between the “heavy” 9.5-megabyte raw image and the 1.2-megabyte and 380-kilobyte JPEG compressed images.



Also, compare the two JPEG compressed files with the zoom insets and note that both images are comparable with regard to resolution and detail in the magnified portion. These images remain 1.2 megabytes and 380 kilobytes, respectively, and further demonstrate the minimal effect of JPEG compression on image quality. However, note that all images that are printed in a publication (for example, all the images in this book) are printed in a *halftone* pattern (a multitude of minute, regularly spaced dots of ink; in this case, dots of four different colors), which may obscure any differences.

This process makes it realistically possible to store many digital images and facilitates handling (copying and moving) of individual photographs. There is a caveat, however: if you make changes on a given JPEG image and then save it in a JPEG format, multiple compressions will result in loss of detail and image quality. Therefore it is important to always save an original image and create another file for the image that is being altered so that multiple compressions and loss of detail do not occur. Most modern imaging software, such as Adobe PhotoShop and Apple's Aperture, preserves the original data by applying a set of instructions to altered images as opposed to making permanent changes, thus avoiding loss of information and image data and saving disk space. Of course, while this can preserve image quality, it is dependent on the user's handling this feature correctly. In clinical photography it is important for medicolegal reasons to always save an unaltered photograph.

Storage cards are removable storage devices housed within the camera that store processed images from the sensor. These are principally solid-state type storage devices as opposed to optical (CD-ROM) or magnetic (hard drive). They come in several different formats (such as compact flash card, secure digital card, and memory stick), memory sizes (which dictates the number of photographs that can be stored), and speeds (the rate at which information is written onto and read off of a card). Data from a storage card can then be downloaded to a computer either by connecting the

camera to the computer via universal serial bus (USB) or FireWire, or by removing the storage card from the camera and using a card reader. The method of transferring data is important to consider, because there are significant differences in the speed at which photographs can be downloaded. FireWire and personal computer memory card (PCMCIA) readers are the fastest methods to date and will make a significant difference in download times when managing many photographs at a time.

Peripherals and Data Storage

A back-up system for all digital photographs should be used routinely: one on-site backed up on a daily basis and one off-site backed up on a weekly basis.

A computer with a large-capacity hard drive should be used for storage with enough RAM to handle large photographic image files.

A monitor that is at least 15 inches is preferred.

A color printer should be used; the expense of photo-quality paper should be saved for when it is really needed.

A pen-driven, tablet-type touch pad (for example, the Bamboo; Wacom, Vancouver, WA) can be used for photo editing. This mimics the hand motions used in drawing much better than a mouse making edits and morphing easier.

A high-speed storage card that is 100× or more results in very fast photo reading and writing times, which is especially advantageous with large image files and transfers of a large number of photos.

The megabyte capacity of a storage card should best suit your needs. Too large and you may have too many photos to download at once. Just the right size and you can take many photos but be forced to download your photos on a regular basis.

A FireWire or USB 2.0 cable card adapter should be used to transfer photographs to the computer. These are the fastest methods currently available. More recently, Eye-Fi has introduced a wireless-capable SD card, obviating the need to remove the card from the camera to transfer photos.

Digital Imaging Software

Once an image has been transferred to the computer, appropriate software is needed to view, archive, edit, or print a photograph. Most operating systems today come with basic storage, viewing, and photo-editing software. Many additional applications are available with advanced features for viewing, archiving, and retrieving images. Specialty software is also available that allows the surgeon to easily manipulate and *morph* (short for “metamorphose”) photographs to mimic operative changes. A preoperative photograph can be manipulated to mimic an operative procedure, assisting the surgeon and patient in preoperative planning and consultation. The use of morphing software during the patient consultation will be addressed later.

As with film cameras, digital cameras are vulnerable to the same optical distortions mentioned earlier, in addition to a host of additional artifacts unique to digital photography. *Artifacts* (image distortions) based on image processing, and compression can occur, in addition to noise (the visible effects of an electronic error). It is important to know that the possibility for these phenomena exists, but a detailed discussion of them is beyond the scope of this chapter. Suffice it to say that in clinical digital photography these are unlikely to be encountered.

An organized approach to storage of photographs is essential. At a minimum each patient should have a folder for all of his or her photographs, but today there are numerous programs that allow attaching searchable key words, which can include diagnosis and procedure as well as demographics. Although this takes additional time during uploading of photos, it is well worth the effort later when trying to retrieve photos. Some examples include Canfield Scientific's Mirror; Extensis's Portfolio; Ulead's iPhoto; and ACDSee.

Recommendations for Photography in Plastic Surgery

The choice of digital camera should be based on several factors governing the ability to generate high-quality standardized photographs. The camera should have manual controls, accept interchangeable lenses, have the ability to control external flashes, and mount on a tripod. As noted above, an SLR is preferable for all of these reasons. Some point-and-shoot cameras have high-quality lenses, manual controls, multiple flash capabilities, and can take high-quality photographs, but there is great variability based on brand and model. Adequate clinical photographs can be taken with these point-and-shoot cameras, but SLR cameras offer more versatility and will produce superior images that are easier to standardize. Entry-level SLR cameras with a lens are now priced only a little higher than point-and-shoot models.

It is imperative that the surgeon develop a method of frequent and reliable backup of all images. A number of backup systems are currently on the market. Optimally, backup is done daily to a large storage device that is backed up locally, and on a less-frequent basis to a storage device physically located away from where the images are made in the event of a catastrophe (local system failure, virus attack, fire, earthquake) and loss of all data. Thus at a minimum the images are on three hard drives or other storage: the primary computer or server, a backup drive on-site, and a backup off-site.

A top-mounted flash, or better yet, a studio setup with multiple floor- or ceiling-mounted flashes, is ideal to minimize shadows and produce studio/portrait-quality photographs. As space for a studio is not always available in all office settings, an examination room can serve as a dedicated photography area using a painted wall or curtain as a backdrop. Mountable twin flashes are available in lieu of floor-mounted flashes.



This is an example of a digital photography studio. The camera is set up with a combination of floor- and ceiling-mounted flashes and a neutral background. In the digital studio, a computer with the appropriate software and a printer should be available for viewing, editing, and printing photographs. When editing digital photographs with morphing or “paint and draw” techniques, the use of a digital tablet and stylus mimics natural hand motions much better than a mouse. Using a tablet for such tasks will greatly facilitate their execution.

Requirements for a Digital Photography Studio

A room at least 10 by 12 feet
A uniform color backdrop that can be changed, depending on the patient's skin tone
The camera mounted on a tripod
A swivel sitting stool so the patient can sit for facial photography
A floor mat indicating patient foot positions for body photography at 45-degree oblique, 90-degree lateral, and 180-degree posterior views
Multiple floor- or ceiling-mounted flashes to eliminate shadows (two flashes for the background and two flashes for the subject)
A computer with appropriate storage, retrieval, and editing software, a color printer, and stylus-driven tablet-type touchpad for photo editing
A monitor of at least 15 inches
A stylus-driven touch pad for photo editing (this is better at mimicking natural hand movements than a mouse is)

Managing Photographs and Text for Presentation

Frequently, clinical photographs are used for presentation purposes. Before any clinical photograph with personal identifying features is used in presentation format, consent must be obtained from the patient. If consent has not been obtained, the photographs should not be used in an educational or public forum.

Any time clinical photographs are used for presentation, education, or demonstration, the photos should be clear without distracting elements, and they should be large enough that when projected they can be easily viewed. A good rule of thumb is that any photograph should not be less than one third of the total projected image. If the photograph is too small, it cannot be adequately appreciated and will not succeed in conveying the desired point of the photograph.

Some useful image-saving guidelines are as follows:

For presentations/projection on a screen: *The maximum pixel width of the screen is currently 1600 pixels, so an image on half of a "slide" should be about 800 pixels for optimal clarity.*

For print production: *For each inch that you intend in printed image width, multiply by 300 and round up. Thus a photo that is to print as 3 inches wide $\times 300 = 900$ pixels wide minimum. It is also best to let the publisher downsize and crop the image to your instructions.*

Photographic Standards in Plastic Surgery

General Concepts

Many excellent articles have been written on the photographic standards for clinical photography.

Whether or not your office has a studio, patients should be in a private and comfortable setting for clinical photography. All jewelry and makeup should be removed for facial photographs. Long hair should be held back off the face, forehead, and ears. Clothing should be removed, and disposable low-profile privacy garments used in body photography. A uniform nonreflective background of blue, grey, green, or off-white should be used. The choice of background color depends on the patient population and should be matched to maximize contrast with skin tone. The backdrop can be a painted wall or door, a studio backdrop, or common bed sheet or towel easily found in the hospital setting. The subject should be positioned 18 to 36 inches from the backdrop.

Techniques for Taking Clinical Photographs

A dedicated photography area or studio is ideal for picture taking, if possible.

Patients should be made to feel comfortable having their photographs taken, and permission should always be solicited.

Photographs should be taken in a private, well-lit setting; patient comfort and dignity must be maintained.

Recommendations for standardizing all photos of particular body regions should be followed with regard to composition, lens choice, subject distance, and alternate views. An aperture of $f/8$ is used to lengthen the depth of field and still allow enough light for good exposure.

The grid screen in the viewfinder is used to help with patient positioning.

The lens is set to a fixed focal distance; then the camera is moved to bring the subject in focus. This helps in standardizing photographs and facilitates preoperative and postoperative comparisons by maintaining a constant reproduction ratio.

A uniform background will enhance the subject outline and improve contrast—darker colors for light-skinned individuals and lighter colors for dark-skinned individuals.

Flash position should be monitored to hide shadows.

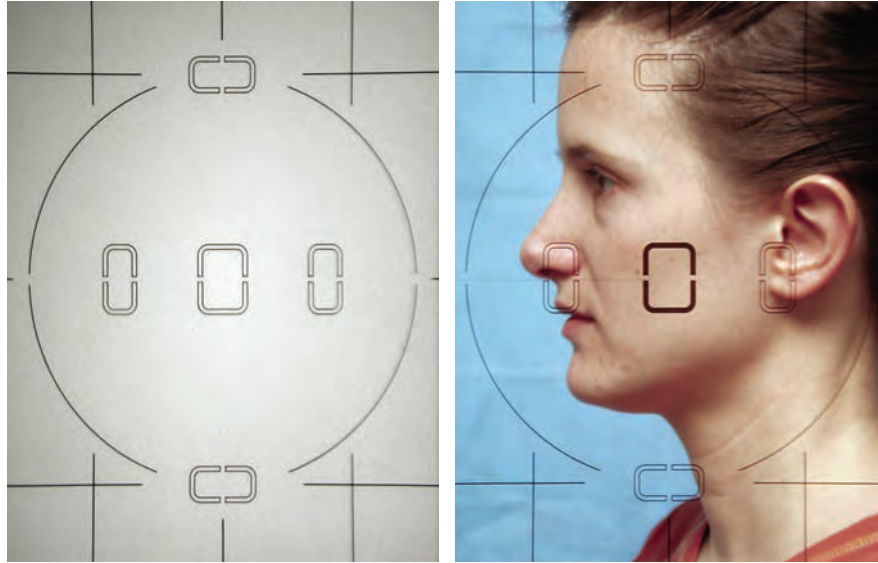
For intraoperative photographs, the operative field should be clean, distracting elements minimized, and technical demonstrations simplified.

For facial photography, the patient should wear minimal or no makeup. Jewelry and eyeglasses should be removed, and shirt collars should not obstruct the view of the neck.

For body photography, privacy garments should be worn, with no street clothes.

A normal or basic JPEG setting will maintain good photo quality and keep image files down to a manageable size (less than 1 mb, preferably under 500 kb)

The lens should be held at the same level as the area being photographed. A viewfinder equipped with a grid screen is very helpful in determining proper alignment, as demonstrated below.



Fixed focal length lenses should be used, avoiding the distorting characteristics of wide-angle and zoom lenses. If a zoom lens is used, it should be high quality and have a focal length range much larger than what would be used clinically to avoid the distorting effects at the ends of its range. The same point on the zoom can be used for reproducible results. The size and focal length of the lens used is based on the part of the body being photographed. The lens choice should position the photographer at a comfortable working distance from the patient and allow for adequate composition of pertinent features. The photographer should establish standard anatomic landmarks to be included in each given view. A subject distance from the camera lens or a reproduction ratio to fill the frame with these landmarks should also be determined. The reproduction ratio (for example, 1:2, 1:4, or 1:10) can be found on most SLR macro lenses. These ratios represent the size of the subject and the size of its image on film, or in other words the size scale to which the photograph renders the subject. A 1:1 ratio represents a life-size image, and so on. These ratios are not valid when a 35 mm lens is used with a digital SLR because of the magnification; thus a safe rule of thumb is to set the camera 3 feet away to photograph the patient's face and 6 feet away to photograph the patient's body.

As much as possible, intraoperative photographs should adhere to the recommendations for photographs taken outside the operating room. The operative field should be cleaned, fresh border towels placed to frame the subject, and any distracting items removed from the field. Operating room lights are intense spotlights and should be turned away from the field during photography to facilitate accurate metering and exposure. If operative techniques need to be demonstrated and instruments are visible in the photograph, instruments with a dull finish should be used (alternatively, bone wax can be applied to shiny surfaces) so that reflections are minimized. All demonstrations should be simple, with minimal distracting elements. Photographs should be taken at right angles to the patient and from the same vantage point, usually with a wider orientation photograph before any close-up photos are taken. Before any series of photographs is taken of a patient, we strongly recommend that the patient's name and the date be recorded. This can easily be done by photographing the nameplate from the patient's chart before beginning the photographic series.

The box presents a helpful mnemonic device to keep in mind while taking clinical photos.

Mnemonic Device for Photographic Consistency

FLASHBACK

- F *Framing* anatomic landmarks and proper *focus*
- L *Lighting*
- A *Aperture* setting
- S *Subject* distance and *shutter speed* setting
- H *Hold* consistent reproduction ratio
- BACKground

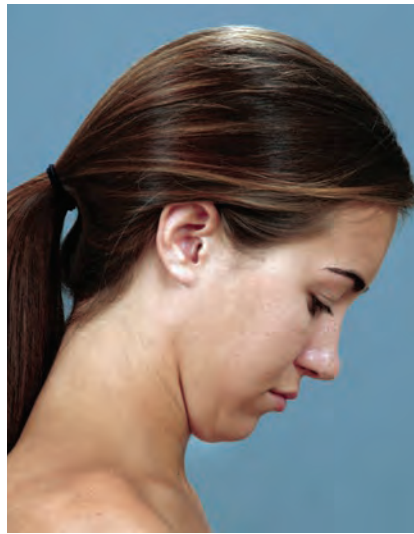
All aspects of clinical photographs should be kept consistent, including use of the same camera, lens, lighting, film, patient positioning, and image framing. By following the preceding guidelines and adhering to the standards that follow, you will obtain excellent photographs, ensure reproducibility, and facilitate valid preoperative and postoperative comparisons.

Photographing the Face



Full-face photographs should be taken with a 90 mm lens (or digital equivalent) and should include the neck and ears. A reproduction ratio of 1:9 is used. The hair should be pulled back, jewelry removed, and no makeup or a minimal amount worn. Shirt collars should not obstruct the view of the neck. Anteroposterior views should include the clavicular heads and the top of the head. Eyes should be looking straight ahead, and the mouth should be relaxed. Additional images should be taken with the face in animation to document facial nerve function preoperatively. Oblique photographs should be taken with the medial canthus of the distal eye just meeting the nasion (both left and right views should be photographed for oblique, lateral, and tilted-down positions). The patient's whole body should be turned, not just the head,

to avoid torsional changes in the appearance of the neck. Lateral views are taken with the philtral columns aligned along the Frankfurt horizontal (a straight line from the tragus to the infraorbital rim) and kept parallel to the lower border of the photograph, with the eyes looking straight ahead. If a single flash is used, the flash should be oriented on the same side as the nose to avoid shadows.



An additional lateral tilted-down view is taken with the patient gazing downward to create a double chin.



Close-up views of the face are obtained with the same-size lens, using a reproduction ratio of 1:4. These views are better at demonstrating facial rhytids and more detail about specific facial areas. The face is divided into upper and lower halves. The upper half is from just above the brows to the upper lip. This provides a closer look at the eyes, cheeks, and nose. Consider photographing the eyes with a lower flash setting or using only ambient light for improved detail of periocular structures. A smaller aperture ($f/11$ or $f/16$) will give better depth of field at closer range. Photographs of the lower half of the face extend from the middle of the nose to just below the chin, giving close-up views of the nasal tip, mouth, chin, and neck. The same guidelines apply to patient positioning as for full-face views.

Photographing the Nose



Photographs of the nose will also require a 90 mm lens. The same rules for the face apply for the anteroposterior, lateral, and oblique views of the nose, the only difference being that the framing is closer, from the top of the forehead to the bottom of the chin, with a reproduction ratio of 1:4. A basal view of the nose should also be included. This is done by lining up the top of the nasal tip with the medial canthi, and provides information about nasal base width, the nasal tip, and the dorsum. Additional views specific to the nasal tip can be obtained with the “worm’s eye” (basal) view, lining up the top of the nasal tip with the level of the upper eyelid crease. This view obstructs the dorsum but can provide more information about the columella, septum, nasal sills, and tip symmetry. A lateral smiling view can be done to help assess the effects of facial animation on the nasal tip.

Photographing the Ears

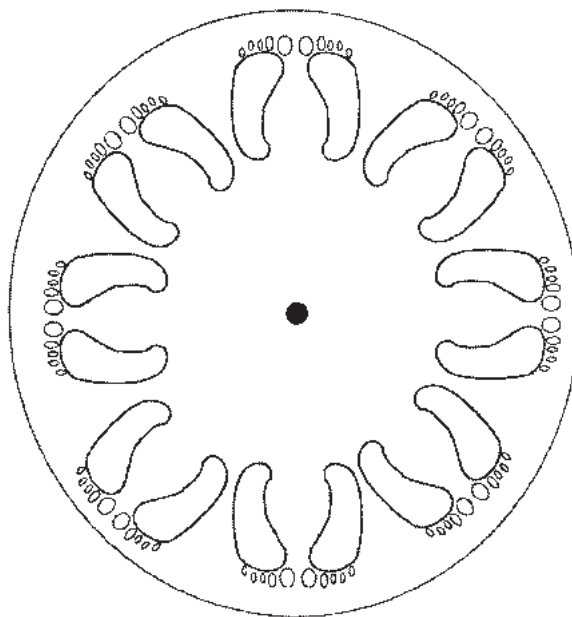
Photographs of the ears include the standard anteroposterior facial shot in addition to a posterior view with the hair pulled up. Close-up lateral views of the ears with a reproduction ratio of 1:3 show details of the helixes, concha, tragus, and lobule.

Photographing the Teeth

Quality standard photographs of the teeth and occlusal relationships can only be obtained with a ring flash and cheek retractors. Anteroposterior and oblique views should include the nasal tip and chin.

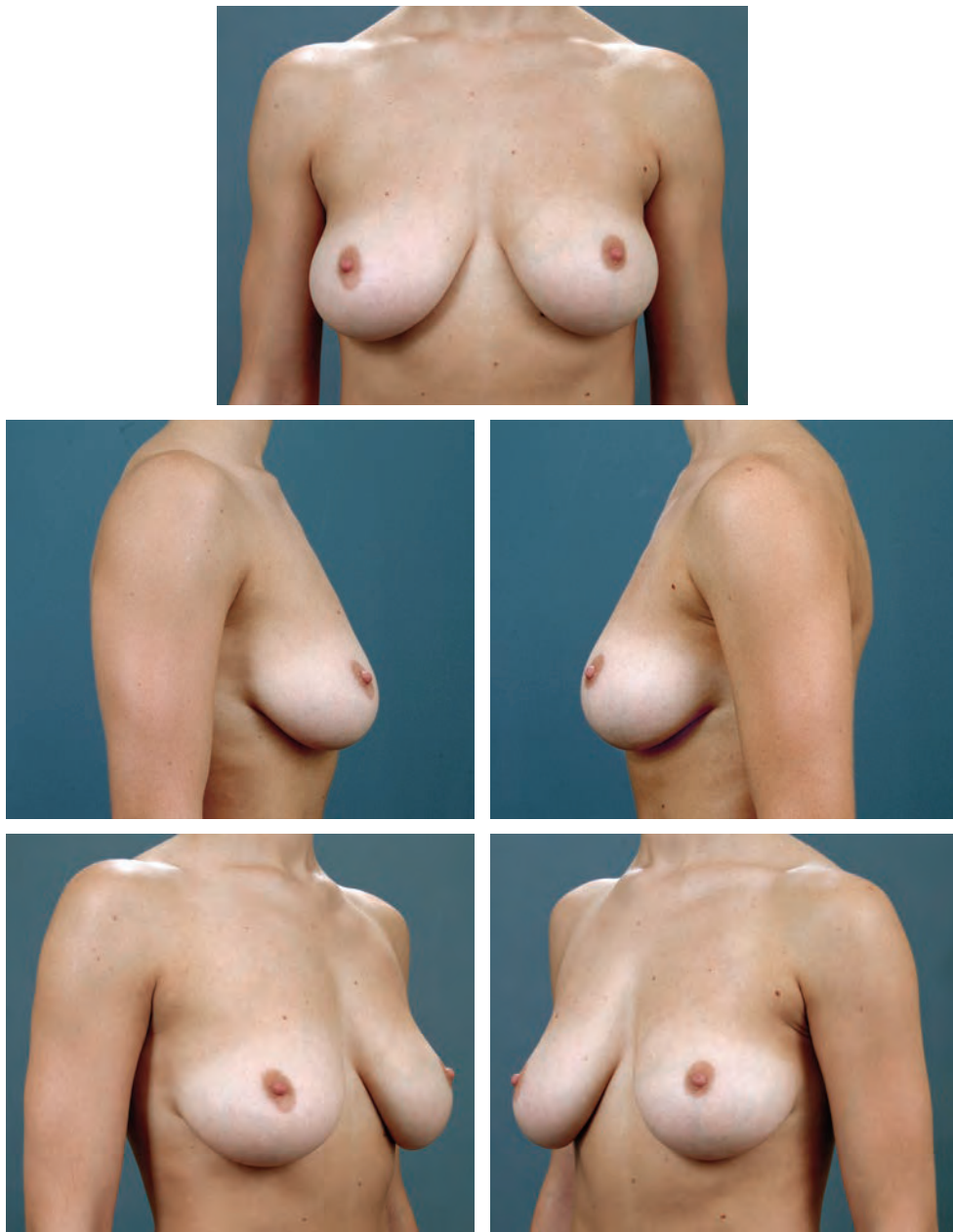
Photographing the Body

Because photographs of the body cover a larger area than those of the face, a 50 mm focal length lens at a distance of about 3 to 6 feet from the subject is used. The same recommendations for lighting, flash position, and background apply. Because patients will be in varying states of undress, it is very important to ensure a comfortable and private environment for photography. Standard disposable cover garments are used so that aesthetic features and body contours can be more easily seen while simultaneously maintaining patient dignity.



For the majority of body photographs, a reproduction ratio of 1:12 is used. A floor mat that has various feet positions marked for oblique, lateral, and posterior views is helpful. In this way patients can simply place their feet in the specified areas so they are lined up properly for the photographs.

Photographing the Breasts



When the patient's breasts are to be photographed, the patient should be instructed to hold her arms comfortably at her sides with her back straight and shoulders slightly rolled back but not pulled upward. The shoulders and clavicles should be included, as well as sufficient space below the bottom edge of the breast. Anteroposterior, lateral, and oblique (the patient turned 45 degrees) views should be obtained. Patients should turn their whole body rather than twist at the hips for oblique views. In a transverse rectus abdominis myocutaneous (TRAM) reconstruction, the breasts and abdomen down to the level of the upper thigh should be included so the umbilicus and pubis can be seen.

Photographing the Abdomen



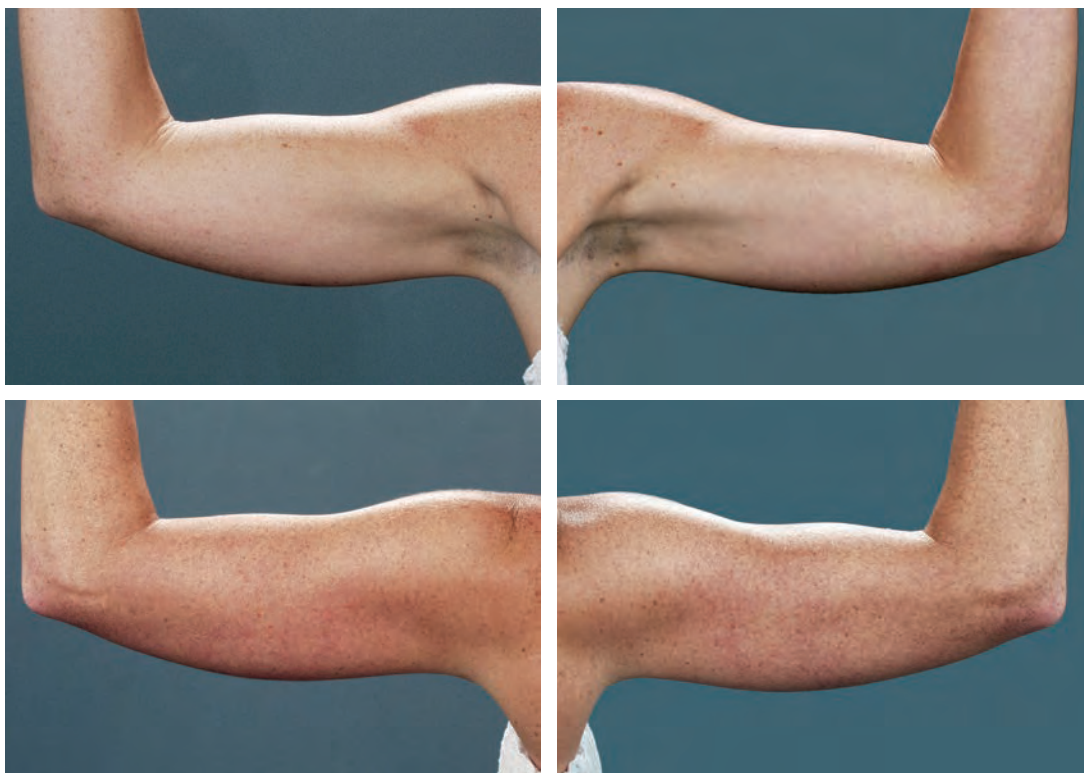
The abdomen is framed from the inframammary fold to the upper thigh. The arms are held above the level of the photograph, folded across the chest. Anteroposterior, lateral, and oblique views are taken. Additional lateral views with the patient bent 30 degrees at the waist can be helpful for assessing excess skin and overhang. Privacy garments should not cover the location of any incisional scars.

Photographing the Hips and Thighs



When photographing the hips and thighs, the patient's arms are held folded across the chest, and the feet are separated to show the full contour of the medial thigh. The hips and thighs are framed from just above the umbilicus to just below the knees. Anteroposterior, lateral, oblique (of the front and back), and posterior views are taken.

Photographing the Arms



The arms are photographed individually while the patient is bent 90 degrees at the elbows and abducted 90 degrees at the shoulders. The patient should be upright, and anterior and posterior views should be taken. The head is cropped to maintain anonymity and focus attention on the arms.

Digital Imaging and Morphing

Imaging and morphing software can be an excellent teaching tool for use with a patient who will be undergoing plastic surgery. If a digital format is used and imaging software is part of the patient consultation, the surgeon should sit down with the patient at the computer monitor after all appropriate photographs have been taken. Viewing the photographs with the patient allows the surgeon and patient the opportunity to analyze areas of concern and joins them in preoperative decision-making. With effective use of a software program, the surgeon can demonstrate the possibilities and limitations of a surgical procedure in a very realistic visual manner. Sometimes these consultations can expand a patient's desire for additional procedures. Caution and judicious use of manipulating software must be exercised so that one does not create unrealistic expectations and undermine the efforts to educate and

prepare patients for their surgical procedure and postoperative prospects. It is mandatory that the original images be saved in an unedited format.

Legal Issues

Clinical photographs, although considered a part of the medical record, represent a unique incursion into a patient's privacy. Therefore plastic surgeons should recognize that patients have specific rights that apply to the taking and use of these photographs. Consent for taking photographs or video recordings of any sort should be obtained and kept on record. This should also include the consent for publication and display of these photographs. An example of photographic consent forms is shown on pp. 144 and 145. In general, publication in a journal, textbook, or website should be done with the patient's specific consent for that use as well as the general consent form obtained in the office. It is recommended when obtaining consent to publish patient images on the Internet that the precise name of the website be included in the consent form. Any images submitted to be displayed on the web should be rid of any metadata that could identify the patient. It is safest to simply rename all image files with generic terminology and indexing, and never use names.

There have been cases of photographs being taken of unconscious patients without their consent; these are a clear invasion of the patient's privacy. The person who takes the photographs has legal ownership of the photographs unless the photographer is in the employ of the plastic surgeon. Computer images are considered part of the medical record and as such should not be deleted or destroyed. To do so can incur civil or even criminal charges.

Legal Safeguards

Consent should be obtained for all clinical photography.

Specific expressed consent should be included for publication, display, or presentation of any photographs, especially those with identifiable elements (this includes tattoos or birthmarks as well as facial features).

Special measures should be taken for photographs to be published online.

A statement should be included with any altered or morphed image given to a patient that it is not a guarantee of an operative outcome; in addition, a method of authentication should be used.

All patient photographs should be kept as a part of their medical record and treated as such.

Patient photographs should not be destroyed.

PLASTIC SURGERY PHOTOGRAPHY CONSENT

Page 1 of 2

I hereby voluntarily grant permission to _____
and/or their designated employees to take and use any preoperative, intraoperative, or postoperative
photos of myself for purposes of record, research, education, and medical publication, as well as
assisting others in making their surgical decisions. Any of these uses may be eliminated from
this form.

I further understand that no form of compensation shall become payable to me for the use of these
photographs.

I hereby release _____
and its agents from any and all claims and demands arising out of or in conjunction with the use of
these photographs.

Signature_____
Date_____
Print Name

I hereby certify that I am a parent or the person legally responsible as the guardian of the above
patient, a minor person, and that I also hereby provide authorization and grant the releases described
above in this document.

Parent/Legal Guardian Signature_____
Date_____
Print Name

PLASTIC SURGERY PHOTOGRAPHY CONSENT

Page 2 of 2

Please initial in the spaces below:

_____ I consent to being photographed and/or videotaped before, during, and after treatment.
These images will become part of my permanent medical record.

I give my permission for these images to also be used for:

- _____ Educational purposes
- _____ Scientific publications
- _____ Other publications
- _____ Demonstration to other prospective patients
- _____ Internet

I give my permission for photos of my:

- _____ Face
- _____ Body
- _____ Breasts

to be used on:

- _____ Your preferred website
- _____ Other website: _____

Patient Signature

Date

Print Name

Witness

Common Errors in Clinical Photography

Zoom or wide-angle lenses should not be used at the limit of their range.

For facial oblique views, the entire body should be turned, not just the head, so the neck contour is not distorted.

Distracting backgrounds and dirty operative fields interfere with clear patient photography.

The pincushion effect of closeup photography and short focal lengths should be avoided.

Low-number aperture settings with shallow depths of field should not be used.

Altered photographs should not be submitted for publication or presentation unless they are explicitly labeled as such.

When consulting with patients and using morphing software, the surgeon should be conservative, taking care not to alter images beyond his or her surgical capabilities.

The advent of digital imaging and morphing software that can mimic postoperative results introduces new legal issues. Although we do not know of any lawsuits regarding the implied “guarantee” of an altered digital image, certainly the risk of this happening is real. If imaging is used as part of patient consultation, it is imperative to ensure that the patient understands that digital imaging only represents a “possible” outcome and is not a guarantee. Any altered images shown or given to a patient should include this statement: “THIS COMPUTER IMAGE CONSTITUTES A SIMULATION AND IS NOT A GUARANTEE OF YOUR RESULT” or a similar phrase, in capital letters on the photograph. Images of any sort that are given to patients should be authenticated with a time-date stamp or signature to ensure image legitimacy and to minimize the possibility of a patient tampering with images.

Concluding Thoughts

To practice plastic surgery is also to practice photography. As we strive to improve our skills as surgeons, we should also aspire to be good clinical photographers and apply standard techniques to the taking of photographs. We must exercise care to maintain patients’ privacy and rights and to use photography to educate our patients, our colleagues, our trainees, and ourselves.

Clinical Caveats

A comfortable, private area should be provided for all clinical photos with a dedicated imaging system.

All image data should be backed up on a regular basis.

It is essential to obtain patient consent for taking photos and using them for educational purposes.

Annotated Bibliography

Chavez AE, Dagum P, Koch RJ, et al. Legal issues of computer imaging in plastic surgery: a primer. *Plast Reconstr Surg* 100:1601-1608, 1997.

This article includes a brief review of the law regarding clinical digital photography. The lead author is a graduate of the Stanford Law School. The authors state that to date no cases regarding computer imaging exist in federal or state case law. Sound recommendations are made to reduce legal susceptibility when using digital photography.

Galdino GM, Vogel JE, Vander Kolk CA. Standardizing digital photography: it's not all in the eye of the beholder. *Plast Reconstr Surg* 108:1334-1344, 2001.

These authors have written multiple publications on clinical photography. This article compares clinical photos taken with different digital cameras with different resolutions. Sound guidelines regarding the standards of clinical photography are reviewed.

Milburn K. *Digital Photography Bible*. Chicago: IDG Books, 2000.

This is a comprehensive guide to digital photography that reviews the needs of a digital studio. It covers digital cameras, scanners, and image processing. This is an excellent resource for the serious amateur or professional photographer. The section on processing and editing digital photographs is extensive.

Photographic Standards in Plastic Surgery. Plastic Surgery Educational Foundation Clinical Photography Committee.

This pamphlet is a quick guide to the standards of patient positioning and camera settings in clinical photography. It is a must-read for anyone learning the standards of plastic surgery photography and handy to keep in a studio.

URL: www.dpreview.com

Digital Photography Review is an independent resource providing news, reviews, and information about digital photography and digital imaging. The reviews and comparisons are very thorough and informative and should be considered a must to consult before purchasing a digital camera. The site also has an informative section about general and digital photography.

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PART II

BUSINESS BASICS



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CHAPTER 6



The Practice:

Models, Management, and Marketing

FOAD NAHAI, GUSTAVO A. COLON, WENDY LEWIS,
MARIE CZENKO KUECHEL, ANDREW R. BERGER

The Environment

FOAD NAHAI

In today's competitive environment, practicing good medicine is only one of the talents that a successful aesthetic surgeon must possess. Business, financial, and marketing acumen, communication and organizational skills, office planning and decorating expertise, website and social media marketing knowledge, and myriad other skills or information may be required for a practice to not only run smoothly and effectively, but also to be a successful financial endeavor. These are not things we learned in medical school or during residency. With the rapidly changing face of medicine, we have to take a far more active role in understanding and directing the business and planning aspects of our practices, in addition to the purely medical and surgical aspects of providing our patients with the finest care possible.

This chapter and the three that follow cover a spectrum of issues and basic decisions associated with running an aesthetic surgery practice and offer solutions that have worked in the real world. The topics addressed range from decisions about the basic practice model (whether an academic or a private practice), management issues, patient relations, financial and budgetary considerations, communication skills, staffing and services, marketing and practice enhancement, online tools for practice enhancement, and legal considerations.

The Practice Model

There are a number of highly successful aesthetic surgeons flourishing in a variety of practice models, so it is clear that there is no one formula for success. It cannot be stated categorically that an aesthetic practice does not belong in a university setting or that the only way to have control is to be in a solo practice. Having said this, each of these practice models—university setting, private practice, group or solo practice—will affect the surgeon and the patient. The surgeon's working environment, control of everyday decisions, financial independence, and schedule flexibility are a direct reflection of the practice model. Similarly, and perhaps of greater importance, the practice model will also have a profound impact on the patient's experience.

Many renowned university programs attract patients from all over the world because of their reputation, the prestige of the institution, and the well-founded assumption that only the finest of physicians would be on staff. Equally, there are outstanding physicians in private practice whose rise to prominence has not occurred under the umbrella of a prestigious institution but through outstanding performance. This is

true in all areas of medicine, including aesthetic surgery. Many patients will place their trust in plastic surgeons on staff at the academic centers merely because these surgeons are at that center. In the private setting it is the surgeon's reputation and standing in the medical community, rather than institutional affiliation, that is important.

Traditionally in plastic surgery, it was common for young plastic surgeons, whether in private practice or academics, to start with a combined reconstructive and aesthetic practice, far more reconstructive than aesthetic, with much emergency work and cases referred or handed down by senior colleagues. As the young surgeon became established, the practice would grow in one direction or another and over the years, those of us with a special interest in aesthetic surgery would slowly build our aesthetic practices so that eventually we could limit our practice to aesthetic surgery, passing on to junior partners and colleagues the nonaesthetic part of our practices.

This model worked well for many of us who currently enjoy a sizable aesthetic surgery practice. However, this model may not work as well today, because we now practice in a very competitive environment with competition not only from our plastic surgery colleagues, but also from other core physicians and surgeons, those who are not surgical specialists, and even individuals who are not medical practitioners. The young plastic surgeon entering practice today who wants to focus on aesthetic surgery has to plan a specific course to attain those goals. Times have changed and one can no longer start a practice, cover the entire field, and expect one day to have built sufficient volume of aesthetic surgery patients to shift focus in that direction. The good news is that even though the field is highly competitive, demand for aesthetic procedures continues to grow. With this continued growth and the explosion of information via the Internet, a patient seeking aesthetic enhancements will be far better informed, more focused, and more demanding.

Each of us will have to weigh our options so we can choose the practice model that will afford us the opportunity to build and maintain an aesthetic practice in an environment in which both patients and the surgeon are satisfied.

Reflections on My Experience

Having practiced aesthetic surgery for a number of years in a university setting and now in a private group practice, I have spent many hours ruminating about these practice models and their potential impact on the total patient experience, the practice environment, and the surgeon's flexibility, professional fulfillment, and career satisfaction.

Early in my career, patients chose me for their aesthetic surgery because of my position in a prestigious academic institution, with referrals from within the clinic as well as from outside physicians. There is no question that such referrals composed the initial building blocks of my aesthetic practice. Over the years, the focus of referrals shifted from physician referrals to word-of-mouth referrals based on patient satisfaction. Today most of my patients are self-referred or come because of recommendations from friends or family, and because I now have a recognized name within the community. Although I still see physician-referred patients, even from prestigious academic centers, these constitute a small portion of my current practice.

As my aesthetic practice began to grow, it became obvious to me that my patients were selecting a surgeon who they felt would, in all likelihood, deliver the results they were looking for. However, I also came to realize that a good result was only part of the equation; it was the total experience that mattered most. By *total experience* I mean the patient's encounters with all aspects of the practice: the medical and nonmedical staff, the physical and human environment, the ambiance, and personal interactions. In today's competitive environment, the total experience may be just as important to some as the quality of the result.

Leaving the university for private practice had a significant impact on me personally and on the experience that I could offer to my patients. When I was at the university, new aesthetic patients were processed with all other new patients, often by clerks with little if any knowledge of aesthetic surgery and no personal interest in the patient or my practice. Following the initial processing, patients would proceed to a waiting room that was shared with our reconstructive patients and, for a while, with neurosurgical patients. Such an environment was not conducive to providing patients with a feeling of privacy, warmth, or nurturing. By contrast, in a private group practice focused on aesthetic surgery, those factors that adversely affected the patient's experience in the university setting have now been eliminated. Patients benefit from an environment in which everyone is focused on their particular needs. I think that all of these changes are a direct result of the degree of control that my partners and I have over the environment within our practice and the training of our staff.

In the more personal environment of a private group practice, the patient is more likely to build a relationship that goes beyond the surgeon and extends to the staff as well. This improved relationship has been reinforced for me on numerous occasions by my long-time patients who followed me from the university into private practice. They have been very complimentary about the change, specifically mentioning that they prefer this smaller, more personal and private environment.

The change in my practice setting has also had a profound impact on me. I now have full control over every aspect of my practice, including finances, office hours, and operating room access, to name but a few.

It is encouraging to note that as cosmetic medicine and aesthetic surgery have become more competitive, with patients now expecting more personal attention, forward-looking universities have developed cosmetic medicine/aesthetic surgery centers to provide the same patient experiences that are available in the community. This is a good strategy, because it makes the university-based aesthetic surgeon competitive, increases revenue, and may well contribute to retention of faculty.

As surgeons, we are in control when we are in the operating room. There isn't one of us who has not been frustrated by events in and out of the operating room that are beyond our control. In the university setting and in some group practices, there is a hierarchical structure. In solo practice there is no such structure, and this is probably a mixed blessing. The surgeon is in full command, but also has to individually deal with all contingencies. In the university, although I enjoyed a close personal relationship with my partners within the section of plastic surgery, the hierarchy went from my section chief to the department chair, to the dean of the medical school, to the vice president for medical affairs, and ultimately to the university president. Each of these individuals likely had more control over my finances and practice environment than I did. Each had his own opinions and priorities as to what was best for the university, the medical school, the department of surgery, and even the section of plastic surgery. These views often did not coincide with my priorities and did not place the pampering and nurturing of my aesthetic patients first.

I would be remiss if I did not acknowledge that despite my lack of control over the university environment, for many years I was able to flourish and develop as a surgeon within it and to provide excellent medical care to all of my patients. Furthermore, there is no question that as a young surgeon starting out, this environment provided me with an excellent opportunity for building a practice, and my colleagues and partners were highly supportive of my activities and growth.

As the focus of my practice shifted from reconstructive to aesthetic, from patients who needed and benefited tremendously from a first-class tertiary referral center to those who sought a more private, personal setting, I realized that at the university I was not in a position to change my environment or theirs. This is in clear contrast to my current private group practice setting, where my partners and I can make any change in our environment rapidly and efficiently.

One of the most rewarding aspects of my career has been the opportunity to work side-by-side with some of the brightest young minds in our specialty. Of course, I am referring to the many residents I have had the privilege of training and working with who have become leaders in our field. Over the years, only one or two of my reconstructive patients have ever inquired who would be doing their operation. The same cannot be said of my aesthetic patients, who even to this day in private practice will ask me who will operate on them. The answer then and now is that I do all my own operations and make all the decisions, but I will have an assistant. The question of resident involvement in performing aesthetic surgery is not new; the debate will continue, and I do not have the answers. There is no question that we are responsible for training the next generation of aesthetic surgeons, but we also have a responsibility to our patients and their privacy. Even though we currently have a fellow and a resident whom we teach in our practice, this is a far cry from the university setting, with numerous residents not only in plastic surgery but in anesthesia and other specialties, not to mention the medical students our patients are exposed to. The presence of such trainees is sometimes of concern to our patients. I have learned that a discussion of the role of trainees and their involvement in patient care—specifically their role, if any, in the operating room—is essential to gain patient confidence and to provide the peace of mind that the surgeon he or she has selected will in fact perform the procedure. I will always inform my patients and seek their permission to have anyone other than our full-time office-based surgicenter staff present in the operating room.

We are very fortunate in our group practice to have our own in-house American Association for Accreditation of Ambulatory Surgery Facilities (AAAASF)-approved, state-inspected surgical facility. Although there are pros and cons to owning such centers, the greatest advantage, again, is control—control over when I start to operate, when I finish, how many cases a day I schedule, and which days of the week I operate. I had no such control at the university, other than blocked time. This flexibility, in my opinion, far outweighs any of the disadvantages of owning a surgicenter.

A few words about group versus solo practice: I have never been in a solo practice; I have always been in a group, at one time with as many as six partners. There is no question that in a group, *control is shared*. One partner is the administrator who deals with the day-to-day problems and headaches and makes most of the decisions; major decisions are made by the group. This may vary from practice to practice. In solo practice the surgeon/proprietor has full control but also has the full weight of all decision-making and financial burdens.

In a group practice, we consult each other concerning patient management, and it is most reassuring to be able to call your partner to consult about a problem. In solo practice, although colleagues may be only a phone call away, it is not the same.

Another issue is coverage. We gladly take calls for each other and take care of each other's patients in an emergency. This allows us schedule flexibility and the opportunity to travel and time for professional activities, knowing that our partners will provide excellent care to our patients during our absence.

Business and Financial Strategies

Although many of us would prefer to focus our attention on the surgical and patient care aspects of practice and leave the business and finance to someone else, that is not realistic in today's health care environment. To run a successful practice, a surgeon must have a basic understanding of the business aspects of day-to-day operations and a budget and plan for reaching the goals to drive the practice. Although it is essential to have expert accounting and other business advisors to run the numbers and execute strategic and financial plans, the surgeon needs a working knowledge of these matters to ensure that the practice runs profitably and effectively and that he or she understands the business aspects of daily operations. (See Chapter 7 for detailed information on financial planning.)

Managing the Office

Delineation of Responsibilities

Tempting as it might be for the surgeon to run his or her own office, it is money well spent to hire an office manager. A well-qualified office manager is an asset in either a solo or group practice. Although a solo practice may "get away" with the surgeon managing it all, it is more difficult and far less practical to try to do this in a group practice.

The practice manager is responsible for the day-to-day running of the practice, including collection and posting of fees, managing the staff, and other duties and must be empowered by you to do so.

In our practice, my assistant/patient coordinator meets with all new patients and is responsible for scheduling them. They will contact her for any changes in schedule and related questions. The office manager and administrative partner are responsible for hiring and firing and other personnel matters.

Relationships With Staff

We are all busy, and the last thing any of us needs is more meetings. However, an essential element in the success of any endeavor is communication. Although individuals within the practice communicate with each other daily, it is essential that the entire practice and smaller groups within the practice meet on a regular basis. In our practice, we regularly schedule the following meetings and have found them to be a most effective means of communication.

Doctors' meetings, which include the partners and the office manager, the anesthesiologists, and the manager of the surgicenter

Staff meetings, including all doctors and the entire staff

Administrative meetings, including all secretaries, administrative assistants, receptionists, and the office manager

Nurses' meetings, which include nurses, operating room staff, and the office manager

It is very important for the staff, especially any newcomers, to be familiar with your practice philosophy. We make all of our staff aware that our practice philosophy is to provide the best and safest medical care to our patients in a warm, friendly, caring environment. The patient's privacy is of utmost importance, and all staff members are aware that they may not discuss any of the patients outside the office environment. We emphasize the role that each of them plays in the maintenance of such an environment. We have monthly staff meetings with an agenda covering various topics ranging from employee benefits to compliments from patients, expansion plans, and other matters. We have found that these monthly meetings where all staff and doctors are present are essential to maintaining a close working relationship with our staff. This nurtures a sense of teamwork and emphasizes the important role they play in the success of the practice.

Training and Telephone Protocols

The first contact any new patient has with your office is through the telephone or your website. Contacts through the website are necessarily impersonal. Your telephone operator or receptionist is often the very first direct contact the patient will have with your office. The receptionist will make the first impression on your prospective new patient. It is important that calls be answered in a timely fashion by someone with a pleasant voice announcing the name of your practice, followed by the telephone operator's name and the question, "How may I help you?" The receptionist should avoid picking up the phone, announcing the name of the practice, and immediately asking the patient to hold. The one thing more annoying than this is an automated telephone answering system by which the patient is invited to respond to a number of options. We are in a service industry; our patients expect the best and there is no substitute for a kind, warm human being on the phone rather than an

impersonal machine that takes the caller through multiple options, then a selection must be made immediately or the call disconnects. Although such automated systems are promoted to save money, in the long run it is a far better investment to have a knowledgeable, well-spoken receptionist answer the telephone. The cost savings may not be real if patients hang up or are left with a poor first impression of your office and do not schedule a consultation based on this initial encounter.

The training of the telephone operator and receptionist is very important. This is usually the responsibility of the office manager, or outside consultants can be brought in to train the staff in customer service. Remember that you and your partners set the tone of the practice. Your staff will see how you interact with your patients, and it will affect their interactions.

Dress Code

Professional demeanor and dress are essential. Your practice should have a dress code policy. Patients expect a certain standard from their physicians and staff. A well-dressed, well-groomed staff reflect favorably on the practice. Extremes of fashion should not be worn; an outfit that looks spectacular as evening wear is not appropriate in the reception area. The dress code will obviously vary from practice to practice, depending on your practice philosophy and the patient mix. All staff should wear tags indicating their names and job titles/positions, and nurses and physician assistants should wear lab coats and name tags identifying them.

Office Design and Flow

The office should be arranged in such a way that the patient arrives, checks in, sits in the waiting room, is brought back to the examination or treatment rooms, and from there can go to video imaging, scheduling, and eventually check out, pay, and make another appointment, all without having to retrace and retrack.

If possible, space and expense permitting, the ideal is to have two separate waiting rooms so that immediate postoperative patients with facial dressings and those recovering from peels or resurfacing do not share the same waiting room with new patients. The immediate postoperative patient needs privacy and is better served by seating in a small private waiting room where he or she is the only occupant. Likewise, it is best not to expose new patients to this view of an immediate postoperative patient before you have had a chance to discuss the procedure and the process of recovery involved.

The second, more private waiting room is also useful for patients who would prefer not to be in a “public” waiting room. This may include individuals with celebrity status and others who desire a greater degree of privacy.

Advertising and Practice Promotion

When I started in practice, advertising by physicians was unheard of. All of that changed in the 1980s when the Federal Trade Commission (FTC) allowed advertising by physicians. As the late Dr. Michael Lewin put it in 1983, “There was an outpouring of originality, misrepresentation, and sleaze.” In the quarter-century since then, very little has changed; we continue to see false and misleading advertising, not just by physicians but by some manufacturers as well.

Despite these drawbacks, which reflect human shortcomings, advertising is a fact of life for physicians and is here to stay. In addition, the advent of the Internet and the new social media, such as blogs, LinkedIn, Facebook, and Twitter, have taken electronic connections to the next level and forced surgeons to embrace this new paradigm. Physician advertising is poorly regulated. The most stringent guidelines are those set out by professional societies which hold their members to very high standards in their advertising and web presence. A few states have passed laws that affect physician advertising. Two excellent examples are the California law that requires physicians who claim “board certification” in their advertising to mention the particular board and the Florida law, Truth in Medical Education (TIME), which requires that providers indicate—orally, in writing, or on their name tag—whether they are physicians, physician assistants, or nurses.

Community Outreach

My late partner, John Bostwick III, was a true master of marketing through community outreach. As a man of enormous charm and intelligence, he always understood, even when he was new to practice, that one of the best ways to attract patients is to become involved and to make yourself available as a speaker and educator, as a source of information for possible referring surgeons, as an advisor to support groups, and as a local authority. John always made time for these activities, no matter how busy he was. When one of the general surgeons at Emory University Hospital had a patient who wanted to speak with a plastic surgeon, he could always count on John. He made himself available as an advisor for local breast cancer and breast reconstruction support groups and was always ready to speak on a variety of topics, aesthetic or reconstructive, when a public forum was being held. These contacts were a ready source of referral, both from the patients who encountered him and from the surgeons and other physicians who funneled their plastic surgery referrals to him.

He also recognized the value of reaching out to referring surgeons, sending them autographed copies of his books and patient education materials to share with patients, and making sure that he maintained regular, collegial contacts with possible referring physicians in town. This served him well.

Internal Strategies for Practice Promotion

GUSTAVO A. COLON

If internal promotional programs are in place and effectively used to deputize patients, friends, relatives, and other physicians to refer to your practice, the cost of promotion to bring in new patients to the practice can be significantly diminished. At the same time, groups outside your immediate practice circle can be approached using cost-effective marketing tools other than mass-media advertising.

The best internal marketing tool is a well-trained staff. As mentioned previously, the staff person who answers your phone makes the first impression with prospective patients. As obvious as this seems, I have noticed that many physicians seem unaware of how their phone is being answered. Patients should feel that from the very first phone call their needs are your most important concern. They should also perceive that your appointment schedule and other aspects of your office management are handled in a highly efficient manner.

It is vital that all staff members who deal directly with patients be consistent in their approach; they should be adequately prepared through a comprehensive staff training program. The staff should always express your philosophy, plans, and procedures—not their own personal ideas.

The next step in creating a positive impression is the initial office visit. Office decor should be comfortable and appealing and consistent with the practice. Ostentation should be avoided, since it could have a negative psychological effect on patients, who might automatically assume they cannot afford your services. The flow of patients in and out of the office should be smooth, with prospective patients separated from current patients if at all possible. Finally, ample parking should be available in close proximity to the office.

Every surgeon occasionally has a patient who wants to argue about fees or voice other complaints; as minor as these disagreements may be, they surely would be disconcerting to new patients and should always be discussed in a private setting. Patients want their physician's office to be well organized and efficiently run for psychological reasons as well as practical ones. If the office is chaotic, patients may conclude that the surgeon's operating room is similarly haphazard.

Small touches are important. Every patient who visits our office receives a thank-you note, mailed out the next day. We also make a point of sending thank-you's to referring patients and physicians. It is also important to keep in touch with past patients, even if it is only a once-a-year mailing of a newsletter, practice brochure, or patient questionnaire. People appreciate receiving information on new techniques in aesthetic surgery or being updated on changes within your practice. If you send out any kind of literature, invest the time and money to produce an attractive and

professional-looking piece. A poorly designed newsletter or brochure will not achieve positive results for the practice. Tracking patients through a computer system should make periodic mailings a relatively easy task.

Monthly, potential new surgical patients should be tracked against new patients seen in consultation. At least once or twice a year, this ratio should be compiled and checked. If the ratio is less than 50% of new patients who actually schedule for surgery, try to find out what is happening to the rest of your prospects. Consult your records for clues. This review is likely to suggest changes you might make in your practice management and your personal style and/or your staff's approach to patients. Personal public relations should be used rather than advertising to boost your image in the community. This will keep the promotional costs down. Offer seminars on aesthetic surgery or plan an open house in the office. The staff should be adequately prepared for these kinds of professional or social interactions in or outside the office, especially if you have an office surgicenter.

In any patient contact, it is important to maintain a warm, personal manner. The patient should be shown through eye contact and a brief touch that he or she has your respect. Include in your notes personal information the patient mentions, such as a new job, an upcoming vacation, the wedding of a son or a daughter, and so on. Then the next time you see the patient, you can inquire about the vacation to Bermuda or how the new job is going. The patient will be amazed at your memory, and such inquiries will help convey your genuine interest in the patient. It is that kind of friendly professionalism that earns trust and shows that you are a caring physician.

Your patients are your most receptive audience; keep them happy and informed and focus on providing a rewarding patient experience. A professional, ethical reputation is essential; this should be reflected in your every interaction with patients, staff, and others. It has been demonstrated that a happy patient, on average, will tell three or four other prospective patients about you, but an unhappy patient will spread the bad news to 20 or more potential patients.

Patient Relations

The Role of the Physician

WENDY LEWIS

Patients need to feel that they can bond with the surgeon and have confidence that he or she can address relevant concerns and provide needed services. Because there are so many choices today among practitioners, likability is often the determining factor when patients choose you over your competitors. They want to feel a connection with their plastic surgeon. When training, expertise, reputation, results, and costs are equivalent, intuition and personal impressions will factor into their final decision.

Building trust with patients is critical to the success of an aesthetic practice. You can instill confidence through the words you choose, your tone of voice, body language, eye contact, and facial expressions. Patients want to feel special and unrushed, as if they are the only patient you have. They want and expect your full attention during every visit. As mentioned previously, your ability to remember small details about each patient will help to establish a strong bond. Whenever possible, it is important to speak in specific terms that relate to each patient, rather than in general terms that are less personal. This more personal approach shows that you have taken an interest in the patient, and that he or she is not just a number in your practice.

Steps for Building Rapport With Patients

- Smile warmly when greeting the patient and use his or her name.
- Shake hands as you meet, and establish eye contact.
- Seat yourself on the same level as the patient.
- Do not allow interruptions during the consultation.
- Inquire what the patient's particular concerns are.
- Listen carefully, without interrupting or contradicting.
- Don't fidget; remain focused on the patient.
- Jot down notes as reminders of personal details.
- Let your responses reflect that you are actively listening; repeat the patient's words back for confirmation and mutual understanding.
- Ask open-ended questions to stimulate further communication.
- Do not appear rushed or eager to conclude the meeting.

Well-informed patients can be a challenge. On the one hand, if they are knowledgeable about procedures, have done their research, are serious about proceeding, and are essentially prequalified, they can reduce your consultation time significantly. On the other hand, some patients think they are well informed but have actually received incorrect or misleading information from unreliable sources. These patients may pride themselves on being well informed, so it is wise to acknowledge their efforts. In this situation, your job and that of your staff becomes more difficult, because you will have to reeducate them. When a patient comes to a consultation with a thick file of printouts from websites, articles from magazines, and a legal pad of notes and questions, it is helpful to inquire about the sources of this research to get a sense of the quality of the information on which the patient is relying. Even if you disagree with something a patient says, you should avoid contradicting the patient; instead, diplomatically point out another way of approaching the subject without making the patient feel stupid.

Communicating

To relate to potential new patients, you need to understand how to effectively communicate with them. When people visit an aesthetic surgeon, they are often uncomfortable and unable to communicate freely. You may find yourself having to coax information out of a prospective patient. You may have to ask questions in more than one way to extract the real responses you need to determine the best treatment plan. Probing further may allow you to gain insights into who the patient is and his or her motivations.

In other cases, the patient may not stop talking long enough for you to get your points across. This may be from a combination of nervousness, excitement, and anticipation, or a sign of a controlling personality type. In this instance, it may be best for you to talk less and listen more. By paying careful attention to the subtle ways in which patients express themselves, you can pick up important clues to their personalities, fears, and possible psychological issues; this facilitates better screening.

Most surgeons start a cosmetic consultation by asking the patient to describe what his or her principal concern is. It is rarely going to be just one feature or area; rather, the patient may have a laundry list of many areas needing attention—the skin, the face, and the body. The first item mentioned usually holds particular significance. For example, if a patient opens by tugging at the slack skin under the chin and states, “I feel like I am beginning to show my age,” the lower face may be the major source of concern. Therefore, if you suggest a face lift and blepharoplasty but fail to adequately address the neck, the patient may be disappointed.

To streamline the consultation process, it is important to get the patient to focus on the problem that is most pressing. It is nearly impossible to cover multiple areas sufficiently in a single visit, especially if it is a first visit. If the patient comes in with a legal pad of questions, you may suggest that the initial consultation be divided into two sessions so there will be enough time to cover everything. The patient should be urged to prioritize—face versus body, or eyes and nose versus breasts and liposuction—so you can map out a long-term plan that is safe, sensible, and in line with the patient’s budget. Start with the first stage. If all goes well, the patient will return for other procedures or treatments over time, and you will have built a long-term relationship.

While explaining how you would address the patient’s concerns, speak clearly, keep it simple, and use straightforward, conversational speech. Avoid phrases that instill fear and anxiety or confuse the patient. For example, “discomfort” is preferable to “pain,” and “redness and bruising” will be easier to grasp than “erythema and purpura.” Provide ample opportunity for the patient to ask questions, which will allow you or your staff to go into greater detail based on the patient’s level of understanding and quest for specifics. When you feel that the consultation is coming to a logical conclusion, always ask if you have left anything out or if the patient needs more clarification.

At the close of the consultation, you'll want to reassure the patient that you have performed many of these procedures with excellent results, and that you feel confident that you can meet the patient's goals and expectations. Think empathy; convey that you understand their concerns and fears, and that you look forward to seeing them again.

Cosmetic patients expect clinical excellence. They need to know that they can expect consistent results in your practice, especially for repeat treatments. If nonsurgical procedures go well, patients are more likely to feel confident entrusting you with more invasive procedures in the future.

Today's patients will not be comfortable with being pressured into booking surgery at the first visit. You can expect that if you are the first plastic surgeon they have consulted, you will surely not be the last. The average patient today will see at least three surgeons in consultation, and often twice that, especially if free consultations are common in your geographic region. Beware of the patient who has seen an unreasonable number of doctors; this is usually a red flag that he or she is not serious, is unable to make a decision, or is unstable.

The Role of the Patient Coordinator

The clinical and nonclinical staff in your practice who deliver service play a significant role in creating the patient experience. One of the most critical roles in an aesthetic practice is that of the patient coordinator; he or she is the "go-to" person who manages the consultation process with patients. A good patient coordinator can have a profound impact on the success of a plastic surgery practice. This is the person to whom patients turn when questions arise. Patients want to feel that they are in good hands and in a safe and nurturing environment. The patient coordinator helps to achieve that goal.

A highly skilled patient coordinator who has been with the practice for many years reflects favorably on the surgeon and practice; he or she is seen as a loyal staff member who fosters a continuity of care that is comforting to repeat patients and reassuring to new patients. Frequent turnover may signal to patients that the office is disorganized and inefficient and that the doctor is difficult to work for.

The patient coordinator serves as a vital link between the surgeon and the patient. Patients often perceive this professional as more approachable than the surgeon and consequently will often be more open to confiding private information and concerns. The patient coordinator must be able to connect with patients on a personal level and to instill trust and confidence in the surgeon and the practice. The patient coordinator can promote your credentials, training, and expertise with patients much better than you can, presenting your surgical results in the most effective manner.

The patient coordinator is responsible for much of the handholding and personalized attention to detail that is provided in a well-run aesthetic practice. Communication skills are of paramount importance. This professional should be able to handle the most difficult and demanding patients with equanimity and a friendly, helpful manner, never showing annoyance or frustration. This key staff member should be nonthreatening to both male and female patients and mature enough, for example, to make perimenopausal women feel at ease in disclosing their concerns about the aging process.

In a busy aesthetic surgery practice, it is common for the patient coordinator to conduct a preliminary consultation with new patients before they meet with the doctor. This professional should be adept at establishing a bond with patients during these initial meetings that will help to guide them through the surgical process and prepare them for what to expect during the consultation, thereby saving valuable doctor-patient consultation time. An effective patient coordinator should also be attuned to the nuances of conversion. A low-key approach reviewing the merits of the procedure and highlighting the surgeon's unique capabilities is usually preferable to an overly aggressive sales pitch that can be a turn-off to many patients.

It is always preferable to assign this critical role to an individual who can make this patient interaction his or her foremost priority. A patient coordinator who is encumbered with a multitude of responsibilities cannot devote sufficient time to appropriately manage potential patients. This professional's effectiveness will be limited if he or she feels overburdened and is pulled in too many directions to give patients the individual attention they expect. It is virtually impossible to act as a true patient coordinator while having to answer the phone and schedule appointments in between explaining the complexities of a face-lift procedure. Patients also find these interruptions to be distracting and inconsiderate of their time.

The environment in which the patient coordinator works is another key consideration. To perform the job effectively, the patient coordinator should have a proper office or secluded area in which to counsel patients. Whenever possible, this office should have a door that can be closed to preserve patient privacy and create an intimate atmosphere in which patients can talk confidentially without fear of being overheard. With the current emphasis on medical privacy regulations, this type of private space should be considered mandatory. For young surgeons just starting out in practice, it may be acceptable to have an office manager or nurse handle these responsibilities during the first few years. However, as the practice grows, it is important to hire someone whose main function is to educate your patients, promote your skills, and schedule procedures.

Potential Pitfalls in the Office

- Long lead time for consultations, treatments, or surgery
- Long waits in the reception area before patients are seen
- Delays in returning phone calls
- Excessively high fees; poor value
- Doctors or staff members who appear rushed and inattentive
- Unprofessional, inattentive, or rude staff
- Poor office management
- Reluctance to show before-and-after photographs
- Reluctance to discuss training, qualifications, and board certification
- Lack of attention to details, service, and follow-up

Patient Education Tools

Before patients decide to proceed with treatment, they need confirmation that they can relate to your practice and the quality of your work and will be happy with the outcome. Educational tools are helpful in supporting your treatment recommendations and in assisting patients to visualize the range of results they can expect. Patients want to see examples of your results. These tools are also a valuable means of marketing the practice and the quality outcomes it provides.

Technology offers a number of tools for improving doctor-patient communication; these can be helpful when discussing different procedures and their associated risks, limitations, and possible outcomes. For example, digital photo albums and PowerPoint programs can be used to showcase your clinical photographs on a continuous loop, both on the practice website and in the waiting room. Some practices have invested in touch-screen patient education centers to highlight the procedures offered. Skin analysis systems offer another opportunity to engage patients and educate them about their skin quality and to recommend products. Most vendors provide practice marketing materials, including brochures, postcards, mailers, DVDs, media clips, and even reward programs that can be effective in attracting new patients. The addition of a sleek flat-screen monitor and a DVD player in part of your reception room can transform this area into a patient education center.

Patients have come to expect some form of computer imaging in a modern aesthetic practice. They want to see simulated results to help them decide whether this is the right surgeon to meet their needs. Computer imaging is an effective communication tool during the consultation and when reviewing surgical results. It provides a basis for defining goals and developing an appropriate treatment plan. It also helps to rein

in patient expectations by demonstrating what is and is not possible to achieve through surgery and adjunctive treatments. When showing patients preoperative and posttreatment photos, it is important to select patients of the same sex and similar age, ethnicity, and skin type who had comparable procedures. Patients cannot be expected to imagine what their results will look like; they want the surgeon to show them what to expect.

In the age of Internet and social networks where consumers meet online to discuss their experiences, it has become commonplace for prospective patients to ask to speak to other patients. If the surgeon is unwilling to have satisfied patients serve as a reference, then staff members who have undergone treatment are a good alternative.

Signage within your practice is also important to educate patients about every procedure, treatment and product that the practice offers. A common lament among doctors is the long-standing patient who undergoes treatment somewhere else and proclaims, “If I had known you do that, I would have asked you about it.” One way to avoid this missed opportunity is to regularly communicate with your patients through email blasts and newsletters, keep the practice website up to date, display a menu of your services in patient areas, and provide brochures on the brands featured in your office.

Office Materials

FOAD NAHAI

Today’s patients want to be as well informed as possible. They have access to a wealth of information online, some accurate and informative and some highly misleading. We have the opportunity to provide our patients with balanced information concerning aesthetic surgery. This is one of the best marketing devices we have. We have three avenues open to us for disseminating this information: our website, informational brochures, and electronic media, such as DVDs and videos. On the website, you should include a brief biography or mini-curriculum vitae of each surgeon in the practice, a statement of your practice philosophy and mission, contact information and address, maps and directions to the office, and images of the office, surgicenter, and overnight stay rooms if you have them. You should also include a list of frequently asked questions, a description of operative procedures and cosmetic treatments offered, and a gallery of preoperative and postoperative pictures.

Although most patients have access to your website and have probably visited it more than once before making the appointment to see you, it is worthwhile to mail a package of information about the practice to each new patient at the time that the initial appointment is made. In our practice, this includes a folder with several inserts including a description of the practice, a biography/mini-CV of the surgeon with whom they have made the appointment, directions to the office, and a list of local hotels

and restaurants (see Chapter 1). In addition to the information about the practice, an appropriate procedural information brochure is placed in the folder. The design of the information packet should be coordinated with the look of the website. All of this information should also be available on your website.

During the initial consultation, most patients are shown preoperative and postoperative images of patients who have undergone similar procedures. It is a good idea to offer patients the opportunity to view an informative patient education video or DVD of the procedure they are interested in. For patients who will have implants, an additional informational booklet is provided. For patients undergoing Botox or Restylane injections, the manufacturer's brochure is also helpful.

An effective internal marketing approach is to have a variety of brochures about procedures available in your waiting and examining rooms. A patient who is seeing you in consultation for a face lift may not be aware that you or others in your practice also perform breast and body-contouring procedures.

MARKETING AND COMMUNICATION INITIATIVES

MARIE CZENKO KUECHEL

Making a Connection

The very last thing that many aesthetic surgery providers manage in their practices is the very first thing your patients will encounter—not your staff, services, or fees, but your marketing and communications. Most people acquire information about aesthetic surgery from television, magazines, the Internet, or other people; however, this is not always how they locate a provider. Where individuals connect with a provider varies widely; it can be through referral by a physician, friend, or family member, through an Internet listing, or an advertisement.

The best way to manage the messages that influence your patients' decisions is through strategically targeted communications that make a connection that yields the right results. Every connection you make can enhance your practice's ability to thrive. Making a connection requires:

- A goal that defines what you hope to accomplish by making a connection
- Effective and appropriate vehicles for delivering your message
- A call to action that motivates others to act
- A cost analysis of these communications (worth as well as expense) to maximize their value

The most successful practices establish a connection, maintain it at every opportunity, and communicate effectively. This is neither marketing nor advertising. Marketing encompasses all the activities necessary to get others to accept or purchase your services or products. Advertising is a marketing strategy—a paid message about a service or product for sale. Many successful aesthetic practices do not advertise, but every practice must market, persuading others to accept or buy into their services. Marketing is essential for effectively communicating your practice's identity, for getting others interested in the services you provide, and for enabling potential clients to connect with you. You must convey how and why you can best fulfill the patient's desire for appearance enhancement and extend the invitation to act on this relationship. Communication and education are part of the marketing mix and are intricately intertwined: without one, the other is useless.

In an aesthetic surgery practice, education is the basis of every message. Regardless of your audience, you need to communicate essential information about the services you provide and your ability to provide them. The way in which a message is delivered to your intended audience represents half of its value. This can be done with varying levels of efficiency, speed, attraction, and cost.

Although patients are usually the focus of your marketing and communication strategies, it is also wise to target some of these communications to referral sources and business-to-business resources to enhance your ability to attract new patients.

Marketing Channels

There are three general communication initiatives essential to every practice of aesthetic medicine: patient relations, outreach, and advertising. Even if you have the skills to provide services and have willing patients who desire your services, your practice will need to communicate through one of the following marketing channels:

1. **Direct communication:** Specific messages designed for visibility and education, to retain current patients, to encourage service and repeat service, and to elicit referrals. An example is the patient education or core practice materials that you put into your patients' hands or make available in your practice setting.
2. **Outreach:** Outreach entails no-cost or low-cost messages to your target population that provide visibility, education, and generate traffic. Examples include your practice's website, your referral sources, *social media* (such as blogs, Twitter, and Facebook), and one-to-one networking.
3. **Advertising:** Ads are created specifically to reach the market of individuals interested in your services or those in a specific demographic. Ads provide vis-

ibility and education and generate traffic, but there is a fee for their transmission. (Examples include directories, magazine or newspaper ads, the recorded message on your telephone hold system, and even articles you pay to have placed.)

Marketing and Communication Goals

Goals must define a target and an endpoint, something that signals that you have accomplished your goal. Look carefully at the messages and tools you use to connect with your market, community, peers, patients, and staff. Goals for your marketing and communications include the following:

Visibility: Your practice must be visible to those with whom you need to communicate. Make certain your message is consistent with the image you want to project.

Announcement: Announcements should be made when there is something important to convey, such as a new location, a new staff member; different hours, added services, new policies, or rebuttals to misinformation by the media. Don't announce something dated or trivial, and don't attempt to impress your audience with something you cannot substantiate. For example, don't claim to be the leading provider of a cosmetic injection or to have some innovative technique with injections unless you can support this claim.

Solicitation: The service or a product you sell is part of your business and your success. Sharing your service menu on a website or with referring physicians is an example of solicitation.

Education: Every communication should educate, directly or indirectly. If you don't have at least one key piece of valuable information to share, remain silent. Explaining your service menu to staff, referral sources, prospective clients, and peers is part of this education process.

News: News is timely, previously unreported, important information that is of interest to others. It is not self-serving. If you have valuable news, share it.

Novelty: A novelty is something new and fresh. If your goals for connecting are based on novelty, be certain that you are well informed about what that novelty can accomplish. You may be excited about a new procedure, product, or device, but before you promote it, make certain that it holds promise for the long term. You may wish to be known as a trendsetter, but be certain you are backing the right trend.

Compliance: You need to communicate to current and prospective patients that you comply with the highest standards of care and ethics in your specialty, whether with CME or accreditation of facilities.

Pressure: The only appropriate pressure would relate to a clinical matter that affects a patient's outcome or health. Pressure to act now because of pricing or novelty creates a false connection and will result in a failed relationship.

Price: Your services have a valid cost. Connecting with a potential patient on price is valid only when you know specifically what is desired and appropriate for the individual.

Connection: You must develop marketing strategies to help you maintain your connection to others. Connections can come in the form of an invitation, a personal message, a reminder, or simply a communication that maintains your visibility for your patients, referral sources, or the community.

Call to Action Essentials

In marketing strategy, a *call to action* is the response that your communication is intended to elicit in specific groups. Much like the practitioner who does not ask for referrals, a practitioner who does not extend a call to action is not likely to receive a reply.

Your audience at large: In communications that generate interest and visibility, the objective is traffic, conversion, and retention. Your call to action may be as simple as letting people know where they can find you, or as direct as an invitation or query about an individual's desire for services. The call to action must be clear, timely, and effective and must not invade privacy or violate good judgment.

Prospective and current patients: The best calls to action allow individuals to act on their own time, in their own fashion, with no deadline, money, or personal pressure attached. Consumers today are savvy about what they want and are aware of attempts to elicit a response from them. Use this to your advantage by producing a message that is educational but also speaks to patients' personal desires. In this way you will create a call to action that fits your audience.

Patients and referral sources: To generate added business, your call to action for patients and referral sources should be direct. The purpose of your communication requires that you ask for referrals, so the call to action should provide the information and motivation necessary for the referral source to act. Ongoing patient education and outreach through newsletters, clinical updates, and special offers must include valuable information about what you want others to act on; the inclusion of an incentive is added motivation for the individual being referred.

There is a difference between incentive and gratitude. *Quid pro quo* (something for something), such as a gift or bonus for a referral, is unethical in the realm of medical treatment, much less elective medical treatment. Gratitude, not incentive, is essential. Gratitude acknowledges that you are aware of an individual's effort on your behalf and in turn, your gratitude fuels future referrals.

Your call to action with referral sources must make it easy for a referral to come to you. Establishing relationships with referring physicians is essential to your practice's success. These referral sources need to be your partners in patient care; therefore you should keep them informed as well as support their status as providers to that patient.

Beneficial referral relationships are sustained with efficient communication. Provide practice materials to those who refer patients to you, and don't forget to keep them updated any time you have new information to offer.

Business to business: Whether you are dealing with a commercial advertiser, a pharmaceutical vendor, or even a professional society, your call to action requires that you state your expectations, why this organization has value to you, and how you intend to be of value in return. Your value in return is not just revenue; it is exposure, loyalty, and active participation in upholding standards in your profession and defining trends.

Inside-Out

Outside your practice, you attempt to attract the attention of others so you can establish a connection. Inside your office, you have made the connection of interest; now you must ensure that it translates into service delivered and loyalty generated. The vehicle you use to communicate with your patients, staff, and those who are regularly in your office is not as important as how you use it.

Interpersonal communication: Interpersonal communication is the vehicle of communication that exists solely within your practice and is your most effective communication vehicle. It delivers your message directly to an individual and allows him or her to respond directly. Interpersonal communication within your practice need not be the sole responsibility of one person. As long as the lines and responsibilities of communication are clear, interpersonal communication should be a team effort.

Telephone: As discussed earlier, telephone communications are key to your practice. Next to interpersonal, in-person communications, your office will communicate most frequently by telephone, so this tool must be used effectively. You should call only where you have permission to call (the patient has indicated that he or she may be contacted by phone). When making calls, always greet the person and ask if the timing of the call is convenient. Be prepared with all necessary information and questions. Deliver your message and then determine whether the recipient of your call has questions, concerns, or comments. Look for closure, even though you are the one who made the call. Even if the call is simply an appointment reminder, make certain the patient knows when and where to arrive, what to expect, and that you are looking

forward to welcoming him or her. Automated appointment reminders may save you time and money, but they are impersonal and uninviting. It would be better to text or email the patient than to do this. (See Chapter 1 for more information on interpersonal communication and telephone etiquette.)

Email: Email is an effective means of communication when it is welcomed, informative, and personal. Email that is overused will be ignored. When your office emails people for multiple purposes, be certain you have a distinct sending address for personal patient email, one for general messages and one for business. Email may be quick, but it need not be impersonal, and it must not be impolite. Sensitive information or information specific to an individual's course of treatment should not be conveyed in emails; it is better left to a telephone conversation for privacy.

Today email is best used for administrative tasks, such as collecting and sharing information or documents. It is effective for appoint reminders or for delivering instructions. Email is also an excellent method for sending targeted messages from your practice, such as an invitation to a special event, a new product in stock, or simply to fill appointment slots that are open.

Voice mail: If you must leave a message, ask that the intended recipient return your call; never offer detail, because you cannot know who will listen to the message. Avoid an exchange of voice mail questions and answers. Set up a convenient time for a phone conversation or an in-person appointment. If it becomes too difficult for patients to connect with you, they might just disconnect the relationship. Define a policy for the office's voice mail; require that it be checked regularly and ensure that every call is answered the same day.

Text and instant messaging: Although text messaging has become popular and many use it in the same manner as email, do not view it as equivalent to email. If your patient or those you are communicating with have indicated that they are open to accepting text messages, keep these communications short and simple, such as appointment reminders.

Print: Printed materials remain an essential part of any practice. A print document may be easier to view; it can be transferred electronically as a PDF or by hand. A handwritten note is still the most gracious way to say "thank you." Some communications, such as congratulating a patient on an exciting life event or achievement or expressing sympathy at a loss, should only be sent as a handwritten personal note. Such courtesies should not be lost in the rush of daily communications; the personal touch will have deep meaning for the recipient. This is a part of building and maintaining an ongoing relationship with a valued patient.

Computer: PowerPoint, computer animation programs, and other automated functions can be used to educate and communicate with patients. These may support or enhance interpersonal communication and education, but they cannot replace them, nor are they the primary means of communicating. *You are in a personal services industry, so it is vital to keep it personal.*

Multimedia: Whether you use computer messages or play video messages of interest in your office, don't allow multimedia to dominate the environment or replace the personal connection, or you will simply lose your connection with your patients.

Display: Various items will be displayed in your office, such as skin care samples, tabletop posters, even the syringe tray setup on the examination room counter. Carefully consider which items to display and where to place them. Avoid clutter—too many diverse or unrelated displays are distracting to patients.

Connections With Your Patients

There are specific kinds of connections that only you (or you in association with key staff members) will make with your patients. These include the consultation, physical examination, patient evaluation, discussion of treatment options, treatment planning, education about treatments, photography, patient instructions, and patient consents. How you conduct these basic functions will have a direct impact on the success of future interactions with your patients and your ability to convert them or retain them.

Treatments and follow-up functions can seem routine, but they are an important means of relating to your patients.

Treatment: Until your patient accepts treatment, you will make numerous connections for multiple reasons, all culminating in treatment. Whether the process takes a few moments, several visits, several weeks, or even months of consideration and time, treatment is the goal. All of the basics for connecting in your practice—environment, greeting, function, administration, and closure—must be conveyed with the same care throughout the patient's experience. Your goal is not to make the connection for this treatment alone; you are striving to satisfy the patient's desires and make the entire experience satisfactory.

Follow-up: After treatment, three things seem to happen: (1) patients follow procedures for a necessary visit, such as suture removal, or (2) they return when something just isn't right, and (3) sometimes they revisit the practice when they desire additional treatment. Some practices suggest a follow-up timetable, but they don't insist on it or schedule it—they wait to hear from patients. Proactive practices employ one of the many communication tools available to stay in contact with patients and to follow up regularly. Whatever your method of maintaining contact, follow-up must not simply be a rote post-treatment necessity or a means of addressing complications. Meaningful, productive follow-up is a matter of good practice.

Managing or exceeding expectations does not result from a single marketing strategy or any single connection you make with your patient; it results from the numerous connections you make inside your office, using multiple communication vehicles to achieve a satisfied and loyal patient.

Connections With Referral Sources

Within your practice, it is essential to connect with the people who are your sources for referral and help you to grow your practice. Patients who refer others to you will also return as patients themselves or will accompany their friends. You may see them on social occasions hosted by your practice, or you may reach out to them regularly to express gratitude and personally acknowledge their importance to your practice. Other physicians, service providers, or your direct peers who refer patients to you may connect with your office to refer, confer, learn, or observe. Invite them in, keep them connected, and in turn they will continue to connect others to you. There are important strategies for managing your referral sources, and keeping them connected inside your practice.

Remain personally connected: Remind others that you appreciate them as individuals, that they are important to you and are not just referral sources. Greetings on the anniversary date of a major procedure, annual follow-up calls, or a personal note any time will be welcomed.

Remain clinically connected: Keep your sources abreast of new developments in your practice or specialty regarding what is relevant to them or to the patients they refer to you. Rather than simply putting this in writing, invite them in for a luncheon, seminar, treatment, or to observe. Keep them educated, and they will keep others educated about you.

Show gratitude: The most common reason for a disconnect with your sources, next to arrogance, is failure to show your appreciation. If you cannot say thank you, don't expect future referrals.

Referral sources grow your practice from the inside-out, so keep them inside in as many unobtrusive, personal, and appropriate ways that you can, manage your relationship with them, and the expectations you have for that relationship.

Business-to-Business Connections

Inside your practice you need to connect with and manage relationships and expectations with sales, service, and patient resources—those whose businesses or products support your practice or who want your support in their endeavors. These business-to-business resources can be the most overlooked connections inside the office, simply because they are more often viewed as “selling” rather than “servicing.” When

connecting with resources, you certainly don't want to tax your valuable time, nor do you want to miss out on valuable opportunities:

Screen and team: Screen all visits and functions for resources carefully before agreeing to a meeting; make certain the time is well spent for both sides. Assign a team member to manage the relationship, review new products, data, research, procedures, or services, and provide you with the most pertinent information so that you can make a reasoned decision.

Pay attention: If you have only 10 minutes to meet, give that resource person your full attention during that time. If you are not willing to devote time to this individual, have a team member screen and report back to you; be sure that team member follows up with the resource, because you never know when you might need the one person you've been avoiding.

Ask for data and analysis: Resources often come to you with an opportunity. Expect and request data and analysis that show whether that opportunity would be attractive to your practice. In doing so, your resource has the opportunity to connect, and you have the opportunity and the information to make an objective judgment.

Outside-In

The most commonly identified marketing strategies are those that reach individuals outside your practice and bring them in. Connecting from the outside-in is a more complex process today than ever before. As author David Shenk noted in *Data Smog*, a marketing publication, the average American encountered 560 daily advertising messages in 1971, which rose to more than 3000 messages per day by 1997. Today various groups, from Nielsen to the Magazine Publishers of America, report that the average American may now be receiving as many as 6000 daily commercial messages—a truly overwhelming number. As a result, your marketing strategies must be more targeted than ever. Four distinct strategies—advertising, outreach, directories and media relations—must be engaged to create and maintain visibility, generate traffic, educate others, and invite those on the outside to come in.

Advertising

Advertising is a form of communication that maintains your visibility to an outside audience. This is a controlled communication that is an extension of your practice in which you have total command of the goals, message, tone, and call to action to be conveyed. Advertising messages can be disseminated through a number of vehicles, ranging from print (billboards, newspaper, magazines, directories, and direct mail) to electronic media (radio, television, the Internet, and other electronic delivery channels).

Advertising can be general and serve the simplest and most far-reaching goal: visibility. It can also deliver a targeted message to an audience that is potentially interested in and responsive to your services. Knowing your audience and its potential response is of primary importance when choosing the right vehicle to deliver your message. This vehicle must be based on the demographic segment it targets and the potential effectiveness of this message once conveyed. The need for creating and delivering paid messages and for measuring their impact on your practice is fundamental. Every advertising plan should be monitored and evaluated continuously throughout its execution. Strategies that do not work can be modified. If you fail to reach your intended audience, reexamine their demographic viability and interest and reevaluate the vehicles used. Messages that miss the mark must be redefined.

Advertising Essentials

Advertising is the marketing strategy that most succinctly characterizes you and your practice to the people with whom you have the least personal connection. Any successful advertisement must:

- Address a specific goal: visibility, announcement, solicitation, education, news, novelty, or compliance. Pressure tactics and price do not belong in advertisements for medical services. Define your goals so that you can measure the success of this connection.

- Call attention by making a visual and/or verbal connection to the audience (headline). Who does this message need to positively attract?

- Clearly communicate your purpose, which may be as simple as visibility, or as complex as announcing a new service (body). Use a tone that is attractive, inviting, and familiar (words, images, colors). What is your message designed to convey or accomplish, and to whom is it directed?

- Directly and clearly issue a call to action related to your purpose (how, where, and why others should reply). Determine how you want others to respond to this message.

- Tie all elements together concisely and consistently.

Whether you develop ads on your own, hire a professional agency, or allow the channel through which you advertise to craft your message, you must micromanage how you, your practice, and your message are represented:

- Any paid message must be detailed and precise in its imagery and language. To someone who does not know you, this introduction should convey professionalism. To those who do know you, it should be consistent with the professionalism they have grown to expect.

- No aesthetic surgeon should allow any paid message to be disseminated without personally reviewing the message first and feeling fully confident that it is representative of his or her image and practice. Trust your intuition and judgment if you do not feel comfortable with this message. You have worked hard to build your image, and it is crucial that the message be true to your mission.

Outreach

Outreach is any event or opportunity that allows you or a representative of your practice to deliver a message of purpose. For an aesthetic surgery practice, outreach creates visibility for you and your practice at a defined time when you or your representative can personally extend your message. Through outreach, much like advertising, your practice must directly convey who you are and a concise message to a target audience. Unlike advertising, where a message is concise and controlled, through outreach, your audience and the vehicle or partner you rely on may take control of the effort. The vehicles for your outreach strategies are among the most varied, from traditional means such as holding an event to the rapidly growing outreach of social media.

Like advertising, outreach can put you in touch with prospective and existing patients. Outreach strategies individualized to your practice and focused on a specific audience are often overlooked, despite the immense value they have to your practice for renewing communications with inactive patients to remind them about your services, or for referrals, or to maintain visibility. You have to reach out beyond your practice to keep people coming in. Who better to reach out to than those who already have an established relationship with you? Some outreach efforts can be golden opportunities to put you in the spotlight for individuals who are interested in your services but are not yet ready to make an appointment for a consultation.

Beware of participating passively in an outreach effort that is shared or driven by another group; make certain your image and message can be delivered in a predictable manner with a set agenda. Participate in planning and carrying out these forms of outreach, and make certain that you know the other participants and their expectations and contributions as well as your audience's expectations. Many aesthetic surgery practices are hesitant to engage in live or social outreach because of the unpredictable return on investment and lost time away from productive practice. However, most successful practitioners recognize that if you do not reach out to those interested in your field of expertise and those in your geographic or professional community, you cannot expect that they will reach in to engage you.

You may have discounted the value of some of the new social networking channels of communication as too gimmicky for your taste, but online networking is here to stay, and your practice can capitalize on the growth of these social media. The generation who will be your target population in a few years is extremely Internet savvy, and you must be, too.

Twelve Outreach Tactics

No matter which of the many outreach strategies you employ, successful management requires that you define goals and a call to action that will bring patients into your practice.

1. ***Seminars/lectures:*** Seminars and lectures must be of interest to the intended audience. Individuals must walk away having learned something beneficial to them personally or professionally. Make certain you have a clearly defined agenda and goals for your seminar, with an organized presentation, no matter who or how many are in the audience.
2. ***Treatment events:*** Treatment events may be as intimate as prebridal party preparation, or an event that draws complete strangers to experience something new. Seminars are often combined with treatment events. Be sure that the attendees are willing to participate and that all appropriate procedures are followed, including screening of candidates, patient education, and informed consent. Before anyone is treated, regardless of the procedure, confirm that you have consent to treat and that the individual is comfortable accepting treatment in the group. I personally don't like treatment events that go beyond aesthetician services, skin care, and cosmetics. Anything more is a truly personal endeavor and should be provided in private.
3. ***Expos and trade shows:*** Trade shows and expositions can be hosted by any number of businesses, or they can be a collaborative effort arranged by a marketing company to bring together similar businesses. Expos and trade shows take time, preparation, and the right staff to interact with and educate visitors, and such events can be unpredictable. You may find yourself standing idle or be very busy interacting with attendees. It is important to know who is hosting the event, the audience who is attending, and the past history for this event. Then you can gauge your time and investment accordingly. Do not hand out samples of products unless you anticipate you will have enough and they will be appreciated; bring ample, high-quality, branded information about your practice and try to make beneficial connections. Offering things such as complimentary skin analysis will draw people who ordinarily would not partake of your services—but you must understand that it is unlikely you will ever see those people again.
4. ***Social occasions:*** Social occasions offer an excellent opportunity for networking, whether you are the host or a guest. Don't arrive at your neighbor's cocktail party and hand out business cards, but don't be shy about asking people what they do so you can share what you do. Even among people you know, social occasions are an important time to network. Put others at ease in your company so that when they need your services or want to refer someone to you, they will not hesitate.
5. ***Philanthropic events:*** Philanthropic events are an important way for a physician to give back to the community and to create goodwill. You may find the audience is not of the demographic you would ordinarily attract, but giving

of your skill and time is recognized and appreciated. Make the most of it, using these occasions for media relations, announcements, and demonstrating for your existing patients and referral sources that you selflessly give to others.

6. **Viral marketing:** Viral marketing is “the buzz.” It’s what you do to get everyone talking, sharing, forwarding, listening, and engaged in your message for reasons that sometimes have little to do with you. Although it may originate as advertising, viral marketing is a ploy designed to be so intriguing, so infectious that people share it.
7. **Social networks:** Social networks range from Facebook, Twitter, and MySpace to LinkedIn and Yelp. There are general social networks for making friends, and specific social networks. The premise of these networks is that you establish yourself with a profile (information about you), and then you network with others on the site through blogs, chatrooms, email, and instant messaging. These virtual communities have rules, but that does not prevent people from acting dishonestly or maliciously. Social networks are for social discussion and connection; they are not a place to give advice or solicit patients. Even if you don’t engage in social networks, you should know what they are and monitor them, because your patients may just be talking about you.
8. **Sharing:** Sharing is a means to post videos, images, and stories on YouTube, Flickr, or a multitude of other sites. The reality is that although these sites are affordable (no cost) and accessible, they are not an effective means to reach out to a prospective patient or a wider audience. Such sites are generally unmonitored and somewhat unrestricted, and you may find that your well-intended message has morphed into something damaging to your image.
9. **Blogs:** A blog (the term is derived from Web + log) is an online “diary” on which people post commentary, share experiences, ask questions, and engage in conversations. Blogs are often read by those who don’t participate. Like social networks, blogs have rules, but sometimes it is unclear who is monitoring to make certain participants follow the rules. Some physicians choose to start their own blogs on their own website or intranet for patients to ask questions and discuss topics of interest. This may be beneficial to your audience, but if you start a blog, you need to keep it fresh and moving. Much like social media, although you might not want to spend the time on blogs, you should know what they are and monitor them carefully.
10. **Reviews:** Reviews of physicians, medical procedures, and beauty products are available online. You may be the subject of a review and not know it; multiple sites crop up that offer patients the opportunity to anonymously review your practice and your services. The best way to know where you are reviewed or discussed is to regularly search for your name and brand through a search engine and see what listings come up. Contact the webmaster of any site that has incorrect information about you. They will likely try to sell you enhanced profiles; however, they must either correct erroneous information at no charge or remove your information from their site.

11. **Wikis:** Wikis (the term is derived from the Hawaiian word for “hurry quick”) are sites with collections of Internet content that are interlinked and can be accessed by anyone to add content. Wikis are for public education purposes, not for posting about oneself.
12. **Directories:** Paid or unpaid, this is so large a category that although it was once simply known as “yellow pages,” now it is an outreach strategy all its own.

Directories

Directories come in print, electronic, and Internet-based formats; they can be very narrow (all the physicians on staff at your local hospital) or broad (the national directory of all members in your specialty society).

Measuring response with directories is essential to managing the expectations you have for your effort. Exposure is the first consideration; who will see you, and how will they find you? Then it is a question of what communication vehicle specifically prompted an individual to act and contact you. Electronic directories have the added advantage of built-in tracking mechanisms. However, such systems measure numbers, not the quality of connections. The most reliable method for measuring response to any communication strategy you employ is to simply ask those who engage your practice these questions and track the responses:

Who or what referred you to our practice?

Where were you exposed to a message about our practice?

Where did you obtain the information you used to contact us?

Media Relations

Media relations include interviews, press releases, and story placement (publicity); they provide opportunities for you and your practice to be a source for public information on the subject of your profession and practice. There are two ways to engage national and major market media relations to garner publicity:

1. If you are a strong enough presence and personality who has significantly greater value or standing than your professional peers, you can drive your own media relations efforts.
2. If you are a strong, dedicated, and articulate personality who is active in research or teaching in your specialty; in the local, regional, national and international professional organizations you belong to; and with companies who manufacture or supply the treatments you administer or sell, you will have value to a media outlet. You can garner media relations through your contribution to these groups, either by driving your own media relations efforts, by partnering, or by acting as a spokesperson for the group you represent.

You must accept how media relations efforts are driven and realize that if you want reputable media coverage through channels that have value to your target popula-

tions, you must adhere to the principles of ethical media relations, and to your own principles.

Once you understand the principles of media relations, determine how you wish to communicate with media, whether you want to direct your own efforts or engage others, and the results you expect. Know who to contact to regularly update your contacts. For your message to be effective, it must be placed directly in the hands of the journalist who can most effectively use it to fulfill the interests of viewers, listeners, or readers.

Essentials of Media Relations

Whether you engage the media or you are approached by a media outlet, there are some media training basics to adhere to, regardless of how well you know or trust a journalist:

- Make certain the journalist or media outlet has integrity and that your message will be fairly and accurately transmitted.

- Prepare carefully for any meeting or interview. Ask for the specific focus and your expected contribution to any comment or interview as well as an agenda so you may prepare accordingly. Practice the dialog you expect to provide with any journalist. When this conversation does take place, have any supporting information you may wish to provide at hand for easy referral.

- Ask to review any portion of your contribution to a media effort for clinical accuracy. This is fact-checking to ensure that you are not misquoted; it is not editorial control. Do not make the mistake of telling a journalist how to present his or her story, or you will never again be a source for media relations.

- Protect patient privacy when media are present on your premises or when speaking with media. Certainly the best story is a personal story; involve your patients in a general way when possible and be candid about the effort. If a patient agrees to participate in your media relations efforts, you must obtain a release from the patient for his or her participation, whether this is to be in person or through photographs, even if the patient is not readily identifiable in the photographs. This cannot be a quid pro quo arrangement (in exchange for free service) unless that service is nominal and unattached to the effort at hand.

- Communicate effectively and consistently with any media organization. Provide supporting data, follow up all questions with supplemental information, and be sure that you know when your contributions will be broadcast or printed so your office staff will be ready to field any phone calls or inquiries that result.

- Maintain the media relationships you develop with verbal and written expressions of appreciation, similar to what you do to maintain your relationships with patients through correspondence related to patient care and innovation.

Advertising/Editorial Hybrids

Paid advertising today is often not limited to an ad; in many cases short articles, profiles, and even full-length feature stories can be bought in publications or on radio or television. You may even participate in a special advertising section on a specific theme in a local publication. Meant to look like unbiased editorial content, these hybrid pay-for-play efforts are commonly referred to as *advertorials* (advertisement + editorial). These hybrids contain artwork and editorial content and are disseminated or published for a fee. An advertorial can be placed in a defined section within a publication that is labeled as advertising, or it can be supplied content included in a local publication. All hybrids, whether simple advertorials or paid programming, must be contracted as advertising, and you must carefully review the fine print.

Advertorial: Most ethical and credible publications will state clearly that advertorials formatted to look like articles are advertisements. A quality publication will distinguish any paid messages from editorial content that is researched, attributed, and vetted as factually correct and balanced. Such a publication does not want to lose its reputation for objectivity or confuse or mislead its readers. They do not want to appear to recommend, feature, or present a product or service that has not been researched and reviewed through appropriate channels. If you are not willing to have the advertisement labeled as such, then your intention is to deceive. If the publication allows an advertorial without labeling it as advertising, its policies and format should be clear to readers so they can easily distinguish between paid and unpaid content.

Special advertising section: Regional and metropolitan publications often include special advertising sections on a specific theme that allow a templated advertisement (a photograph and a set number of words), or a mix of advertising and content at special rates. If you know the context of the special section and all the other businesses, products, or providers featured, and are comfortable being showcased among this group, a special advertising section can be a positive method for reaching a focused audience. If the section is unlimited in how many providers like you are included, or undefined in the selection process of those features in the special advertising, it is best not to be lost in a sea of unqualified providers or diverse and unrelated products and services.

Paid programming: There have been many instances of television or radio programs that appeared and disappeared for which a physician was offered the opportunity to be featured in a documentary, or to star in his or her own program if he or she raised sponsorship dollars or paid a fee. The results of these programs are questionable. What you spend on paid programming is better invested both in time and money on efforts to connect with serious prospective patients rather than those who randomly connect with your radio spot or television debut.

Pay-to-play: In pay-to-play, a medium offers to mention you in an editorial context in exchange for your advertising. Although publications and programs should support their advertisers, they should never be so brazen as to offer

pay-for-play, nor should you demand such a deceptive practice. If you have an established relationship with the medium, use it as a resource, and their representatives will reach out to you with questions about your practice or upcoming story ideas. If you cannot truly claim to be an expert on a topic, paying to be recognized as one will not yield positive results.

Paid features: An interesting phenomenon has emerged that combines several articles or program segments featuring various topics or physicians to create a full publication or program. These paid features are just that: the opportunity to pay and have a well-trained editorial team shape an article or a segment about you or feature you as the expert on a topic of interest, such as anti-aging treatments. Look carefully at the publication, the program, and all the other topics and providers featured. In most cases, no matter how straightforward the professional intent, these are easily identified by your audience as paid efforts.

ONLINE MARKETING TOOLS

ANDREW R. BERGER

Today one of the most important means of promoting your practice is through online marketing tools. Your website creates a picture of you, your credentials, your practice, and the menu of services you offer. Various communication tools can help spread the word about what's new with your practice, upcoming events, cutting-edge procedures, and results. Newsletters, social networking, and blogs, among others, are all part of the new media that are helping to define the current online communications that doctors and their practices need to understand and implement if they want to grow their practices.

Your Website

A well-designed website that has been optimized for Internet search engines is also an important and effective marketing tool, and if planned effectively, does not have to be a drain on the practice's resources. Rather, it can provide a positive source of new patients and revenue and serve as an educational tool for your patients.

Design

Your visitors' first online impression of your practice depends on your website's design; therefore it should be both aesthetic and professional in appearance and easy to navigate. Many visitors judge the quality of content within the website by the organization and design of the overall site. Your company's logo and colors should be used throughout the site, creating a consistent look and feel. Slight variations in de-

sign between different sections can enhance your website if used appropriately, but drastic shifts in appearance can leave your visitors disoriented. It is essential that your website's design be unique to distinguish your practice from the myriad sites offering similar services.

Content

Your website's design invites visitors into your site; the content of your website should hold their attention. Content is the core of your website. Even the most aesthetically pleasing site will attract few users if it is not informative. Well-thought-out content not only educates your visitors about your practice but also encourages repeat visits. Furthermore, having relevant content plays a pivotal role in search engine placement and greatly increases link popularity to your site.

Search Engine Optimization and Submission

Every day search engines (programs that search for and list Internet documents containing keywords or keyword phrases) direct millions of Internet users to their online destinations. It is likely that your website will receive more than half of its visitors from these search engines. Therefore your website should be developed in such a way that major search engines and indexes can easily catalog and search your content. Depending on the search engine, it can take anywhere from hours to months for your site to be listed. Once optimized and cataloged properly, your site will gain visitors who type in keywords relevant to your practice.

The various search engines frequently change their algorithms to ensure that they get a variety of relevant results. There are a number of techniques you can use to achieve more prominent search engine placement. None of these techniques will guarantee you the top spot in all of the search engines; however, following these principles will significantly improve your website's search engine placement.

Selecting relevant keyword phrases (not just keywords) proves exceedingly important. For instance, in addition to selecting "plastic surgery" as your keywords, choose "plastic surgery in Boston" or "Botox in Boston" as well. Be as specific as possible.

These keyword phrases should persist throughout the following elements of your website: website title, uniform resource locator (URL; your website's "address"), meta tags, and content. Although sprinkling relevant keyword phrases throughout your web design will improve your search engine placement, flooding your web pages with keywords may have a negative impact. Many search engines may ban you for overusing keywords, and your visitors will show little interest in content that is so compromised by keyword phrases.

An abundance of relevant text content is as valuable to search engines as it is to your readers. Search engines catalog all the text information from each of your web pages. The more text content information you have cataloged in the search engines, the greater the chance search engine users will find your website in their query results.

Link Exchange

Link exchange is one of the most effective ways of attracting targeted visitors to your website. Aside from search engines, most users find new web pages through other related websites. In a link exchange, the owners of two websites agree to place each other's links on their sites, usually for free. Understanding how to make the most of link exchanges is crucial to increasing your site's traffic.

Link exchange has a direct effect on your site's link popularity, which is the number of links that point to your website as measured by the search engines. Since the objective of search engines is to serve those sites that are recommended by many other sites, most incorporate popularity factors into their ranking algorithm. The quality of the sites linking to you, however, is being closely examined as well. Therefore it is important to get links from popular websites whose content closely relates to yours. Getting only a few links from popular websites will be more useful than getting several links from less-popular websites.

The easiest way to look for link partners is through the search engines. Enter your keywords to find out which sites get listed first, and then contact each site owner to suggest a link exchange. If most sites listed are your direct competitors, come up with related keywords instead. For instance, if your area of specialty is rhinoplasty, look for sites that deal with other types of facial plastic surgery. You may also be able to exchange links with related publications or professional associations. If you have an online newsletter, submit its link to online directories that are reserved exclusively for newsletters.

Visit a site before asking its owner for a link exchange. Try to personalize your link request email instead of sending an automated message to every site. In your email, always suggest a title and short description of your site that may be displayed on the link partner's website. Your main keywords should appear somewhere within the title, the description, or both.

Aside from link exchanges, offering quality content on your website is an indirect way to increase your link popularity. People generally link to websites that offer unique and useful information and will do so without being asked. Another way to promote your site is to allow other websites to display your site's content in exchange for a link back to you. In summary, the more links your site has from quality websites, the more traffic your site will likely receive.

Online Advertising

Aside from search engine submissions, you can market your site through pay-per-click or pay-per-impression programs. A pay-per-click program typically places a text link or a banner ad to your website and charges you a flat fee each time a visitor clicks that link to visit your site. Although a pay-per-impression program also places a text link or a banner ad to your website, it charges a fee based on the number of visits (impressions) to the web page your link resides on. When considering these programs, select only programs that place ads on sites that attract visitors within your target market. Generally, pay-per-click programs and text links have been shown to be more cost effective than pay-per-impression and banner ads, respectively.

How Many People Visit My Website?

To effectively run an online marketing campaign, it is important to determine not only your initial level of website traffic (the number of visitors to your website), but also any changes to these traffic levels in response to your marketing activities. This will help you assess the effectiveness of your marketing campaigns as well as the activities of outside consultants or services you might hire to assist you. The web server, which is a computer where your website resides, likely already has installed website statistics software for tracking website traffic. You can communicate with your website hosting company to determine whether you currently have one of these programs available to you. If not, they can usually be added to the web server for about \$100 to \$300 a year.

eNewsletters

Newsletters are effective marketing tools that serve a dual function: educating your patients and promoting your practice. With the growing popularity of medical newsletters and the enormous interest in aesthetic surgery, it is only natural that a well-constructed newsletter will provide an effective vehicle for communicating your message to current and prospective patients. Although traditional newsletters can still be effective marketing tools, eNewsletters provide some distinct advantages over their print counterparts, both in efficiency and economy.

eNewsletters are a relatively inexpensive way to communicate with patients. Professional email marketing services can cost as little as \$25 to \$50 per month for an email list of approximately 2500 emails and allow unlimited email marketing campaigns to your list. By comparison, one traditional newsletter with print, design, and

postage costs could amount to more than a year's worth of email marketing service. Keep in mind that most of these services require that your email lists are "opt-in," which means the emails within the list have been voluntarily given to you by your current or prospective patients and have not been purchased. Although initially this requires some additional effort to acquire and build your email list, your growing list will lead to increasingly effective direct marketing campaigns.

Today creating an online campaign through an eNewsletter service is an easy process and does not require technical training. These services provide you with simple templates and a wide variety of design formats. All you need to do is fill in your message. Keep your message focused, and provide embedded links throughout the email to various pages within your website, such as announcements of new services, honors received, new developments in plastic surgery, and office contact information. Distribution is instantaneous through a click of the mouse and can be scheduled for launch at any time.

A variety of features within these services will greatly aid in growing your eNewsletter community while allowing you to efficiently run your campaign and track its effectiveness. Simple link features such as "Forward to a Friend," "Update Profile/Email Address," and "Unsubscribe" will help you easily manage your eNewsletter subscriptions. Consider selecting a provider that offers statistical information on the number of subscribers opening the newsletter and visiting your website through embedded links in your email campaign. These statistics can help you fine-tune your newsletter based on your subscribers' actions.

You can promote your eNewsletter by featuring it in brochures and other printed materials and on your website. Choose a service provider that supplies a referral button within each newsletter for readers to forward the information to friends and relatives and a sign-up button for these new contacts to join your subscription group. Newsletters provide an inexpensive means for maintaining regular contact and building relationships with your current patients, as well as capturing and educating prospective patients.

Getting Help

Admittedly, most surgeons don't have time to personally develop their online marketing program and will hire a company to handle the details. The descriptions presented here outline factors that are important in a successful online marketing ef-

fort. The following are some important considerations for your online marketing campaign:

Purchase your own domain name: Make certain you purchase your own domain name and that it is on an automatic renewal system for annual registration fees. Domain names can be purchased for about \$10 per year from a domain registration company.

Use a website statistics package: To assess the effectiveness of your online marketing campaigns, it is essential to determine not only your initial level of website traffic, but also any changes that result from your marketing activities.

Create a pleasing website design with relevant content: Develop a website that is aesthetically pleasing to your visitors while educating them on the procedures and services you provide. Websites full of relevant content are more easily “seen” by the search engines and are more likely to result in return visitors.

Use eNewsletters as cost-effective marketing tools: These campaigns can help you to promote your practice economically and efficiently while assessing the potential interests of prospective patients by tracking clicks on embedded links in your email campaigns.

Establish link exchanges: Building large link exchange networks with related websites can greatly assist in search engine placement. Remember that the quality of the incoming link is usually more important than the quantity.

Enhance your potential for search engine optimization/submission: Keyword phrases should persist throughout your website design: website title, uniform resource locator (URL; your website’s “address”), meta tags, and content. Although sprinkling relevant keyword phrases throughout your web design will improve your search engine placement, flooding your web pages with keywords may have a negative impact.

Concluding Thoughts

FOAD NAHAI

It is extremely challenging to develop and maintain a successful aesthetic surgery practice, and not without significant financial risk. It requires hard work, planning, and perseverance. Before setting any goals, the surgeon must assess his or her strengths and weaknesses. We all have areas of interest, procedures that we excel in and others that we don’t do as well. The practice should be built around the strengths of the surgeon or surgeons, taking into account competing practices. For example, if there are several surgeons in your community who excel in breast augmentation but there are none who perform rhinoplasty, provided you have the skills and interest, your practice should focus on rhinoplasty where you have an opportunity to gain significant market share with little competition. A successful cosmetic medicine/aesthetic surgery practice is built around patients and their needs. Surround yourself with qualified, motivated staff members who share your vision and commitment to patient safety and customer service.

Clinical Caveats

The practice model directly affects the surgeon's working environment, control of everyday decisions, financial independence, and flexibility of schedule.

The total patient experience, including his or her encounters with all aspects of the practice, is just as important as the quality of the result of a procedure.

To run a successful practice, a surgeon must have a basic understanding of the business aspects of daily operations and a budget and plan for reaching the goals that will drive the practice.

Regularly scheduled staff meetings nurture a sense of teamwork and emphasize the important role everyone plays in the success of the practice.

One of the best ways to attract patients is to become involved and to make yourself available as a speaker and educator, as a source of information for possible referring surgeons, as an advisor to support groups, and as a local authority.

The patient coordinator serves as a vital link between the surgeon and the patient, and must be able to connect with patients on a personal level and to instill in them trust and confidence in the surgeon and the practice.

Computer imaging helps to establish better communication with patients to define goals, develop an appropriate treatment plan, and effectively communicate expectations by demonstrating what is and is not possible to achieve through surgery and adjunctive treatments.

A well-designed and optimized website is an essential tool in today's aesthetic surgery practice.

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CHAPTER 7



The Practice: *Staffing, Services, and Financial Planning*

MARIE CZENKO KUECHEL

There was a time when an aesthetic practice was all about outcomes—the physical improvement that resulted from aesthetic surgery. Today, managing your aesthetic surgery practice involves a combination of inextricably linked factors, including producing good outcomes, interacting with patients, empowering staff members who excel, providing services that meet patient needs and are priced affordably yet profitably, marketing to promote treatments, and communicating to educate your patients.

This combination is essential for achieving patient goals and managing a lucrative aesthetic surgery practice in a competitive environment in which other providers and multiple options vie for consumer dollars. Whether to invest in surgery or a luxury vacation, a car, or even a piece of jewelry is a decision your prospective patient must make; the answer depends on the physical desire and outcome, but also on the experience. Although your outcomes and interactions with patients may be your responsibility and under your control, your staffing, services, financial considerations, and marketing rely heavily on the efforts of others and on variables that may be out of your control.

Managing your aesthetic surgery practice begins with staffing and services and includes your financial model and marketing strategies (which are discussed in depth in Chapter 6). One might call these the core factors for aesthetic surgery practice management.

Staffing

The staff members you employ will interact with your aesthetic patients. In most cases these individuals are the first and last point of patient contact, perhaps even the primary contact. They are your messengers, gatekeepers, spokespersons, and advocates. Before you consider whom to recruit and what qualities your team should have, consider the diverse skills that staff must possess to work collaboratively. Ideally, your staff should include four functions—service, clinical support, patient management, and administration—that are integral to managing your practice and achieving patient expectations. Whether employees or contractors, staff are part of your team and essential to your daily operation.

Service Providers

Today's aesthetic practice commonly requires more than a surgeon providing services intended to achieve specific aesthetic outcomes. *Physician extenders* (physician assistants or registered nurses) and, in many practices, aestheticians provide services to complement aesthetic surgery or to achieve specific aesthetic goals that may not require surgery. Fundamental to managing these individuals is the understanding that this is your practice, these patients belong to your practice, and these providers are an extension of you. They may be permitted or required to act autonomously based on their individual expertise and on patient needs, but how, when, and to what extent can only be defined by you, within the parameters defined by state law and your profession.

Clinical Support

Whether exclusively supporting you in the operating room or fulfilling a dual role of providing aesthetic services to your patients and clinical support to you and other team members, clinical support staff are essential; no one can function alone. The individuals who provide clinical support are essential for managing patient expectations; they may be the ones who allay patient anxieties before surgery, administer anesthesia, or provide assurance and comfort immediately after surgery. Or they may be invisible to your patient, such as the scrub nurse who rarely ventures outside the operating suite or interacts with conscious patients. Those who come in contact with your patients must accept the demands of managing expectations at all times. Because of this intricate interrelationship among support and provider roles, it is vital that the scope of service and clinical support functions be clearly defined in job descriptions, be well communicated among the team members, and be appropriately scheduled.

Patient Management

The term *patient coordinator* has been coined to describe the role of the individual responsible for patient management. In some practices this function is performed by a nurse or another clinical support person. Titles are less important than are the dedication and skills of the individual who fulfills the patient management function. This professional is a vital contributor to your team and is responsible for managing the entire patient experience, including all the documentation and related communications. The patient coordinator is the pulse-point for your patient. This is not a position to entrust to a commissioned, contract, or consulting individual; patient management must be a vested function in your practice. For an aesthetic surgeon who is strong on clinical skills but short on interpersonal skills, the patient coordinator is not merely a vital contributor; he or she is the most important member of your team, because without this person, you may not have patients who will accept your services. (See Chapter 6 for a detailed discussion of the patient coordinator's role.)

Administration

Office manager and *receptionist* are common administrative roles in the practice. Most often these are full-time employees, but these functions can also be supplied by office management consulting firms that assume responsibility for the business aspects of your practice. Effective data management is essential to successful administration; this will take the least amount of effort if it is conducted in a timely, systematic, and well-organized fashion. Administrative roles may be very focused, or broad based to include financial and operations management, property and facility management, and human resources management. I don't believe in hiring someone whose only function is to serve as a receptionist; every person in the office must be capable of and responsible for answering the phone and greeting visitors.

Your team may be lean, efficient, and diverse in their duties, or may include multiple individuals and layers for providing service and administrative support. There is no one model that characterizes all aesthetic surgery practices or a single operational skill set held by all surgeons or business owners. It is important to recognize that the number of providers, the pace of your practice (number of procedures performed), and the mix that exists in your service model will all factor into determining the right number of people to employ. In addition, your surgical team, whether provided by the hospital or surgery center where you operate, or employees or contractors at your own office-based or ambulatory surgicenter, will also influence the ultimate number of team members you require. Your own surgical staff can multitask to perform preoperative and postoperative functions and even provide such services as injections, making your team more diverse in talent, although more limited in numbers. An outside surgical team can free your in-office clinical staff to provide appropriate nonsurgical services while you are in surgery, creating an added revenue stream, or may carry out essential patient management functions. There is no single model. What is more important than the number of people on your team is their contributions and loyalty to the practice and to your patients.

Every person on your team must be loyal to you and to the practice. All team members must thoroughly understand your specialty, as they should in any medical practice or business. In addition, they must be willing to continuously learn and keep current with the advances in your specialty, even if that includes services you do not provide. An aesthetic practice requires individuals who fully understand the uniqueness of providing elective services and are willing to meet the expectations of patients who have very specific physical and experiential needs. They must be discreet, warm, compassionate people who also know when and where to draw the line, because they will regularly become involved in the most intimate details of your patients' lives, bodies, and choices.

Recruiting

Throughout your practice career you will either need to hire more staff or to replace those who leave, from the natural process of turnover or because they are dismissed. In recruiting staff, two questions need to be addressed:

1. Where do I recruit quality staff?
2. Should I hire based on skills or personality?

Your staff, particularly those with direct contact with clients and patients, must be chosen based not only on skill, but also on personality and presence. An individual with the wrong personality or image for the position does not easily change, but with the right foundation, skills can be honed or acquired. Personality is the critical variable. Staff members represent your practice as much as you do. In fact, in almost every case, they are the first in-person impression a patient receives of your practice. They do not need to be a physical model of aesthetic perfection or a mirror of your finest work. They do need to be articulate, kind, patient individuals who understand that appearance is an important personal issue for the patient.

Where to Recruit?

When the need arises to fill a position, the best place to start is always from within—to nurture current team members with the potential to fill the role, or to engage them in helping you recruit other talented individuals with whom they will have to work as part of your team. When you don't find the right candidates among this internal network, you should look outward, but slowly. Look to similar (not necessarily the same) businesses or practices for the right basic skills and the essential personality traits. You can train and educate a capable individual, but you cannot overcome personal or service deficiencies that will be obstacles to your patients' having a consistently excellent experience.

Screening

Recruitment only begins with finding appropriate candidates for the job. Critical to recruitment is screening. Interviews should be conducted not once, not twice, but at least three times and should include the following components:

- Email correspondence beyond the presentation of resume and credentials
- Telephone conversation for a set period at a set time
- Face-to-face meetings with other team members and with the physician on one or more occasions

Before or during the interviewing process, you must check the candidate's references, understand his or her salary expectations, and explain the need for drug testing, a credit report, or other screening requirements before the individual may be hired. As you get closer to identifying the right candidate for a position, two things are essential: a demonstration of skills, and shadowing. Invite the candidate to spend a few hours or a day within the practice to get a feel for the pace, position, responsibilities, and office environment.

Once you have found the right candidate and have screened appropriately, you can make the decision to add this individual to your team. But remember, this is a team—so include other staff members in the decision-making process, because they will be working together in managing and meeting expectations in your practice.

Qualities to Hire in Your Aesthetic Practice

Competencies and personality are obvious factors in determining whom you will hire. From the front office staff to the scrub nurse, those on your team should also possess the following qualities.

PRIDE Taking pride in oneself, in one's appearance and actions, in one's work, in the team, in your business, and the services it provides is essential in a service-oriented business that is inextricably tied to appearance and self-esteem. Pride indicates a sense of self-worth; this is very different from being arrogant with a sense of superiority. It is important to recognize the difference and hire those who understand and strive for excellence in all aspects of their professional and personal endeavors.

RESPECT Respect is not simply reflected as deference given to the surgeon: every team member must possess an appreciation of patients, vendors, housekeepers, other staff members, and certainly the surgeon. Respect must also be paid to procedures, systems, protocols, and patient privacy. Although you may not perform life-saving procedures in your practice, they are life-changing for many, and they also carry the potential for risk; staff must understand and respect these potential risks and the impact these procedures have on patients.

A THIRST FOR KNOWLEDGE Those you hire must want to both learn and teach on a regular basis. Exceeding expectations in the aesthetic surgery practice requires a strong and empowering connection between your staff and patients to educate them beforehand about the possibilities, responsibilities, and limitations involved with surgical procedures. In that process questions can arise. An educated staff with a thirst for knowledge will always seek the answers they don't have, confirm the validity of those answers, and convey these facts. You will also need to continually upgrade your own skills, keeping pace with technology, techniques, and best practices, and differentiating between valuable learning and overhyped training.

HUMOR The ability to laugh is essential in the work environment. It is also, in good taste, a means to allay anxiety, to establish a connection, and to deal with stress. Staff with a sense of humor and good taste have the ability to keep the team or a patient at ease and engaged.

PATIENCE A service business as intimate as aesthetic surgery requires people who exhibit patience for the client, the process, and all associated emotions, details, and potential complications. Efficiency is important, but not when it forces others to be hurried, or to overlook details, or when impatience becomes obvious and affects team cohesion. We all have moments when a patient or situation has taxed our tolerance; it is important to respond by regrouping, or revisiting the situation at a time when everyone has a fresh perspective and the ability to focus again on the importance of the situation. Decisions or actions made impatiently are not confident decisions or actions.

Training

Specific training was once thought to be an essential prerequisite to working in an aesthetic practice. Today, however, we recognize that training is an ongoing process in a service-oriented business. Although the foundation of the practice may remain constant, the service mix may change to adapt to the introduction of new treatments, technologies, and techniques. As much as your credibility is the core of a successful practice, so also is the credibility of those who work with you. Clinical staff have a duty not only to keep abreast of new information, but also to remain current on skills and training. Encourage this, reward this, display the certificates, and communicate your staff's level of knowledge and training to your patients. Recognition of individuals' growth in the performance of roles contributes substantially to their job satisfaction and ultimately to employee retention. Administrative staff have a duty to keep abreast of market, operational, and business knowledge. This should be rewarded, and the value of advancement should be communicated to the entire staff, because it will inevitably benefit everyone in the practice when administrators can improve the skills that make the practice succeed.

Training Essentials

The aesthetic world is changing rapidly. It is essential that new skills, technologies, and treatment protocols that add value to your service mix be thoroughly investigated and honed before adding them to the service menu. Without training, whether from a book, a seminar, a webinar, or other professional resource, you and your staff cannot progress.

Respond to trends. Learning about the trends and procedures you will not offer is as essential as mastering new skills. Today's patients are well educated and have access to an overwhelming amount of information, both credible and of dubious value. To respond intelligently to questions about the treatments and services you do not offer, you need to first understand what those procedures are and be able to state succinctly why you have decided that these do not have value for your practice and your patients.

The aesthetic practice faces daily service and clinical challenges, but what is often lacking is a long-range goal that challenges the individual to progress and grow. It is important to seek new learning opportunities and to promote training that allows you and your team to be stimulated by new, positive, and potentially lucrative opportunities.

Managing

Nurturing and growing your staff as well as managing them is critical to maintaining a strong team. The human resources function is essential, no matter how small your practice or how successfully and harmoniously your team members work together. Management basics include the responsibilities of hiring, payroll, benefits, and policy. You may personally manage your team, or you may choose to empower someone on staff to manage and make final decisions. You may choose to outsource the payroll, benefits, and other human resources functions; you should outsource drug testing or competency tests. Internally, there must be a decision-maker and manager you can rely on to manage compensation, which includes all things provided to your staff in exchange for services: salary, bonuses, or commissions, insurance, and even perks such as treatments. Forms of compensation should not be chosen lightly; they should be researched and defined in your practice policy. The process of reviewing staff contributions, goals, and growth is the most often overlooked basic component of a staff cycle in any small business, and it is inextricably tied to compensation.

You must review performance annually as well as oversee the day-to-day methods and competence with which your staff addresses your patients' needs. We have all seen the difficult patient, the one with unreasonable expectations. We have also seen what happens when a staff member, innocently or during a moment of pressure, contributes to a service failure or implies an unrealistic or unattainable outcome. It is the manager who must resolve these problems for the patient and the team. Can the team member be retrained, or must he or she be terminated?

There will be times when an employee must be terminated, whether for performance issues, in response to economic pressures, or for other reasons. Whether it is you or your manager who carries out the termination, this is stressful. Terminating any individual requires adherence to guidelines defined by law. Acting within the confines of your practice, you must progress with your remaining team, answer the inquiries of patients, and carry out all the functions necessary to continue to serve your patients.

Essentials of Staff Management

ENCOURAGE RELATIONSHIPS Staff members should be encouraged to forge appropriate relationships with their coworkers, the aesthetic surgeon, vendors, and your patients. Clearly state your expectations for the relationships within your practice, and define your expectations for relationships outside your practice, whether family, friends, or acquaintances of your staff. For example, value the patients who come to you for services as a result of a personal or professional relationship with your staff members, and define how you might—or whether you will—offer special pricing, services, or perks to those individuals.

DEFINE BOUNDARIES Some actions are simply not acceptable, such as when an employee contacts patients outside the office. An individual's one-to-one contact for reasons other than the professional needs of your practice is unacceptable. Other boundaries include behaviors such as dress, manners, language use, and even the use of office equipment or conducting personal business on office time. An employment manual that defines everything from dress code to personal calls, Internet usage, and personal use of office supplies is essential to defining and maintaining boundaries.

KEEP AN OPEN DOOR It is essential that you maintain open communication with your team about minor daily events or major concerns and about practice or personal issues that may affect an individual's performance in your practice. Don't dismiss a matter out of hand that seems trivial; listen, put it in perspective, and move the conversation to important matters. Although you should not get involved in personal staff issues, knowing that a member of your team is going through a divorce, the illness of a parent or child, or other problems that may hinder his or her ability to work is essential to your leadership. An open door will help you remain apprised of matters that affect the morale and pace of your office and will establish a level of trust between you and your team.

MAINTAIN RECORDS Human resource records include employment applications, verification of eligibility to work in the country of residence, bonding, drug testing, salary, raises, bonuses, benefits, and performance reviews, performance infractions

and warnings, emergency contact information, certificates and licensure, added skills (such as fluency in a second language), and essential health records (for example, TB test results). These records are all essential to the business health of your practice. You may not wish to be the keeper of these vital records; appoint a trusted and appropriately trained leader to manage this function on behalf of the practice.

LEAD BY EXAMPLE If you expect a staff of timely, top-notch, talented individuals, you too must present that standard. A surgeon who consistently walks in the office moments after the first patient for the day has arrived but first addresses emails, messages, and other business sends the message that patients can wait. We all have bad days, but you must consistently set a tone of mutual respect that demonstrates what is acceptable behavior and what is not, and a tempo that is efficient and professional.

Team-Building

Recruiting and hiring staff requires immense effort; a weakness or void in a staff position is taxing for everyone. Loyalty among your staff, motivation for your team, and rewards that recognize staff accomplishments are critical to staff contributions and retention and help to maintain consistency and continuity in your practice.

Employees' loyalty must be to the team, the patients, and the surgeon. The different providers, functions, and personalities involved in managing your patients' needs and expectations are not mutually exclusive; success happens as a result of the team's efforts. Recognize that you are the team leader; your actions, decisions, interactions, and transgressions will have an exponentially higher effect on the team than those of any other individual. Set the bar high, and recognize that loyalty must be earned daily; it is not intrinsic to your role as the surgeon.

Rewards are essential to motivation; various motivating factors spur different individuals. For some it is money; for others it is praise. Some are motivated by advancement; others are inspired by the fulfillment and satisfaction they receive from accomplishing daily tasks and specific goals; and others are gratified by their role in helping patients to achieve their desired outcomes. Motivate in a manner that is valued by the individual and beneficial to the team. Motivate team members daily when things work well, or when conflict is managed. Encouraging words and leadership are essential in difficult times; without them morale and subsequent enthusiasm and desire to meet challenging expectations will wane.

Five Essential Teams in Your Practice

You may have a staff of three or 30; regardless, the following teams are essential to collaborate on a number of functions within your practice.

Clinical: Whether in the office or the operating room, those who provide service or maintain records of service to patients must work together and meet as a team to review everything from individual cases to processes, and even preferences in supplies and scheduling. This team will also review and critically evaluate data on new procedures, techniques, drugs, devices, protocols to determine what can and should be added to the service offering, and what falls outside your scope of practice or standards for excellence.

Operational: The people who keep patient traffic moving into and through the office are a team that includes both providers and administrative staff. Everything from waiting times for appointments, waiting times at appointments, patient data, payment, and even difficult patient situations must be on the radar of this team, whose principal goals are efficiency, attention to detail, and service.

Administrative: Those who handle calls, questions, accounts receivable, and accounts payable need to work in synergy and set the pace of the office. Information that is not communicated, payments that are not made or received in a timely fashion, and data backups and records that are not up-to-the-minute and secure all pose a serious threat of failure within your office. This team must consistently stay on top of details.

Patient services/marketing: Your service menu, amenities, pricing, patient expectations, website, consultation materials, community efforts, and all the things that are essential to attracting and servicing your patients fall under the purview of this team, who regularly check to see that correct, consistent, and timely messages, services, prices, policies, and other pertinent information are operational. Don't discount this team if you are a referral-based practice; their job is to also find and implement the most effective means for maintaining contact with your existing patient base and referral sources.

Quality improvement: A team of individuals who combine all of the key areas and monitor safety, accreditations, and other vital compliance issues serve as the critical eyes and ears of your practice. Their role is not nitpicking; it is quality improvement and the motivation for all to continuously do their best.

Services

The outcomes you achieve from the services you offer are the basis for your relationship with patients. A service model in your practice consists of more than the surgical procedures you provide; today it must include a multitude of nonsurgical treatments that complement or are preparatory to surgery, refine surgical outcomes, or stand alone as important services to fulfill your patients' appearance-related goals. Your service model is defined further by the menu, setting, and time in which you or staff members provide these treatments. It includes the amenities you offer your patients or the convenience and access to these services. It also includes the manner in which you address what you don't offer.

Service Models for an Aesthetic Surgery Practice

Cosmetic: Medical services that are elected to improve, enhance, or change personal appearance. You are dedicated to medical solutions that address the physical and emotional needs of your patients.

- *Surgical:* A portion of your services is dedicated to surgical solutions in your accredited on-site facility, an ambulatory center, or a hospital.
- *Nonsurgical:* Patients are treated medically, not with scalpels or by making incisions.

Retail: Products that are required or that enhance or extend your services are sold to your patients.

Spa: Services are provided in a luxurious and pampering environment. However, you don't need to call your practice a spa to surround your patients with warmth, comfort, and a relaxing environment.

The box lists the general models that shape a large portion of your practice, although these options will not wholly define your practice. The interest in and demand for innovations in nonsurgical procedures and treatments are burgeoning, but you will not limit your model to one category; you are a surgeon. Purely surgical practices are rare today; these are generally highly specialized and limited in the range of surgical procedures performed. The addition of nonsurgical services to a practice often begins with injections or skin care and may evolve to include energy, laser, and light-based technologies. Nonsurgical procedures are outnumbering surgical procedures nearly 4.5:1, according to the 2008 annual statistics of the American Society for Aesthetic Plastic Surgery (ASAPS). The increase in the popularity of and demand for nonsurgical procedures and the nature of their delivery has created a need and demand for physician extenders: licensed physician assistants, nurse practitioners, or registered nurses and aestheticians who administer treatment prescribed by the physician. However, according to a 2008 survey by the Physicians Coalition for Injectable Safety, 69% of aesthetic surgeons (board-certified plastic, facial plastic, or oculo-plastic surgeons) perform injections themselves in their practices.

Essential Elements of Service

Managing expectations in a personal service-oriented business such as aesthetic surgery requires looking at service as more than simply the treatments you provide.

SERVICE MENU Service in an aesthetic surgery practice can be viewed in one of two ways: as a diverse menu of items including surgery, nonsurgical treatments, and retail products for sale; and as a focused grouping of interrelated services that stem from your primary expertise—surgery. This includes skin preparation and rejuvenation to accompany facial aesthetic surgery, or hair removal to refine a newly sculpted leg or abdomen. It involves treating scars that have resulted from skin disease or surgery. Your service menu may promote other services, such as a patient who has re-

ceived injections of fillers and who now desires the more extensive and permanent results of a face lift. It may extend to a hair removal patient who likes her leg appearance and decides that she also wants her saddlebags improved for a total sculpted look. The service menu must be up-to-date: procedures, products, pricing, and packages. It is important to review data regularly to identify trends and measure productivity and profitability.

SERVICE SETTING Your practice setting is anywhere you offer services or meet and engage your prospective and current patients—your office, a surgicenter, a medical spa, or a satellite location. If you have more than one site, the atmosphere, appointments, privacy, and amenities offered should be consistent at all locations. There should be a connection, where one setting is an extension of another and all locations work together in concert.

TIMES OF SERVICE There are two approaches to the times you provide service to your patients—the times you designate that you will be available, and those times you make yourself available to meet patient needs. In a truly service-oriented practice, patients who request or require evening or weekend appointments get them. Surgery schedules are not defined by the physician alone; they are scheduled according to availability and the patient's recovery needs. Because you cannot be there for all types of services at all times, you must provide for supervision as appropriate and for physician extenders to respond to patient needs.

SERVICE PROVIDERS If your practice is to manage expectations and create an experience that is consistent in service and outcomes, all team members must be service providers, and their titles and goals should reflect that focus. The patient experience is shaped not only by the results achieved through an aesthetic treatment, but also by the connections he or she makes with each service provider.

The Operational Trilogy

An aesthetic surgery practice must focus on three distinct service entities: medical services, personal services, and retail. Each aspect has a distinct function, individual goals in fulfilling patient needs, and a unique contribution to revenue. Although each can stand alone, it is the synergy among the three operational segments that has the greatest value.

Medical Services

The medical treatment a practice provides, who the providers are, and where treatment is provided define medical services. Your skill and care and that of your clinical staff and supporting administrative staff represent the character of your clinical operations. The office, surgical facility, and postoperative care provided represent

the comfort of your operations. In an aesthetic practice the focus of care rests on ability, plus the basics of character and comfort:

- How and where do you conduct consultations?
- Who is your patient support advocate?
- Where are diagnostic tests performed, and how?
- What is the consent protocol?
- What is the preoperative protocol?
- Where is the operating room? How does it function?
- Who provides anesthesia and preoperative, surgical, recovery, and postoperative care?

The process by which you provide services to each patient builds an expectation that you must meet or exceed for every occasion in which this patient is treated. Aesthetic surgery today is not a linear equation, one where the relationship begins when the patient comes to you for desired treatment and ends with a positive clinical outcome. The relationship is cyclical for two very distinct reasons:

Nonsurgical treatments, commonly referred to as *cosmetic medicine*, are therapies that must be repeated, intensified, or changed to produce or maintain results. These may serve as a springboard to surgery as an individual continues in the patient cycle. If you cannot fulfill or maintain the treatment cycle, you have broken the cycle and lost the patient.

Happy patients are your best source of success and growth. Keeping happy patients in an active cycle maintains your visibility with them and reminds them of the value of your services. This will bring them back to you for different or added services, or they will refer others to you.

Personal Services

The services you provide are highly personal in nature. Whatever the extent or range of your service menu, the principles employed by the personal service industries are essential to your patients' experience and overall satisfaction. Personal services are reflected in the way you deliver treatment: by using clinical means to arrive at a physical outcome without the experience feeling medical; by practicing medicine with a team of talented, dedicated individuals who provide medical service while applying the principles of personal service; and by delivering an experience that is wholly based on personal fulfillment for the patient.

Some aesthetic surgery practices not only apply personal service principles to medical practice, but they also enhance the medical practice by adding true nonmedical services. Many practices thrive without them, some offer personal services but don't emphasize them, and still others call special attention to the personal services provided. Some of these personal services may be seen as nonessential, such as cosmetics, massage therapy, concierge services, and a car that delivers your patients home after a procedure.

The Potential Impact of Personal Services on Your Practice

Personal services may have the following effects:

Generate revenues or add expenses: They may produce revenue or increase your cost of operations or your investment in inventory. They may occupy space and require utilities, insurance, marketing, or other essential expenses.

Enhance your mission: Cosmetics were introduced in medical practices to help patients disguise birthmarks, scars, and acne, or telltale posttreatment signs such as redness, or bruising. They have evolved with science and improved formulations to become an integral part of the aesthetic practice, not only for correction and camouflage and for completing the full aesthetic experience for your patient, but also for maintaining results, protecting the patient's rejuvenated, youthful appearance, and nurturing the skin.

Create opportunity: Whether to improve your patients' experience, your ability to serve them, or to invite a new audience to your service business, nonmedical services must create opportunities for you to grow without having a negative impact on your resources or image, or your patients' experience.

Nurture ongoing relationships: Whatever the service, whether it is brow waxing or biofeedback, personal services that by their nature will be repeated by a happy customer keep your core services continually visible to that client/patient, thus creating a greater opportunity for your single greatest source for clients: referrals.

Definitions of medical services, personal services, or retail within your aesthetic surgery practice are straightforward. They intersect in the manner in which you provide them and in the outcomes, safety, ethics, and privacy that characterizes their delivery. Although treatment may create temporary pain, stress, and even fear, a successful aesthetic practice will create a positive, encouraging environment that does not discount these real conditions. Meeting or exceeding patient expectations requires the personal services of providing comfort, individual attention, and positive support.

Concierge Services

A concierge is often defined as a professional who assists guests in a hotel or members of a specific community, such as a condominium complex or a country club. In an aesthetic surgery practice, the term *concierge* encompasses the evolving concept of concierge services. It implies the ultimate in personal service to assist your patients in every aspect of the aesthetic experience. In reality, concierge services simply reflect common sense and common courtesy.

Components of Concierge Service

Attention: Your patients and their needs should always be the central focus of attention. A concierge in the very best hotel would never keep a guest waiting long for an answer; likewise, you should not keep your patients waiting.

Service: Concierges arrange service, where and when you want it. Likewise, in your aesthetic surgery practice, house calls or preoperative in-person checks on your patients who recover at home are appropriate, especially when patients may not want to be seen in public or have limited means to travel.

Accommodation: A concierge makes travel plans and helps travelers who are in unfamiliar territory. Patients may travel significant distances to see you, whether you are the closest geographic choice, are practicing in a choice destination, or are the preferred choice. Patients deserve assistance with travel arrangements for getting to, staying at, and enjoying your location. It is hospitable to do so.

Comfort: A concierge is the person to call with your special personal needs for comfort when traveling. Coordinating postoperative needs, whether these are for skin care, garments, amenities, or a place to recover, is good practice. It is inappropriate to perform a laser treatment on a client's skin, then send that person home with instructions stating, "Apply baking soda compresses and a coating of petroleum jelly for 4 days." Either provide the instructions far in advance so the patient can plan accordingly, or send the client home with the items he or she will need.

You may feel that concierge practices are excessive for most of your patients or are not right for your service model. Nevertheless, don't overlook the special needs some patients may have, and weigh the value of such services to your practice. Keep information on file for a concierge service that is willing to learn your business, understand your expectations, and serve your patients.

Retail

The goods that your practice sells must complement your services, but they also have some independent characteristics. Retail requires appropriate accounting and inventory, including the collection of sales tax. In some practices, retail goods are the only sale on which commissions can ethically be paid. They require an investment in inventory, typically carry a 100% markup, and necessitate close monitoring of inventory (as any retail function does) so that stock can be maintained appropriately for patient-client demand and be accounted for. Sales of retail products are enhanced by effective displays, but such items also attract theft. Products can also be sampled or tested, unlike the surgical procedures and services you provide.

Once clients use and are satisfied with retail items, the expectation is that they will continue to purchase them from you. This creates an ongoing revenue stream and brings the client back to your business regularly to purchase more. These repeat visits represent opportunities for maintaining the visibility of your other services.

Retailing in an aesthetic practice entails more than a patient's choosing a product; it requires that the physician or physician extender recommend the proper product to treat or prevent skin conditions, promote healing or healthy skin, prevent or reverse the effects of aging, and encourage renewal. Today even products sold in the drugstore tout these benefits and more. If you choose to carry retail items to satisfy your patients' needs, you should not sell a product unless you can confidently say that it is effective. If it is sold in a nearby drugstore or department store, make certain you can compete for dollars before you invest in inventory.

Retail can be a vital service complement and business component in an aesthetic practice, but for staff who sell or recommend products to patients, training is critical. Designate specific personnel to staff your retail operations; in some cases they will fulfill the retail function in addition to other roles. For the retail function to succeed, you must insist on staff training in product knowledge and sales technique. Putting products on the shelf and expecting that the client will ask about them is ineffective. Practitioners must find opportunities to recommend products. Sales support staff must expand on this recommendation and further recommend complementary products.

Skin Care

Your skin care choices must not be random selections; they must offer a reliable complement to your practice and its service menu.

Critical Elements of Skin Care

Exclusivity: Products must be those that can only be purchased through a physician.

Expectation: Products you sell must provide a distinctly better or different result from that of products purchased elsewhere.

Science: The research behind the product is consistent with medical research standards, testing, and approval.

Choose products based on the quality of their ingredients, packaging, texture, smell, and ability to stay fresh. Look for unique properties, clinically proven benefits, ease of use, safety, and established brand reputation with vendor support.

Rules of Retailing

Retailing skin care or other products that support your aesthetic surgery services is not as simple as stocking the shelves. Skin care, cosmetics, and at-home mechanical or light-based devices are valuable extensions to your practice, but they cannot sell themselves, and if they are misused or misguide your patients, they tarnish your image rather than creating value. Heed these caveats for in-house retail operations, a satellite medical spa, or an e-tailing operation:

Do not sell prescription-strength products unless you have a patient record, an in-office visit, and a prescription on file for the patient.

Do not sell products you are not familiar with or would not recommend to patients to treat a specific condition.

Do highlight products by problem and solution and by product type and brand, and do list complementary and conflicting products. There is no use selling someone something that results in distress instead of solutions.

Do highlight brands. Consumers look for recognized, well-known names.

Do collect data on those who purchase products from you. You'll want to know not only what they are buying from you, but also from other sources, with what frequency, and how they choose to mix and match. Most of all, you'll want to know when they stop buying, what they stop buying, and what they are asking for that you may not presently provide.

Financial Management

Financial planning and management are essential to any practice. These involve projecting income based on goals, related direct expenses, and overhead costs. Financial management of your practice requires understanding some core elements of finance: income and expenses. Income and expense decisions all factor in managing expectations that, on the most basic level, include your business's profitability, your personal income, the income and benefits you expect to provide to your staff (which may not be the same as what they expect to receive), and the service benefits your patients expect in exchange for what they are willing to pay.

Whether you are in an established, lucrative practice or one that is just beginning and is heavily leveraged, you must comprehend and participate in your financial planning. A plan in which you project, allocate, expense, adjust, and use all of these variables to set reasonable goals is the only means to control the practice's financial operations. To keep these details up-to-date and consistent with expectations, you will need an internal bookkeeper and outside advisors who may include an accountant, a banker, and an investment professional. Although you may trust your ac-

countant to tell you whether you can afford to invest in a new piece of equipment or a new facility, it is ultimately your decision, and you must understand the basic concepts of financial management.

ASSETS Your greatest asset—aside from your surgical training, skills, and certification—is the data you have on your patients and the relationship you have with those patients. Unfortunately, it’s rare that one can put a monetary figure on this asset. Most often assets are measured as tangibles that have worth; assets in your practice equate to property, equipment, and inventory (retail, drugs, and devices), your cash on hand, and the financial investments of the practice, such as retirement plans. Property, equipment, and inventory can all be financed, and they all can serve as collateral (used as security for financing these specific items or other endeavors). Assets in general can appreciate, as a retirement account would grow with interest income in a healthy economy. They can also depreciate, both for tax purposes and in terms of true worth. Technologies often depreciate quickly as they are replaced by newer and more powerful technologies. Tangible assets and your expectations for them are clearly defined on the balance sheet. But recognize too that you must manage your intangible assets—your clients and patients, referral relationships, and your image. While these don’t carry a dollar value that you can leverage, they do carry immense value that is essential to your success. Nurture and monitor your patient flow as carefully as you monitor your tangible assets.

CASH FLOW Cash flow is the amount of money you have on hand based on the income from services and what you must spend to stay in business on a daily basis. A healthy practice makes effective use of cash so you are never out of it, but also so you don’t have large amounts of cash on hand uninvested in your practice or in other lucrative ways.

DEBT Debt comprises the total of what you owe in principal, interest, penalties, on your line of credit, on credit cards, and even in utility bills and property taxes. Debt, like financing, may be short or long term.

LEVERAGING The concept of leveraging is simple: you borrow money to fund your practice or practice growth, planning that what the business makes will cover your investment and interest. Taking it one step further, leveraging also means that the cash you generate will also be enough to fund new endeavors, technologies, procedures, practices, or facilities in the ever-advancing world of cosmetic medicine. Short-term borrowing is for things with a low cost, potentially a short life, but a high cash return. Long-term borrowing is for things with a high cost, a long life, and a predictable return. Leasing is for things with a high cost, a short life, and a predictable return.

PROJECTIONS Generally tied to your tax cycle, projections are used to forecast what you might earn and spend in operating your practice. But projecting requires more than predicting your future based on the past year's taxes, or planning for the year ahead based on the outcomes of financial reports associated with your taxes. Projections must take into account your strategic plans for growth and what you must borrow, any necessary expense consolidation, economic cycles, risks, and new trends and opportunities. Projections are a forecast based on multiple factors, including the past, your knowledge of your patient base, and long-range adjustments in overhead.

Attempting to operate a practice in which nothing is predictable, with no plan or projections, will result not only in expectations that are unachievable, but also in a business that is unmanageable. Even if you practice simply for the love of what you do, you need to stay solvent.

The Importance of Planning

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Despite our love of medicine and the challenge of surgery, operating an aesthetic surgery practice is a business, and issues of solvency, cash flow, and profitability must be addressed. You cannot operate a business that continuously loses money. Without a plan, you will likely find yourself with cash shortfalls and an inexplicable balance sheet, unable to succeed in focusing on what you do best: serving the needs of your patients.

All of this planning may seem a burden, and it is, but what is more burdensome is failing to plan and then looking for a reason to explain unmet goals. If history is documented as it is made, it is more factual, more effective, and more flexible. Fortunately, you don't have to be a financial wizard to do this, and you don't have to do it yourself. You and your partners can work together to define your tactical and fiscal goals and then work with a trusted accountant or financial advisor who can put it all together. As I have learned, the best way I can contribute to my practice is by maximizing my time providing service so the practice can succeed. Your reputation and that of your practice is built on the premise of your service, and you are an integral part of that "brand" and must help sustain it.

Tracking income and expenses is more than an accounting function—the empirical characteristic of financial matters allows you to make some important business decisions about how you practice. The accounting function also provides a basis on which to develop and revise policy, procedures, or pricing; identify losses and gains; and make valid business decisions.

Income

Income goals require that you understand how you make money, and how that money is used within your practice to pay for the items necessary to operate the business and to make your practice function. Patients will pay you by one or more of the means described next.

CASH Most staff are trustworthy and few actually steal, but the easiest thing to take without being noticed is cash. It's easy for an employee to avoid recording a transaction when a patient pays cash, or to hide cash paid for services with a low cost of treatment, such as procedures outside the operating room that need no clinical support, such as skin peels, microdermabrasion, waxing, and massage. Cash becomes an even greater liability when it is used to pay for skin care or cosmetics; if the employee pockets the money, you lose out on revenue as well as the value of your inventory. However, you cannot banish cash from your practice. Patients sometimes want to pay with cash for convenience, to avoid debt, or to avoid any trace of the transaction. If you recognize more or fewer transactions or an erratic cash flow over time, start looking for the cause.

CHECKS Personal checks are still a means of doing business, although they represent a much smaller portion of transactions today. The advantage of personal checks is that electronic banking now allows immediate deposit of funds into your account. The disadvantage is that if funds are not available in the patient's account, you will need to collect. This absorbs staff time, and it will cost you money while you wait to get paid or if you must go to collection. Establish a clear policy that fees are to be paid at the time of service and that deposits for surgery must clear days before the procedure. Define a collection policy for returned checks, or do not accept personal checks in your practice.

CREDIT AND DEBIT CARDS Convenience, rewards, travel miles, and financing are among the reasons a patient may use a credit card. These transactions add security for you as well as your customer, but they also come with a cost of doing business (fees to the credit card company).

Accepting payment by credit and debit cards is not foolproof. A too common situation, unfortunately, is that of an unhappy or debt-ridden patient who has been known to dispute charges in an effort to avoid paying. While this is in resolution, you don't get paid. With credit and debit cards, disputed charges represent a loss to your business. The easiest way to avoid disputes is to have a contract for services. But in aesthetic surgery, defining "return" procedures is not something you want to interject in managing your patient's experience. Enact security practices with credit cards: instruct your staff to discreetly pay attention to the name on the credit card, and match

signatures. Make certain all servers and connections where credit card and other personal information is stored are secure. It is naïve to think that there is no risk with credit and debit cards: identity theft is rampant, and your business may suffer if a scammer obtains your patients' personal credit card or private health care information. No matter how blameless you may be, a con artist who accesses a patient's or your private information will severely damage the patient's experience with your practice.

GIFT CERTIFICATES Selling gift certificates is big business. It allows either a non-surgical service or a specific dollar amount to be given. Laws regarding gift certificates or gift cards and their expiration vary from state to state. Never allow gift certificates to be issued for surgical procedures, and never limit gift certificates to a specific procedure—the recipient may not be interested or may not be an appropriate candidate, and as a result you will be viewed as restrictive, and the gift-giver will feel unappreciated.

PATIENT FINANCING Options in patient finance abound, and practices regularly offer financing programs to patients on high-ticket items such as surgery. But given the cost of doing business, administrative time, and fees paid, there is a value judgment to make in offering patient financing for fees in the hundreds rather than thousands of dollars. Surgeons who offer financing on relatively low-priced services are taking a big chunk out of their compensation; you should establish a minimum amount for financing. Set a limit or define a policy on when patient financing is offered and what it can be used for in your practice.

BARTER Quid pro quo is the oldest principle in business. You provide my skin care services, and I'll refer patients to you or promote your spa in my salon—there are many permutations of this. The question becomes: Does barter benefit the practice or the provider? Barter can be beneficial, because without collecting cash you are reducing taxable income. Although barter is easy, don't diminish the value of your services—barter for what they are worth. Set rules for barter so that each party is mutually benefiting, not one party benefiting at the other's expense. Proper accounting for barter is essential, or any analysis of your model will be flawed.

You must account daily for any income collected by the practice. A daily closing not only maintains balance, but also provides important tracking data. With daily closings you'll notice discrepancies sooner, such as cash transactions that are rapidly falling off. From daily closings you can chart the trend of your most productive days in procedures and product sales. From this you can also plan staffing more productively. And if you look closely, you might even determine whether busier days can

be attributed to more productive staff, or the trends in time your patients like to schedule services or make purchases.

Projecting income is essential to managing your practice. Unfortunately, although expenses can generally be detailed, budgeted, and allocated in a very defined manner, planning income is frequently overlooked and is not always easy to predict. Commonly, practices use a historical basis and apply a reasonable increase based on economic factors or projected growth to arrive at projected and budgeted income. Rarely is income budgeted and broken down in an aesthetic surgery practice as specifically as in other business segments. Why? It is not that this is unreasonable; it is just that it is not easy. You must project income based on the following:

Clinical service fees: Fees are broken down by reimbursed or insurance work, aesthetic surgery and aesthetic medicine, by service and provider. Surgery and anesthesia fees, if collected by your practice, should not be accounted with your practice's clinical service fees. These are facility and anesthesia fees, even if the anesthesiologist is an employee. Revenue generated by anesthesia is an adjunct, not direct revenue to your clinical fees.

Personal service fees: Aesthetician and other nonphysician, non-surgically generated revenue is broken down by service and by provider.

Retail: Retail income is budgeted by each brand and product.

Why is so much detail required? Before even applying direct expenses to each income line item, you will have an easy indicator of your greatest source of gross revenue. Then, once you apply direct expenses, you will have an indicator of all net revenue. Compare the two and see whether your highest gross revenue is also your highest net revenue producer. If not, you must review the direct expenses attached to that revenue producer to find out why a disparity exists. You can also use these factors to do the following:

Build growth on your greatest source of net income, your cash cows (this is easy logic).

Develop or retool those services where income and direct expense can improve (translate to cash cows).

Retool or eliminate services for which income and related direct expense result in a low net income. Retooling is valid if you can reasonably improve net income or if you cannot eliminate a service. Elimination of any service that yields a poor net income may mean a reduction of revenue, but it also allows an increase in productivity. In turn, this allows an increase in time commitment to the services that result in a better return.

In addition, budgeting income in such detail allows you to plan your direct expenses accordingly and maintain appropriate inventory.

Expenses

Expenses come in two specific streams: direct expenses and overhead. Direct expenses are relative to income. An increase in income or service may carry an increase in the expenses directly tied to providing service. For example, if you perform a breast augmentation, you will need the appropriate implants in inventory; the more breast augmentations you perform, the more implants you will need to purchase for inventory, which will increase your expenses. In a less direct equation, if you increase the income projections from personal services, such as clinical skin care, you must also account for the increase in related expenses, including all additional staff, supplies, and even the additional communication that will be necessary to grow that segment of your business. In greater detail, direct expenses include the following.

COST OF TREATMENT The cost of treatment includes single-use items for the cost of treatment such as breast or other implants, units of *Botulinum* toxin, syringes of dermal filler, and single-use packaged chemicals for peels; these are easy to allocate to each procedure performed. Technologic devices must also be considered a cost of treatment; however, how you allocate that cost is something only you can define based on the cost paid for the technology, the cost to operate it, and its depreciation.

GENERAL SUPPLIES General supplies include gauze, needles, cold packs, alcohol, gloves, and other disposables. It's difficult and time consuming to directly assign these costs to a treatment, so an estimate should be used to define a global supply cost to assign to treatments.

BACK BAR Back bar products include cleansers, volume chemicals, masques, massage oils, and skin care products used for treatments. These items cost you money and may be a source of waste or an easy target for theft, so it is essential to maintain an inventory and account for the use of all products. Either estimate a global cost to apply to each treatment, estimate a specific cost depending on the type of treatment, or include this as part of overhead, but in any case, attribute it to cosmetic medicine and keep an inventory.

COMPLIMENTARY TREATMENTS Whether testing a new treatment, providing treatments for staff, or as a thank-you or a touchup, complimentary treatments cost you something. Record this and compare what complimentary treatments cost you to the value they bring you. Complimentary treatments are an important part of demonstrating the value of treatments, creating walking billboards for treatments, testing new treatments, and showing goodwill or reward. I favor complimentary treatments far more than discounts for adding value.

DISCOUNTS Procedures must always be recorded for their full price; discounts must be recorded as an expense. You must have a measure of how much discounts truly cost your practice to determine whether they have value, such as generating increased sales.

Expenses also include what you pay providers and staff. There are multiple models of compensation, and combinations among the models.

HOURLY WAGES Wages are paid for time spent on-site, whether the individual is productively engaged in treatment or not. This is most often the least expensive model, but also the most likely to result in nonproductive time when disruptions to scheduling occur. If you pay hourly wages to providers of cosmetic medicine, make certain their job description includes duties to be undertaken when they are not actively performing treatments.

COMMISSIONS Commissions can be paid on product sales. It is unethical to pay a commission to someone who converts a patient to accept treatment. By doing so you would make a medical treatment a commodity; this is not a car, a stock sale, or a real estate transaction. Therefore you must not commission booking procedures. Higher commissions are typically paid for commission-only models; lower commissions are commonly coupled with hourly wages. Commissions can be individual or can be team based. Commissions can drive people to sell, to compete for sales, and to up-sell; that is, sell more than the patient was originally willing to buy. Carefully consider the relationship of commissions to your image and your client base and determine whether commissions create incentive and value, or pressure.

DIRECT PERCENTAGE OR SET FEES Direct percentage or set fees are more common with contractors than with employees. The provider receives a direct percentage of the revenues collected, or a set fee for specific treatments provided. Or the contractor may actually make the collections and pay you a direct percentage or a set fee.

OVERHEAD Overhead expenses are those incurred regardless of the pace of your business or income projections. These can be variable for many reasons. For instance:

Rent or mortgage is easily defined and likely unchanging in a yearly fiscal plan (unless you refinance or default on a payment and incur penalties).

Compensation of salaried employees and benefits to those employees are also easily defined and likely unchanging, although a rehire at a different compensation level or change in benefit plans could result in changes to overhead.

Insurance and utilities are easily defined and unchanging, unless you have a claim, the cost of utilities dramatically changes, or your utility consumption changes.

Taxes and interest expense are also defined as overhead, but they are not unchanging. Income changes, tax law changes, your write-offs change, the principal of your debt is paid down, you refinance, or you acquire more debt, and these all influence your overhead.

Projections and Overhead: Finding the Right Balance

FOAD NAHAI

Obviously, projections and your budget cannot always cover every contingency; there are always surprises that will be encountered in any practice. (Who could have imagined the breast implant crisis of 1992 or the recession of 2008/2009 and the impact these events had on plastic surgery practices?) However, a comprehensive set of projections taking the big picture into account will help you to weather unexpected blips in your forecasts.

Although one receptionist may be sufficient, a surgeon may choose to have an extra receptionist to provide better service and minimize telephone hold time. Similarly, a surgeon may choose to have a second nurse in the clinic to provide greater coverage when he or she is seeing patients. These extras are not essential but undoubtedly enhance the patient experience and make life easier for the surgeon. These “luxuries” come with a price, and the surgeon who is not aware of the finances of the practice can easily drive overhead to unacceptable heights. Similarly, an office-based surgicenter owned by the practice may also be looked at as a very expensive luxury. During a downturn, staff can be cut and operating rooms closed, but the tax, mortgage, or rent on the facilities remains unchanged. Although cutting staff may reduce costs, patient safety and the patient experience on which your practice has been built must not suffer.

There are countless examples of just how easily defined overhead expenses in an annual cycle can be variable, and how all of the variables tied to your business operations require a solid, detailed fiscal plan, including appropriate projections. So even though changes in direct expenses are theoretically relative to income and overhead is static, in reality, none of this is entirely predictable.

Limitations

Although few of us like to admit to limitations, we all have a maximum capacity as to what we can reasonably accomplish. Limitations include:

- Physical limitations to what you as a provider can physically accomplish
- Fiscal limitations to what you as a businessperson can economically manage
- Legal limitations defining requirements and limitations for you as a physician and businessperson

It is essential to your success and personal well-being that you recognize and accept the limiting factors that are outside your control while setting personal practice-defined limits that are within your control.

Physical Limitations

FOAD NAHAI

We all have physical limitations, even though our busy schedules would sometimes suggest otherwise. Few of us can deny the reality of what we feel after a day filled with surgery and seeing patients has concluded and we are still reviewing charts, writing chapters, preparing talks, working with PowerPoint, and planning our early-morning flight to present at a meeting in a remote location. Although it may seem glamorous, it can be exhausting.

Clearly, there are limits to what can be accomplished in any given period in providing service, managing the practice, meeting patient expectations, and fulfilling professional, educational, and organizational obligations. The goal is to expand the limits to be able to grow the practice without overtaxing your ability to manage this growth. This is best accomplished by finding other ways to add to growth and income that do not incur additional time commitments on your part and may even afford you some extra time to see more patients. These include adding support staff, adding services that expand your treatment options, hiring providers that complement your specialty (such as an aesthetician or dermatologist), and modifying facilities to provide more room for expanded services and activities.

Financial Limits

In any business there are always financial limits to consider. Even a seemingly “unlimited” cash flow has limits. Why spend something that will not generate a positive return for your practice? If your answer is merely because you want to and you have not done the groundwork to ensure that this contemplated expenditure will yield a benefit to your practice, then that purchase is not for the benefit or success of your practice; it is for your own personal benefit or pleasure.

A financial limit is simply the maximum a provider is able to or willing to spend on a given item. It is not how one overcomes financial limits that is essential to managing your practice; what influences your ability to succeed is how you approach financial limits, including allocations or adjustments of expenditures, or the demands you place on productivity or operations to maximize your return on those expenditures, and the adjustment of goals and objectives. In business there are three options for managing financial limits: borrowing, decreasing expenses, or increasing revenue.

BORROWING Will borrowing directly contribute to your success? Hardly. It will have an impact on your bottom line by requiring interest payments on debt. Although that is straightforward, borrowing will contribute to your success only if it includes well-reasoned related approaches to either decreasing expenses or increasing revenue through enhanced services, operations, image, or all of these things.

DECREASING EXPENSES How aesthetic plastic surgeons responded to the economic downturn that hit hard at the end of the past decade is proof that a practice can decrease expenses without affecting the patient experience. Decreasing expenses must be done in such a way that it does not damage outcomes. You can trim little bits all around, such as finding a more cost-effective supplier and rethinking utilities providers, insurance, or even your communications budget. The sum of a little can result in a lot of savings, but only if it does not diminish services, jeopardize the quality of care, or lead you to fall short of your goals. If you must take future steps, consider what is nonessential, or what is not fundamental to providing the services that produce your practice revenue.

Often the reaction is to find larger cuts rather than trim a little. For example, you may find a staff member or two who are paid more than the average for their positions. However, before you consider replacing one individual with someone else with a lower compensation range, consider the current employee's loyalty and the contributions he or she makes to serving the interests of patients. Can you risk the overall patient experience by bringing in an unknown person? What you reduce or what you spend must all be equated in value. If there is real value in an expense to your practice and trimming or cutting that expense will have a negative impact on your practice, you must make a value judgment. Manage your expectations with those of your patients; decreasing expenses to meet your needs, but falling short on meeting your patients' needs, may cost you far more than you ultimately could expect to save.

INCREASING REVENUE The third option for addressing financial limits is increasing revenue. Will a slight increase in fees affect services or traffic? Can productivity be enhanced to make more time for billable service, and if so, how might this affect quality of care? Can conversion or retention be improved? Can traffic be increased? What will any of these things cost to accomplish? Increasing revenue should reflect the success of your practice, but only when it is relative to the effort and expense necessary to do so, and when it does not have an impact on what your patients expect of you.

When you determine how you will approach your financial limitations, you need to adjust your goals and strategic, financial, and applied plans. Define what you will do to address and resolve your financial limitations in your strategic plan. Revise your budgets and projections accordingly. Track all that you do along the way and

the resulting impact on your practice. Unless you do this, you will not know if your approach was correct or where it may have faltered or failed you. Make adjustments and corrections, and continue to manage the situation.

Concluding Thoughts

Managing a practice is a challenging but rewarding endeavor. Effective staff management and careful fiscal planning are key to producing a well-run and profitable practice. Obviously, the surgeon's skill and reputation is the foundation of any practice, but this must be supplemented and complemented by a staff that is well trained, loyal, responsive to patient needs and expectations, and attuned to quality. With the right systems in place, a carefully thought out menu of services, a trained and responsive staff, and the appropriate fiscal controls, a practice can respond to changing trends and provide a solid platform for future growth.

Clinical Caveats

Managing expectations is key to managing your practice. Managing the patient experience comes first; but your expectations, the expectations of those you employ and even of your community, along with the very real expectations of your family all must be managed, every day. The principles, practices, and strategies of managing, staff, services, and finances are essential to managing your operation. But to truly succeed, you need to do more than simply follow the path where the aesthetic surgery and service industry meet; you must navigate that path daily, implementing these essential concepts:

- *Goals:* Short or long term, narrow or broad, you need goals. Goals for revenue are fundamental, goals for your time, your staff, efficiencies, patient satisfaction or retention, growth, continuing education, even goals for self-enrichment give you a target on which to set your sights and attain. At a minimum, pen a set of goals and review and revise them annually. At an optimum, each day define a new goal, or revisit and refine just one of the goals on your agenda.
- *Quality:* Perfection is an absolute: once you attain perfection you can only plateau, or, as the world around you moves and changes, potentially you may slide. Strive for quality—giving your best, being the best, expecting the best, and encouraging it. Quality does not always require great expense, but it does require attention to detail, care, and respect.

Continued

Clinical Caveats—cont'd

- *Consistency*: Every day is a new day, every patient a new case, every challenge a new opportunity to succeed. The variables and people within your practice are diverse. So that you do not lose site of your goals or jeopardize quality, your approach and expectations must be consistent. Define who you are, what your patients and you expect, and be unswerving in how you go about delivering your service.
- *Flexibility*: Rigid people, practices, and policies have no room to “give.” In a dynamic world, you must be flexible and sensible. However, stretching has its limits; reach too far and you risk injury. Set policies, rules, and boundaries, and within them, allow for the flexibility necessary to achieve your goals while maintaining quality and consistency.
- *Balance*: In your aesthetic practice, strive for harmony in more than the results of your surgical skill. Your practice may be the dominant force in your life, but it is not and must not be the only thing that rules your world. Find balance between your practice and your life outside your practice. Family, friends, interests, and passion for someone or something other than your patients will help you to appreciate the goals you have set for yourself, the quality exemplified within your practice, and the rewards it brings you in income and satisfaction.

Suggested Readings

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CHAPTER 8



Aesthetic Surgery and the Law

MARK GORNEY

It is unfortunate that during the lengthy process of postgraduate surgical education, the vast majority of candidates for certification by the American Board of Plastic Surgery, as well as candidates in otolaryngology, oculoplastics, and dermatology, fail to fully grasp the relationship between aesthetic surgery and psychiatry. Virtually all such candidates emerge into the clinical world filled with knowledge of the latest cutting edge techniques in their specialty, but with only the vaguest sense of the critical importance of appropriate patient selection criteria in elective surgery, the *sine qua non* of building a successful career.

The problem is further compounded by several factors. The first is the love affair between the media and the universe of beauty surgery. The barrage of publicity surrounding new techniques and procedures is inevitably accompanied by promises of improvements as dramatic as they are trouble free. The second issue is the unfortunate decision by the U.S. Federal Trade Commission, which in the late 1980s enforced an end to the traditional prohibition of advertising by physicians. This, added to the fact that aesthetic surgery presents to many practitioners the promise of hassle-free additional income, further confuses the definition of adequate surgical training qualifications and quickly adds a carnival atmosphere to the practice of aesthetic surgery.

Mental health professionals and aesthetic surgeons agree that patients who exhibit signs that suggest a variety of psychiatric diagnoses are very poor candidates for any elective surgery. But some disorders, such as body dysmorphic disorder (BDD), come in many shades of gray. This compounds the difficulty for a surgeon who is not familiar with warning signs that may seem reasonably obvious to a psychologist.

To confuse matters even more, experienced plastic surgeons can recall patients in their practices whose minimal to moderate deformities caused disproportionate patient concern, yet after a well-executed correction, they experienced positive personality and life changes.

So what should the surgeon's appropriate response be when faced with a patient who seems to have an excessive preoccupation with a very slight or imagined deformity? Learning to say "No" may sound easy, but it is far more complicated than it appears (see Chapter 1). Referral to a psychiatrist or psychologist almost always results in an angry patient who walks out and will, sooner or later, have the procedure done anyway (and will reap the consequences). The only reasonable course left to the surgeon is to learn as early in his or her career as possible to select among those shades of gray and where uncertainty exists and to rely on the counsel of more experienced plastic surgeons or psychiatric colleagues, regardless of the consequences. Failure to do so produces problems for the surgeon far beyond the value of any surgical fee. In its ultimate (but thankfully rare) form, ignoring the "red flag" warnings has cost at least five surgeons their lives in the past two decades: all were shot to death by disturbed patients dissatisfied with their results.

To those whose primary responsibility is the maintenance of the highest quality in surgical competence and to the risk managers in the professional liability world, all the continuous dramatic changes in surgical technology have added an ever-growing challenge and an increasingly heavy burden. However, none of these technologic advances should change the essential criteria for appropriate patient selection. In observing these criteria it is impossible to avoid occasional incursions into the domain of mental health professionals.

Of all medical specialists, the plastic surgeon's exposure to professional liability is unique in several respects:

1. The plastic surgeon who performs elective aesthetic surgery is not assuming the care of a sick or injured patient to make him or her well; rather, it is a matter of taking a well patient to make him or her better.
2. The patient judges the results of treatment according to standards that are entirely subjective, and often colored by the patient's self-image. The actual result may be good, but if it does not meet the patient's expectations, it may be judged a failure.

After years of practicing, teaching, and evaluating claims against plastic surgeons, I have concluded that the four most critical elements for successful plastic surgery are these:

1. Competence
2. Appropriate patient selection criteria
3. Documented disclosure
4. True informed consent

The remainder of this section will describe the plastic surgeon's obligation to the patient and review in some detail the medicolegal parameters that apply. My primary purpose is to provide an overview of the significant interface between elective aesthetic surgery and the specter of medical liability.

Legal Principles Applied to Plastic Surgery

Standard of Care

Malpractice generally means treatment that is contrary to accepted medical standards and that produces injurious results in the patient. Most medical malpractice actions are based on laws governing negligence. Thus the cause of action is usually the failure of the defendant/physician to exercise that reasonable degree of skill, learning, and care ordinarily possessed by others of the same profession in the community. Whereas in the past the term *community* was accepted geographically, it is now based on the supposition that all physicians keep up with the latest developments in

their field. Thus community is now generally interpreted as a *specialty community*; the standards are those of the specialty as a whole without regard to geographic location. This series of norms is commonly referred to as the *standard of care*.

Warranty

The law holds that by merely engaging to render treatment, a physician warrants that he or she possesses the learning and skill of the average member of that specialty and will apply that learning and skill with ordinary and reasonable care. This warranty is one of *due care*. It is legally implied; it need not be mentioned by the physician or the patient. However, the warranty is one of service, not of cure. Thus the physician does not imply that the operation will be a success, or that results will be favorable, or that he or she will not commit any medical errors not caused by lack of skill or care.

Disclosure

While attempting to define the yardstick of disclosure, the courts divide medical and surgical procedures into two categories:

1. Common procedures that carry minor or very remote serious risk (including death or serious bodily harm); for example, the administration of antibiotics
2. Procedures involving serious risks for which the physician has an affirmative duty to disclose the potential of death or serious harm and is obligated to explain in detail the complications that could possibly occur

Affirmative duty means that the physician must disclose risks on his or her own, without waiting for the patient to ask. The courts have long held that it is the patient, not the physician, who has the prerogative of determining what is in his or her best interests. Thus the surgeon is legally obligated to discuss with the patient therapeutic alternatives and their particular hazards to provide sufficient information to allow the patient to determine what is in his or her own best interest.

How much explanation and in what detail are dictated by a balance between the surgeon's feelings about the patient and the applicable legal requirements. It is simply not possible to tell patients everything without unnecessarily dissuading them from appropriate treatment. Rather, the law holds that patients must be told the most probable of known dangers and the percentage of likelihood of an adverse result. More-remote risks may be disclosed in general terms, but at the same time comparing their likelihood of occurring with everyday, unexpected events with unpleasant outcomes. Do patients have the legal right to make bad judgments because they fear a possible complication? Increasingly, the courts answer affirmatively. Once the information has been fully disclosed, that aspect of the physician's obligation has been fulfilled. The weighing of risks is usually not a medical judgment but is instead reserved for the patient.

Obviously, the most common complications should be volunteered frankly and openly, and their probability, based on the surgeon's personal experience, should also be discussed. Finally, any or all of this information is wasted unless it is documented in the patient's record. For legal purposes, if it is not in the record, it never happened!

Informing Your Patients Before They Consent

“Prudent Patient” Test

In many states the most important element in claims involving disputes over informed consent is the prudent patient test. The judge will inform the jury that there is no liability on the physician's part if a prudent person in the patient's position would have accepted the treatment had he or she been adequately informed of all significant perils. Although this concept is subject to reevaluation in hindsight, the prudent patient test becomes most meaningful where treatment is lifesaving or urgent.

The concept may also apply to simple procedures in which the danger is commonly thought to be remote. In such cases disclosure need not be extensive, and the prudent patient test will usually prevail.

Refusals

As part of medical counseling, many state laws mandate that physicians warn patients of the consequences of failing to heed medical advice by refusing treatment or diagnostic tests. Obviously, patients have a right to refuse. In such circumstances it is essential that such refusals and their consequences be carefully documented and that the surgeon verify and document that the patient understood the consequences.

Documentation is particularly important in cases involving malignancy, where rejection of tests may impair diagnosis and refusal of treatment may lead to the patient's death. It is important to date all such entries in the patient record.

If the information you present includes percentages or other specific figures that allow the patient to compare risks, be certain that your figures conform to the latest reliable data.

Consent-in-Fact and Implied Consent

What is the distinction between ordinary consent to treatment (consent-in-fact) and informed consent? Simply stated, informed consent verifies that the patient is aware of anticipated benefits as well as risks and alternatives to a given procedure, treat-

ment, or test. On the other hand, proceeding with treatment of any kind without actually obtaining consent is “unlawful touching” and may therefore be considered *battery*.

When the patient is unable to communicate rationally, as in many emergency cases, there may be a legally implied consent to treat. The implied consent in an emergency is assumed only for the duration of that emergency.

Treating Minors

Except in urgent situations, treating minors without consent from a parent, legal guardian, appropriate government agency, or court carries a high risk of legal or even criminal charges. There are statutory exceptions, such as for an emancipated adolescent or a married minor. If you regularly treat young people, you should familiarize yourself with the existing statutory provisions in your state and keep up to date.

Religious and Other Obstacles to Treatment

Occasionally you may be placed in the difficult position of being refused permission to treat or conduct diagnostic tests on the basis of a patient’s religious beliefs or personal convictions. Although grave consequences may ensue, there is little you can do in most states, beyond making an intense effort to convince the patient to undergo the tests or treatment. In some states, court intervention may be obtained. Here too, knowing the law of the state in which you practice is advisable. In all cases the informed refusal must be carefully documented.

If a patient is either a minor or incompetent (and the parent or guardian refuses treatment for the patient) and you know serious medical consequences will ensue if appropriate tests and/or treatment are not undertaken, your legal and moral obligations change. You must then resort to a court order or another appropriate governmental process in an attempt to secure surrogate consent. The participation of personal or hospital legal counsel is advisable to ensure that the legal requirements applicable in your locale are met.

The Six Elements of Informed Consent

In situations in which treatment is urgent (for example, in a patient with severe trauma), it may be needless and cruel to engage in extensive disclosure that could add to existing anxieties. However, you should inform the patient (or the closest relative or guardian) fully and completely of the treatment’s risks and consequences

and document such discussions. The following six elements of a valid informed consent fulfill what the law requires:

1. The diagnosis or suspected diagnosis
2. The nature and purpose of the proposed treatment or procedure and its anticipated benefits
3. The risks, complications, or side effects
4. The probability of success, based on the patient's condition
5. Reasonable available alternatives
6. The possible consequences if advice is not followed

In situations in which the nature of the tests or treatment is purely elective, as with cosmetic surgery, the disclosure of risks and consequences may need to be expanded. Literature available in the surgeon's office can provide additional details about the procedure. In addition, an expanded discussion should take place regarding the foreseeable risks, possible untoward consequences, or unpleasant side effects associated with the procedure. This expansion is particularly necessary if the procedure is new, experimental, especially hazardous, capable of altering sexual capacity or fertility, or *purely* for cosmetic purposes.

Documentation

Written verification of consent to diagnostic or therapeutic procedures is crucial. A simple entry of several lines might suffice, such as: "Have discussed in detail objectives, technique, and potential complications of procedure. Have also discussed location and possible appearance of scars and sources of dissatisfaction. All questions answered. Patient understands and accepts."

Also remember, however, that in an increasing number of circumstances laws now require the completion of specifically designed consent forms. Studies indicate that physicians sometimes actually *underestimate* the patient's ability to understand. If your records disclose no discussion or consent, the burden will be on you to demonstrate legally sufficient reasons for such an absence. It is a test of your good judgment of what to say to your patient and of how to say it to obtain meaningful consent without frightening the patient. No permit or form will absolve you from responsibility if there is negligence, nor can a form guarantee that you will not be sued. Permits may vary from simple to incomprehensibly detailed. Most medicolegal authorities agree that a middle ground exists.

A well-drafted informed consent document is proof that you tried to give the patient sufficient information on which to base an intelligent decision. Such a document, supported by a handwritten note and entered in the patient's medical record, is often the key to a successful malpractice defense when the issue of consent to treatment arises.

The Therapeutic Alliance

Obtaining informed consent need not be an impersonal legal requirement. When properly conducted, the process of obtaining informed consent can help establish a “therapeutic alliance” and launch or reinforce a positive physician-patient relationship. If an unfavorable outcome occurs, that relationship can be crucial to maintaining patient trust.

A patient’s usual psychological defense mechanism against uncertainty is to endow his or her physician with omniscience in the science of medicine—an aura of omnipotence. By weighing how you say something more heavily than what you say, you can turn an anxiety-ridden ritual into an effective claims-prevention mechanism. Psychology literature refers to this as the *sharing of uncertainty*. Rather than shattering a patient’s inherent trust in you by presenting an insensitive approach, your dialog should be empathetic to the patient’s particular concerns or tensions and should project believable reactions to an anxious and difficult situation.

Consider, for example, the different effects that the following two statements would have:

- “Here is a list of complications that could occur during your treatment [operation]. Please read the list and sign it.”
- “I wish I could guarantee you that there will be no problems during your treatment [operation], but that wouldn’t be realistic. Sometimes there are problems that cannot be foreseen, and I want you to know about them. Please read about the possible problems, and let’s talk about them.”

By using the second statement, you can reduce the patient’s image of you as omnipotent to that of a more realistic and imperfect human being, who is facing, and thus sharing, the same uncertainty. The implication is clear: “We—you and I—are going to cooperate in doing something to your body that we hope will make you better, but you must assume some of the responsibility.”

To allay anxiety, you may seek to reassure your patients. However, in so doing, be wary of creating unwarranted expectations or implying a guarantee. Consider the different implications of these two statements:

1. “Don’t worry about a thing. I’ve taken care of hundreds of cases like yours. You’ll do just fine.”
2. “Barring any unforeseen problems, I see no reason why you shouldn’t do very well. I’ll certainly do everything I can to help you.”

If you use the first statement and the patient does not “do fine,” he or she is likely to be angry with you. The second statement gently deflates the patient’s fantasies to realistic proportions. This statement simultaneously reassures the patient and helps him or her to accept reality.

The therapeutic objective of informed consent should be to replace some of the patient's anxiety with a sense of his or her participation with you in the procedure. Such a sense of participation strengthens the therapeutic alliance between you and your patients. Instead of seeing each other as potential adversaries if an unfavorable or less than perfect outcome results, you and your patients are drawn closer by sharing acceptance and understanding of the uncertainty of clinical practice.

Patient Selection Criteria

Contemporary plastic surgeons practicing in the United States will find it virtually impossible to end their careers unblemished by a claim of malpractice. However, well over half of these instances are preventable. Most are based either on failures of communication or patient selection criteria, not on technical faults.

Patient selection is the ultimate inexact science. It is a mixture of surgical judgment, gut feelings, personality interactions, the surgeon's ego strength, and regrettably, economic considerations. Regardless of technical ability, a surgeon who appears cold, arrogant, or insensitive is more likely to be sued than one who relates at a personal level. Obviously, a person who is warm, sensitive, naturally caring, and has a well-developed sense of humor and cordial attitude is less likely to be the target of a malpractice claim. The ability to communicate clearly is probably the most outstanding characteristic of the claims-free surgeon. Communication is the *sine qua non* of building a physician-patient relationship. Unfortunately, the ability to communicate well is a personality characteristic that cannot be readily learned in adulthood. It is an integral part of the surgeon's personality. There are, however, a number of helpful guidelines.

GREAT EXPECTATIONS There are certain patients who have an unrealistic and idealized yet vague conception of what elective aesthetic surgery is going to achieve for them. They anticipate a major change in lifestyle, with immediate recognition of their newly acquired attractiveness. These patients may have an unrealistic concept of where their surgical journey is taking them and have great difficulty in accepting the fact that any major surgical procedure carries inherent risk.

THE EXCESSIVELY DEMANDING PATIENT In general, the patient who brings photographs, drawings, and exact "architectural" specifications should be managed with great caution. Such a patient may have little comprehension that the surgeon cannot sculpt human flesh and blood as one would clay or marble. The patient must be brought to understand the realities of surgery, the vagaries of the healing process, and the margin of error that is a natural part of any elective procedure. Such patients show very little flexibility in accepting any failure on the part of the surgeon to deliver what was anticipated.

THE INDECISIVE PATIENT To the question, “Doctor, do you think I ought to have this done?” the prudent surgeon should respond, “That is a decision I cannot make for you. It is one you have to make yourself. I can tell you what I think we can achieve, but if you have any doubt whatsoever, I recommend strongly that you think about it carefully before deciding whether or not to accept the risks which I have discussed with you.” The more the decision to undergo surgery is motivated from within and not “sold,” the less likely that recriminations will follow an unfavorable result.

THE IMMATURE PATIENT An experienced surgeon should assess not only the physical maturity but also the emotional maturity of the patient. A youthful or immature patient (age has no relationship to maturity) usually has highly unrealistic expectations of what the surgery will achieve. When confronted with a mirror postoperatively, this type of patient is likely to react in disconcerting or even violent fashion if the degree of change achieved does not coincide with their preconceived notions.

THE SECRETIVE PATIENT Certain patients want to convert their surgery into a “secret” and request elaborate precautions to prevent anyone from knowing they are having surgery. Aside from the fact that such arrangements for secrecy are difficult to achieve, this tendency is a strong indication that the patient has a degree of guilt about the procedure. Thus there is a higher likelihood of subsequent dissatisfaction.

FAMILIAL DISAPPROVAL It is far more comfortable, although not essential, if the immediate family approves of the surgery being sought, particularly in the case of a minor. If there is disapproval, errors in communication or less than optimal results, this produces an automatic “See, I told you so!” reaction, which deepens the patient’s guilt as well as dissatisfaction.

PATIENTS YOU DON’T LIKE (OR WHO DON’T LIKE YOU) Regardless of the surgeon’s personality, in life there are people you simply don’t like or who don’t like you. Most experienced surgeons know within minutes of entering the examining room whether they will or will not be operating on that patient. Accepting a patient whom you basically dislike is a serious mistake. A clash of personalities, for whatever reason, is bound to affect the outcome of the case, regardless of the actual quality of the postoperative result. No matter how “interesting” such a case may appear, it is far better to decline the patient.

THE “SURGIHOLIC” A patient who has had a variety of plastic surgery procedures performed and who might be called a *surgiholic* often is attempting to compensate for a poor self-image by undergoing repeated surgeries. In addition to the implications of

such a personality pattern, the surgeon is also confronted with a more difficult anatomic situation as a result of the previous surgeries. He or she also risks unfavorable comparison with previous surgeons. Often the percentage of achievable improvement isn't worth the risk of the procedure.

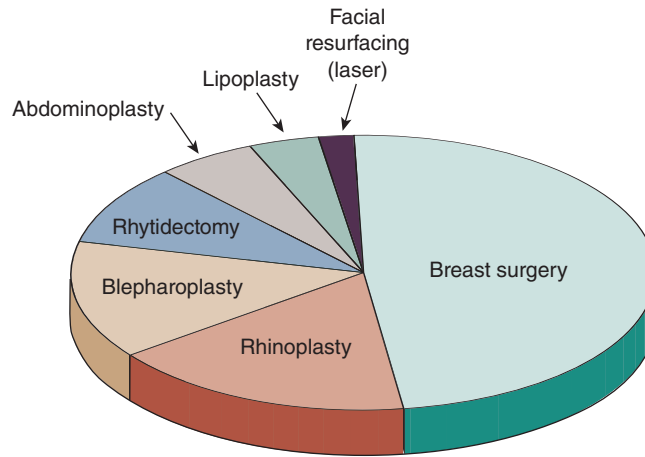
An experienced surgeon is generally aware that patients often try to conceal their true motivation for surgery. This can be a minefield for the surgeon and can result in far-reaching, unpleasant end results.

Generally speaking, there is a clear risk-benefit ratio to every surgical procedure. If the risk-benefit ratio is favorable, the surgery should probably be encouraged and has a high probability of success. If the risk-benefit ratio is unfavorable, the reverse not only applies, but also the unintended consequences of the unfavorable outcome may turn out to be disproportionate to the surgical result. The only way to avoid a debacle is to learn how to distinguish those patients whose body image and personality characteristics make them unsuitable for the surgery that they seek.

The Wheel of Misfortune: Exposures Most Likely to Generate Claims

It should come as no surprise that the overwhelming majority of malpractice claims lodged against plastic surgeons are concentrated in a handful of aesthetic surgery operations. Unlike other surgical specialists, the plastic surgeon attending a patient who seeks aesthetic improvement is not trying to make a sick patient well, but rather a well patient better. This not only places a much heavier burden of responsibility on the operating surgeon, but also subjects him or her to a much broader range of possible reasons for patient unhappiness. Sources of dissatisfaction can range from a catastrophic result to something as unpredictable as a patient's hidden emotional agenda or a simple communications failure.

Competitive pressures in the last few years have also blurred strict criteria for patient selection. As a result, it is not surprising to see a steadily upward trend in the frequency of claims against plastic surgeons. We have surveyed approximately 1000 plastic surgeons about the genesis of patient complaints across 15 years' experience. Losses from lawsuits against plastic surgeons are notable for their frequency rather than their severity (a large number of claims alleging relatively minor damages). Although severity has never characterized plastic surgery's loss experience in the past, the clear trend is toward ever-larger awards, particularly in cases in which an elective procedure has resulted in a patient's death.



Data from TDC, Napa, CA: 2009.

A pie chart shows the distribution of aesthetic surgery claims in our practice in 2009.

Scarring

Most surgeons assume the patient understands that healing involves the formation of scar. Unfortunately, this is seldom discussed in the preoperative consultation. In plastic surgery, the appearance of the resulting scar can be the major source of dissatisfaction. It is imperative that the plastic surgeon obtain from the patient clear evidence of his or her comprehension that without a scar, there is no correction and no healing. The patient must be made to understand that his or her healing qualities are as individual as hair texture or eye color; they are built into each person's genetic program. Documentation of such a conversation in the preoperative chart should go a long way toward making any resulting claim more defensible.

Breast Reduction

The genesis of dissatisfaction most often involves:

- An unsatisfactory scar
- Loss of nipple or breast skin cover requiring revision
- Asymmetry or "disfigurement"

Breast Augmentation

Litigation involving breast augmentation is even more common than with breast reduction surgeries. Approximately 44% of all elective surgery claims involve augmentation. Setting aside for the moment breast implants and autoimmune disease, the most frequent causes of dissatisfaction are:

- Encapsulation with distortion and firmness
- Wrong size (too small, too large)

Infection

The need for repeat surgeries and their attendant costs

Nerve damage with sensory loss

Face Lift and Blepharoplasty

Face lifts and blepharoplasties account for approximately 11% of all claims. The most common allegations are:

Excessive skin removal, resulting in a “starey” look

Dry eyes or the inability to close the eyes

Nerve damage, resulting in a distorted expression

Skin slough, resulting in excessive scarring and the need for revision surgery

Impaired vision

The most dreaded complication in blepharoplasty is permanent impairment of sight. A few years ago, while reviewing a series of five such cases with no evident causation, we suddenly discovered a common thread: in all five patients the operation had been conducted with a local anesthetic containing added epinephrine. All patients had been sent home with less than 60 minutes of recovery time. All had done something after returning home that caused a sudden rise in blood pressure: a sneezing fit, nausea, a constipated bowel movement. This was followed shortly thereafter by orbital pain and massive ecchymosis requiring emergency evacuation of a periorbital hematoma. These problems are difficult; some patients fully or partially regain vision. All require the attention of an ophthalmic surgeon.

Rhinoplasty and Septoplasty

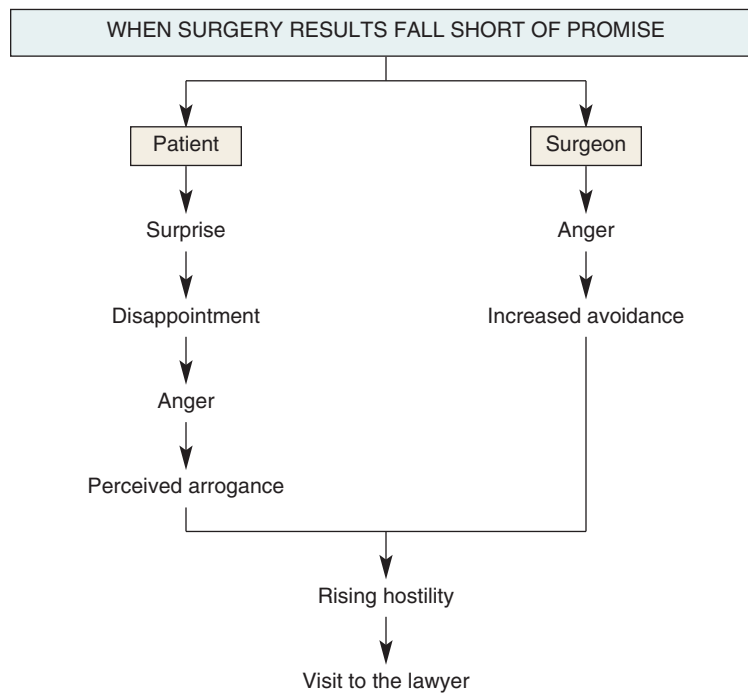
Lawsuits associated with rhinoplasty and/or septoplasty procedures constitute approximately 15% of aesthetic claims. Among the most common allegations are:

Unsatisfactory result: improper performance

Continued breathing difficulties

Asymmetry

Of all operations performed by plastic surgeons, rhinoplasty and septoplasty have the highest degree of unpredictability. The problem is greatly exacerbated by inappropriate patient selection criteria. In these claims there is almost universally a gap between the patient's expectations and the results obtained, even when the surgical outcome appears excellent. The inappropriate use of imaging devices very often causes patients to have unrealistic expectations, as does the showing of “brag books” containing only excellent results. The clear implication is: “This is the kind of work that I do, and this is what you can expect.” Unfortunately, in many cases the actual results fall short of the promise, and a cycle of dismay and disappointment is put into motion.



It is interesting to note that the incidence of dissatisfaction in rhinoplasty is more than twice as common in men as it is in women.

Abdominoplasty

Abdominoplasty with or without suction-assisted lipectomy represents approximately 3% of claims. The most common allegations are:

- Skin loss with poor scars
- Nerve damage
- Inappropriate operation
- Infection with postoperative mismanagement

There is little question that the combination of suction-assisted lipoplasty before the actual abdominoplasty has significantly increased the morbidity rate associated with this operation and doubled the number of claims in this category. Clearly, a much higher percentage of skin sloughs occur in procedures preceded by suction-assisted lipectomy.

Suction-Assisted Lipectomy

Suction-assisted lipectomy procedures, whether conventional or ultrasonic, have now become the single most requested elective aesthetic procedure in the United States. However, the rising popularity of this procedure has brought with it a host of problems. To begin with, because this is not a surgical procedure in the traditional sense, it is being performed by a wide variety of practitioners, some of them with no surgical

background or clear understanding of the surgical anatomy involved. Additionally, with the advent of “tumescent” techniques, an unseemly race has developed to see who can suction out the most fat. The net result has been a dramatic rise in severe morbidity and fatal outcomes from “high-volume” liposuction. What is high volume? It is generally agreed that anything above 5000 cc of extracted fat constitutes high volume. The extraction of this amount of fat causes profound physiologic changes, which in turn can lead to severe complications and/or fatal outcomes. Also, the infusion of large amounts of fluid with even a weak concentration of lidocaine has also resulted in a number of fatal outcomes as a result of anesthetic overdose.

To make matters worse, these procedures are often combined with other prolonged operations. Our experience clearly indicates that when a patient has been under anesthesia for more than 6 hours, undergoing multiple procedures, the percentage of complications and/or fatal outcomes rises dramatically.

The cavalier way in which this operation is sometimes performed requires rethinking, particularly when the amounts of fat extracted are significant. In a number of venues in the United States, the state medical regulatory authorities are beginning to take notice, and unless there is a significant downturn in the morbidity associated with this procedure, there will undoubtedly be some regulatory intervention.

Skin Resurfacing

Chemical peels and laser resurfacing constitute roughly 3% of lawsuits. The principle allegations are:

- Blistering/burns with significant scarring
- Infection/postoperative mismanagement
- Permanent discoloration postoperatively

Because individual healing characteristics are unpredictable, it is probably a good idea to do a “test patch” in an area that can be hidden (for example, the back of the neck). Certainly the printed information given to the patient preceding this operation should contain clear warnings that the quality of healing is linked to the individual’s genetic makeup and cannot be predicted. The operator must make it clear to the patient that final color and texture determination is not always in the hands of the surgeon, and heavy makeup may be needed for an indeterminate period.

Miscellaneous Claims

Approximately 5% of all complaints against plastic surgeons have to do with miscellaneous allegations, such as:

- Untoward reaction to medications or anesthesia
- Improper use of preoperative or postoperative photos
- Sexual misconduct (physician or employee)

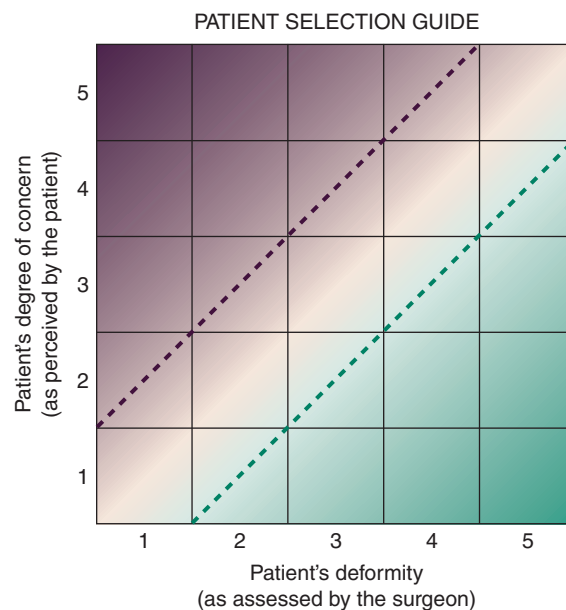
There are certain common issues among all procedures performed by plastic surgeons that are commonly not brought to the attention of the patient in preoperative consultations, yet often are the triggering mechanism for a claim. They are:

- Unexpected scarring
- Lack of adequate disclosure (tailored to the patient's level of understanding)
- General dissatisfaction: the patient's expectations were not met

Psychological and Psychiatric Aspects of Modifying Anatomy

The increasing popularity of elective aesthetic surgery makes it imperative to establish clear criteria for patient selection. Who is the “ideal” candidate for aesthetic surgery? The surgeon must differentiate between healthy and unhealthy reasons for seeking aesthetic improvement.

There are basically two categories that make the patient a poor candidate for elective aesthetic surgery. The first is anatomic unsuitability, but the second is equally important, though more subtle: psychological inadequacy. The strength of a patient's motivation is critical: it has a startlingly close relationship with the patient's satisfaction postoperatively. Furthermore, a strongly motivated patient tends to have less pain, a better postoperative course, and a significantly higher index of satisfaction.



Although these characteristics are impossible to predict with absolute accuracy, it is possible to establish some objective criteria for patient selection. These are illustrated in the graph above.

A patient's objective deformity can be depicted along the horizontal axis (as judged by the surgeon), while the degree of concern over that deformity (as perceived by the patient) can be represented on the vertical axis. Two opposite extremes emerge:

1. A patient with a major deformity but minimal concern is represented in the lower right-hand corner. This is a patient with an obvious major deformity in whom it is clear that any degree of improvement will be regarded with satisfaction.
2. A patient with a minor deformity but extreme concern is represented in the upper left-hand corner. In contrast, this is a patient with a deformity that the surgeon perceives to be minor, but who demonstrates an inordinate degree of concern and emotional turmoil. Such patients are most likely to be dissatisfied with any outcome. The anxiety expressed over the "deformity" is merely a manifestation of inner turmoil, which is better served by psychiatric care than by a surgical procedure.

Most persons who seek aesthetic surgery fit somewhere between the two. The closer the patient comes to the upper left-hand corner of the graph, the more likely that surgery will result in an unfavorably perceived outcome, and possibly involvement of a lawyer.

Effective Communication

Most litigation in plastic surgery has the common denominator of poor communication. This physician-patient relationship can be shattered by the surgeon's arrogance, hostility, coldness (real or imagined), or simply by the fact that "he or she didn't care." There are only two ways to avoid such a debacle: (1) make certain that the patient has no reason to feel that way, and (2) avoid treating a patient who is going to feel that way no matter what is done.

Although the physician's skill, reputation, and other intangible factors contribute to a patient's sense of confidence, rapport between the patient and physician is based on forthright and accurate communication. This will normally prevent the vicious cycle of disappointment, anger, and frustration by the patient, and reactive hostility, defensiveness, and arrogance from the physician, which deepens the patient's anger and ultimately may provoke a lawsuit.

Anger: A Root Cause of Malpractice Claims

Patients feel both anxious and bewildered when elective surgery does not go smoothly. The borderline between anxiety and anger is tenuous, and the conversion factor is uncertainty—fear of the unknown. A patient frightened by a postoperative complication or uncertain about the future may surmise: "If it is the doctor's fault, then the responsibility for correction falls on the doctor."

The patient's perceptions may clash with the physician's anxieties, insecurities, and wounded pride. The patient blames the physician, who in turn becomes defensive. At this delicate juncture, the physician's reaction can set in motion a chain reaction—or prevent one. The physician must put aside feelings of disappointment, anxiety, defensiveness, and hostility to understand that he or she is probably dealing with a frightened patient who is using anger to gain control of the situation.

The patient's perception that the physician understands that uncertainty, and will join with him or her to help to overcome it, may be the deciding factor in preserving the therapeutic relationship.

One of the worst errors in dealing with an angry or dissatisfied patient is to try to avoid the patient. The surgeon must actively participate in the process rather than attempting to avoid the issue.

Body Dysmorphic Disorder (BDD)

As the popularity of aesthetic surgery increases, one is reminded of the fairy tale in which it is asked: "Mirror, mirror, on the wall, who's the fairest of them all?" The number of patients finding comfort and solace in multiple elective surgical procedures is growing. Beyond the unrealistic expectations of aesthetic correction, many patients seek surgery when the need for it is dubious at best. The physical change sought through surgery is usually more a manifestation of the patient's flawed body image or preoccupation with a perceived flaw than of a measurable deviation from physical normality. Beware of the patient showing a pathologic preoccupation about a physical trait that may be within normal limits or so insignificant as to be barely noticeable, but that to the patient has become a consuming obsession.

The trend toward vigorous advertising and marketing of cosmetic surgery continues to grow worldwide, and in such a climate there is a greater probability that individuals with BDD will eventually opt for the surgeon's scalpel rather than a psychiatrist's consultation as an answer to their perceived problem. Increasingly, we see traditional surgical judgment replaced either by financial considerations or plain ego on the part of the surgeon.

Furthermore, it is easy for a well-meaning surgeon to be deceived about a patient's pathologic motivation. Because patients with BDD may not be identified as such in initial consultation with the plastic surgeon, medical disputes about the surgical outcome depend entirely on what was said versus what was understood. For this reason accurate, detailed documentation is absolutely essential.

In the best of all possible worlds, the prospective patient would project from the mind onto a screen exactly the changes he or she conceives so the surgeon could decide whether he or she can translate that image into reality. Lamentably, we have not yet achieved such imaginary technology.

It is also conceivable that the physical deformity really is at the center of the patient's psychological fragility. There are many examples of beneficial change wrought through successful aesthetic corrective surgery. Nonetheless, statistically the odds for an unfavorable result and a claim are much greater when the comparison between the objective deformity and the distress it creates in the patient is out of proportion. The surgeon must assess for appropriate psychological balance in early interviews with the patient and to lean strongly away from surgery in a patient for whom there is doubt of such balance.

At a time of large-scale changes in health care delivery in the United States, certain socioeconomic factors also come into play. With the rising number of practitioners in many specialties, competitive pressures affect patient selection criteria. There is a trend toward substitution of economic considerations for surgical judgment. Because of recent constrictions on medical incomes, some practitioners seem to see elective aesthetic surgery as the last area of practice unencumbered by either insurance or governmental restrictions. This has attracted individuals with inadequate qualifications. Even within the ranks of board-certified plastic surgeons, the trend toward aggressive marketing of services and the need to "sell" surgery has further blurred patient selection criteria.

Concluding Thoughts

It is possible to reduce the likelihood of all these unpleasant experiences by application of simple principles: maintaining good communication and rapport with the patient through good times and bad; restricting your practice to those procedures with which you feel thoroughly comfortable; close and careful attention to documentation of your activities; and above all, the realization that a normal temperature and a valid credit card by themselves are very poor criteria for elective aesthetic surgery.

Clinical Caveats

The four most critical elements for successful plastic surgery are competence, appropriate patient selection criteria, documented disclosure, and true informed consent.

The surgeon should rely on the counsel of more experienced plastic surgeons or psychiatric colleagues when uncertainty exists in patient selection.

The plastic surgeon's exposure to professional liability is unique in that he or she is treating a well patient to make him or her better (not assuming the care of a sick or injured patient to make him or her well), and the patient judges the results of treatment according to subjective standards, often colored by the patient's self-image.

By weighing how he says something more heavily than what he says, a surgeon can reduce the patient's image of him as omnipotent to that of a more realistic and imperfect human being, who is facing, and thus sharing, the same uncertainty.

The ability to communicate clearly is probably the most outstanding characteristic of the claims-free surgeon; communication is the sine qua non of building a physician-patient relationship.

Anatomic unsuitability and psychological inadequacy make a patient a poor candidate for elective aesthetic surgery. A strongly motivated patient will tend to have less pain, a better postoperative course, and a significantly higher index of satisfaction.

Suggested Readings

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PART III

NONSURGICAL COSMETIC TREATMENTS



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CHAPTER 9



Clinical Decision-Making for Nonsurgical Cosmetic Treatments

FOAD NAHAI

In today's fast-paced life, our patients want to look their best yet may not have the time to recover from open surgical procedures. Ubiquitous media and advertising claims promise that they can undergo facial rejuvenation during their lunch hour, or even invasive surgical procedures from which they can recover in only 48 hours. With the emphasis on a youthful facial appearance and an appealing, slim figure, much younger patients are consulting us about facial rejuvenation and body contouring.

We can choose from an array of nonsurgical treatments that for some patients come close to fulfilling the requirement of minimal treatment time with almost immediate recovery. We refer to these procedures as *cosmetic treatments*. In fact, any procedure that can be offered without a skin incision falls into this category. We further divide these procedures into those which are truly noninvasive (no skin penetration) and those in which a needle or laser penetrates the skin. This is an important distinction, because in my opinion, truly noninvasive procedures such as facials, light peels, and microdermabrasion can be safely performed by a trained aesthetician even in a nonclinical setting. More-invasive procedures, such as injections of toxins and fillers, and invasive laser treatments should be performed in a clinical setting, such as a physician's office or outpatient center, rather than at a spa or beauty salon. Some patients may simply faint at the sight of a needle, and very rarely, there may be an immediate allergic reaction to the material; these eventualities are easily dealt with in a medical environment. Although injectable toxins are safe in the hands of trained nurses and physician assistants, a physician should evaluate the patient, make decisions concerning treatment, and be available on the premises when a nurse or physician assistant is injecting toxins or fillers.

These treatments may be the primary treatment or an adjunct to open surgical procedures. In general, they are the primary treatment for a younger patient with early facial aging and an adjunct for an older patient who has already undergone facial rejuvenation procedures.

These procedures are also "practice builders." The young patient who today is undergoing microdermabrasion, toxin treatments, and filler injections will be tomorrow's face-lift patient. Research has shown that patients who are satisfied with their cosmetic treatments are likely to return to the same surgeon for surgical procedures as the aging process continues. It is a rare aesthetic practice that does not offer the full range of cosmetic treatments.

Cosmetic Treatments

Noninvasive	Minimally Invasive	Moderately Invasive
Spa treatments	Light-based treatments	Injectables
Facials	Microdermabrasion	Ablative lasers
External ultrasonography	Fruit acid peels	Peels: TCA, croton oil
	Nonablative lasers	Dermabrasion
	Sclerotherapy	
	Transcutaneous skin tightening	

Options for cosmetic treatments are constantly increasing. New and improved fillers and new toxins are regularly being introduced. An array of nonsurgical transcutaneous skin-tightening devices is under development or in early trials. Lasers continue to evolve, with noninvasive lasers that now can produce noticeable skin tightening. This rapid growth and innovation will inevitably lead to significant improvements in the materials and devices available today, and some of the devices and injectables of today may well be obsolete tomorrow. The first filler that I had any experience with was bovine collagen; it has been at least 10 or more years since I last injected it. It is important that those of us who inject these materials and operate the devices or supervise their use be familiar with the associated physics, mode of action, safety limits, risks, and limitations.

Most of these treatments have proved safe and efficacious, yet we must guard against excessive claims and clearly explain the limitations. Obviously, microdermabrasion is not a substitute for laser ablation or dermabrasion in a patient who has deep facial rhytids. Transcutaneous skin tightening is not a substitute for a face lift. A common reason for patient dissatisfaction with these cosmetic treatments is that the effectiveness of the treatment falls well short of the patient's expectations. Although I refer to these treatments as practice builders, exaggerated claims of their effectiveness, such as marketing them as a substitute for a face lift, will backfire and lead to loss of the physician's credibility.

Choosing the Right Option: The Needle and the Knife



In the first edition of this book, this section was entitled “Choosing the Right Option: The Needle *or* the Knife.” It is no longer a question of needle or knife; these are not competing but complementary treatment methods. We now have enough experience with injectables to know which patients are best suited for them, whose best interests would be served by the knife, and in which patients we can delay a surgical procedure by offering injectables. Before choosing the appropriate nonsurgical or cosmetic option, the patient and surgeon should make the fundamental decision together concerning surgical or nonsurgical treatment or a combination of the two. I like to think of this as the option between the needle and the knife. Many patients have already made their decision before the initial consultation, regardless of the suitability of needle or knife. It’s not unusual for young people who are nowhere near ready for a face lift to come in to discuss a face lift, while individuals with advanced facial aging who are no longer candidates for cosmetic treatments frequently ask for nonsurgical treatments. To most of the younger patients I recommend skin care, light peels, toxin, and injectables, if needed, while strongly advising patients to wait for the appropriate time to undergo a surgical procedure. To an older patient who is a candidate for surgical rejuvenation but comes in to discuss cosmetic treatments, I recommend surgical treatment as the first choice and discuss cosmetic treatments as a less effective alternative and perhaps a better adjunct to a surgical procedure rather than the primary treatment.

The choice between cosmetic treatments and open surgical procedures should be an informed decision. The patient must clearly understand that the effects of most cosmetic treatments are temporary and repeat procedures will be required. *An exception is injection of autologous fat as a filler, which I consider a surgical procedure requiring anesthesia and an operating room.* There is also a limit to the degree of rejuvenation offered by cosmetic treatments, and the patient must fully understand that these treatments are not a substitute for surgical rejuvenation.



This 55-year-old woman was a candidate for a full face and neck lift, blepharoplasty, and resurfacing. She fully realized that this was her best option, but her lifestyle and professional commitments would not allow her to put aside the time required to recover from full facial aesthetic surgery. Instead, she opted for toxin injections to the forehead and glabellar area and Restylane injections for the nasolabial folds and perioral areas. Clearly, a face lift and resurfacing would have produced a much more dramatic rejuvenation; however, the patient is satisfied with this suboptimal but modest improvement, which fits into her lifestyle.



This middle-aged woman realized that her best treatment option was surgical but chose less-invasive procedures. She underwent autologous fat grafting to fill the nasolabial folds, erbium:YAG laser resurfacing of the perioral area and lower lids, and toxin injections to the forehead and glabella. Her brow asymmetry is less noticeable following toxin injections.

Face

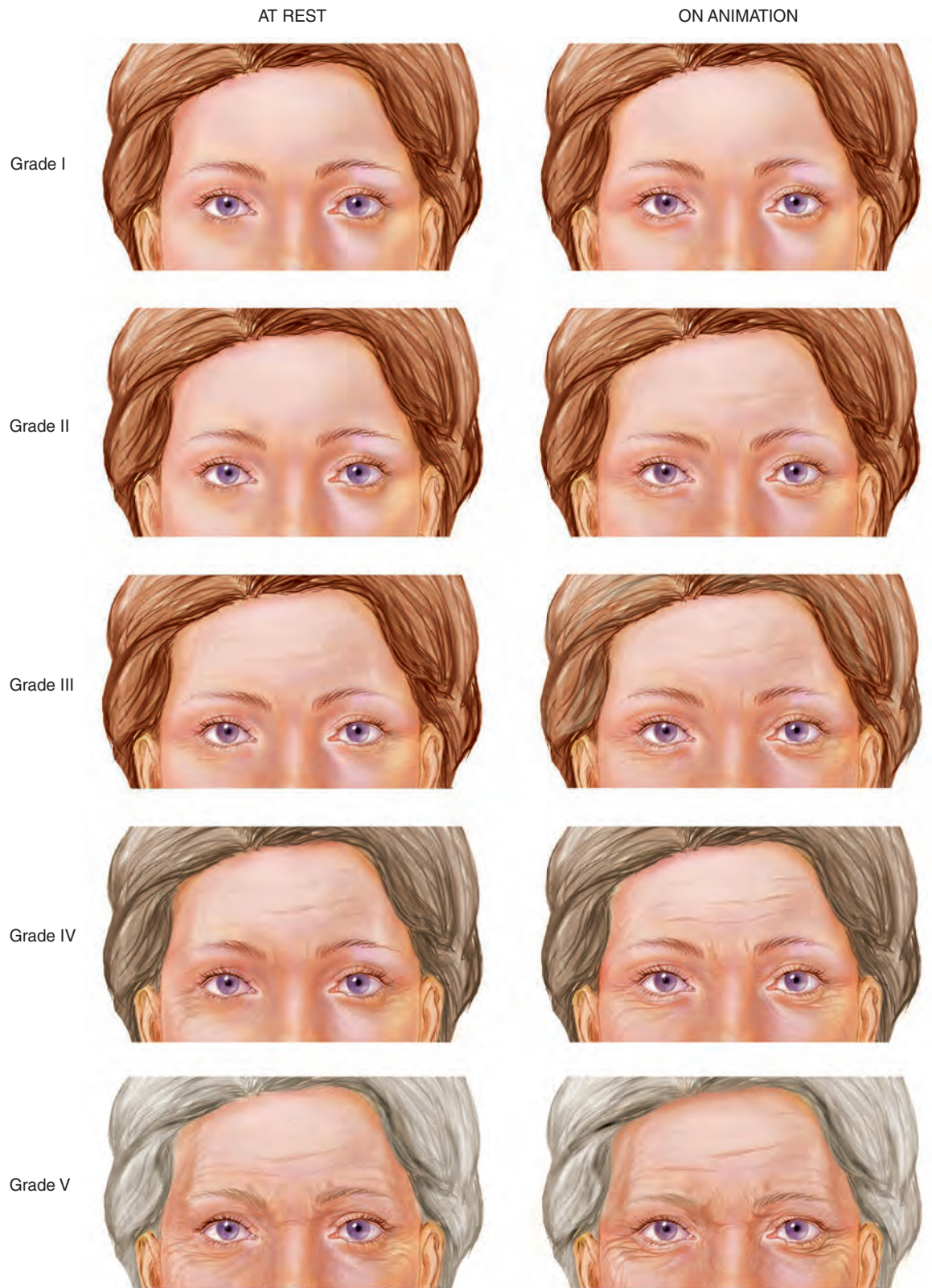
Most women undergoing noninvasive facial cosmetic treatments are seeking improvement of facial rhytids. I evaluate their rhytids at rest and on animation, we grade the rhytids by severity, depth, and extent of the problem, then we make recommendations. In addition, some patients also want improvement of skin blemishes, texture, and color. More and more younger women are seeking preventive maintenance. For them we recommend skin care, including tretinoin, and a general antiaging and nutritional program. Once our aesthetician and I have evaluated the patient’s skin and rhytids, we then classify the patient according to the rhytids, whether present at rest or on animation, and the depth of the rhytids.

Classification of Rhytids

Grade I	No rhytids at rest or on animation
Grade II	Superficial rhytids on animation only
Grade III	Deep rhytids on animation only
Grade IV	Superficial rhytids at rest, deep on animation
Grade V	Deep rhytids at rest, deeper on animation

GRADE I: NO RHYTIDS AT REST OR ON ANIMATION Grade I patients require only preventive and maintenance skin care. I advise them that it is too early for any surgical or invasive procedures and that their best interests would be served by preventive measures, including tretinoin and glycolic acid peels, if needed, but most of all we discuss skin health: avoiding environmental toxins, such as smoking and second-hand smoke, and taking precautions about sun exposure. Patients are also advised on general antiaging measures, including diet, exercise, and the use of antioxidants. We encourage these patients to come in for biannual follow-up visits. Once their facial aging proceeds to the next grade, the treatment plan is adjusted accordingly. Patients should understand that these preventive measures will not eliminate the aging of their skin and at best will delay visible signs.

GRADE II: SUPERFICIAL RHYTIDS ONLY ON ANIMATION For each successive grade, I recommend most if not all of the treatments of the preceding grade plus specific treatments for the current grade. Toxin injection is without question my first choice for this grade. By eliminating muscle function, especially in the glabella, forehead, and crow’s-feet, the lines are eliminated and the brow shape and position are improved. I would not recommend toxin injections for perioral lines at this grade. Toxin injections combined with the treatments outlined for grade I complete the recommendations.



GRADE III: DEEP RHYTIDS ON ANIMATION In grade III patients, for the glabella, forehead, and crow's-feet, toxins again are my first choice and by far the most effective treatment. However, toxin injections alone will not eliminate the rhytids but merely soften them in this grade. With these patients I discuss one of these additional options:

Deep peels such as trichloroacetic acid (TCA) (30% and higher)

Ablative lasers

Dermabrasion

Fillers of small molecular size, such as Restylane (Fine Lines)

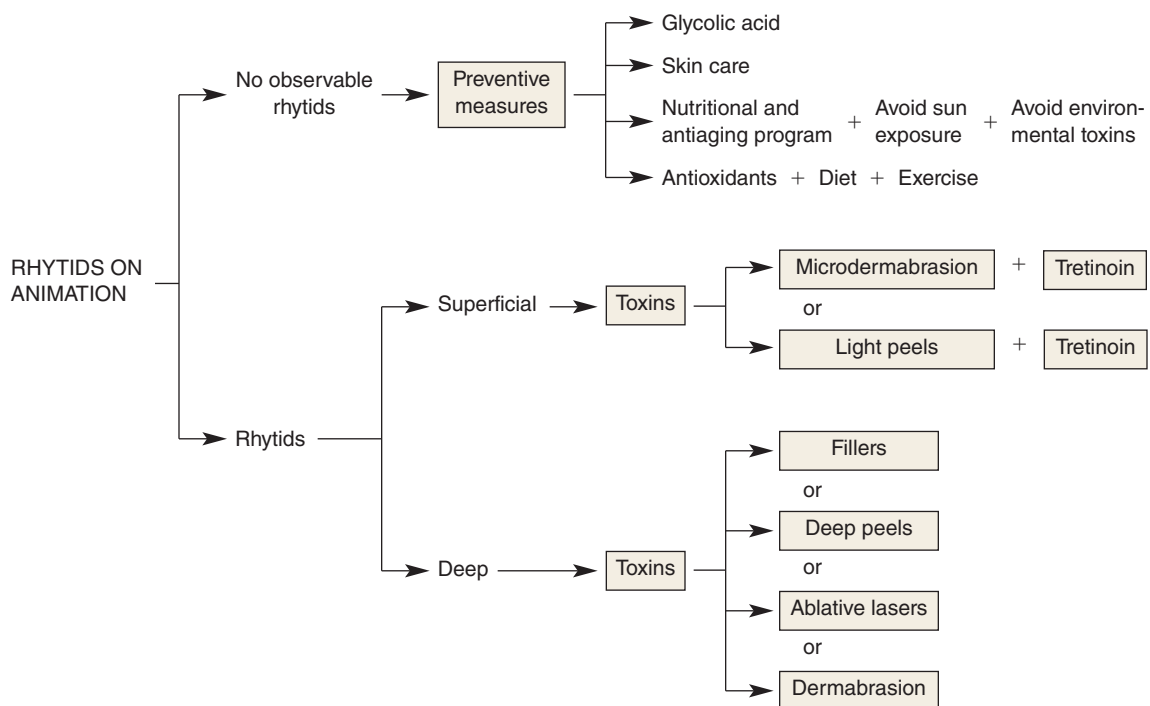
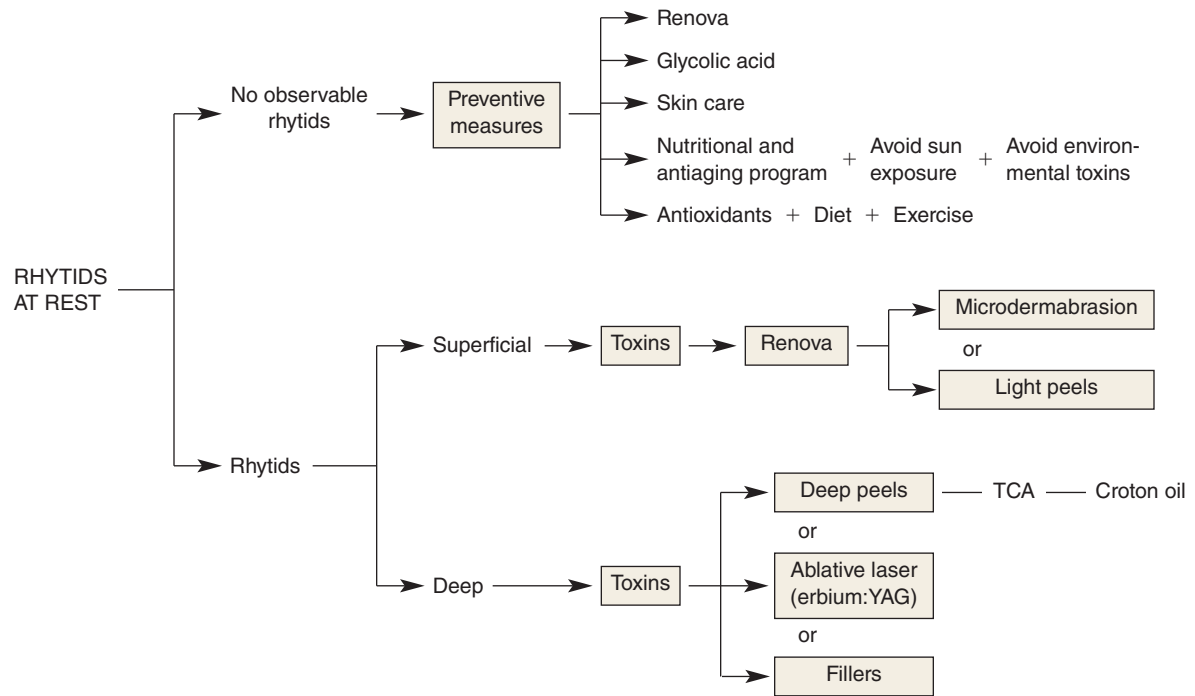
For perioral lines and wrinkles, careful toxin injections may be considered in addition to the previously cited options.

I have found that most women will choose fillers rather than peels, lasers, or dermabrasion for their convenience, despite my caution that fillers are only a temporary solution. Most women are accustomed to the routine of regular beauty salon appointments for haircuts or coloring, so they don't necessarily find return visits to the cosmetic surgeon for touch-ups (which is required for toxin injections) to be objectionable. It further indicates that our patients would rather come back for repeat filler treatments than face the 10 days to 3 weeks of down time following ablative laser, peels, or dermabrasion.

GRADE IV: SUPERFICIAL RHYTIDS AT REST AND DEEP ON ANIMATION The recommendations for grade IV patients are essentially the same as those for grade III patients. However, any ablative procedures (lasers, peels, dermabrasion) will have to penetrate the skin more deeply. Not only will a larger volume of filler be required, but also injections will have to be performed at a deeper level.

GRADE V: DEEP RHYTIDS AT REST AND DEEPER ON ANIMATION Grade V patients are the best candidates for perioral administration of toxins, but as in grades III and IV, toxins alone is not sufficient. At this grade I may recommend a brow lift and a face lift if the rhytids extend beyond the perioral and periorbital areas, especially if severe rhytids are associated with loss of skin elasticity and the shifting of subcutaneous components. I also warn grade V patients that they may require retreatment of ablative laser therapy, dermabrasion, and peels within 6 months to 1 year of the initial treatment.

TREATMENT OPTIONS FOR RHYTIDS



Nasolabial Folds and Marionette Grooves

A number of patients consider deep nasolabial folds to be a sign of aging and seek consultation for improvement of their folds and grooves only. They feel that deep, overhanging folds make them appear to be frowning, angry, or unhappy. Although most of these patients would be best served through a combination of rhytidectomy and local treatments to improve on the folds, they often opt for local treatments only.

Unlike facial rhytids, which reflect the insertion of the muscles of facial expression into the skin, nasolabial folds and marionette grooves reflect not only muscle insertion and muscle pull but also adhesions of the dermis to the fascial layers of the face. Established nasolabial folds and marionette grooves are resistant to superficial and even deep ablative skin procedures. However, muscular manipulation with toxins and superficial and deep injections of filler materials can be very effective in ameliorating these folds. The deeper the fold, the deeper the level of injection and the more viscous the material. In addition to dermal and subdermal injections, filler materials may also be placed within the subcutaneous tissues. Many surgical options are also available, including various rhytidectomy procedures, as well as local excisions. Recommendations are made based on the grading of the folds.

Classification of Nasolabial Folds and Marionette Grooves

Grade I	Visible folds on animation
Grade II	Visible folds at rest
Grade III	Visible folds at rest and deepening of folds on animation
Grade IV	Deep folds at rest and deeper on animation
Grade V	Overhanging folds

GRADE I: VISIBLE FOLDS ON ANIMATION The first line of treatment for these patients is the use of filler material, injected superficially in the dermis. The choices include Restylane (especially Restylane Fine Lines), Juvéderm Ultra, and porcine collagen. Semipermanent fillers such as Radiesse are best avoided in the superficial plane.

GRADE II: VISIBLE FOLDS AT REST For grade II patients, treatment is similar to that for grade I patients, with injections in the superficial and deep levels. At this grade, patients may also be candidates for toxin injections.



GRADE III: VISIBLE FOLDS AT REST AND DEEPENING OF FOLDS ON ANIMATION

Grade III patients will require deep injection of filler material. The best filler in this area is autologous fat. Recommended fillers include, in order of preference, autologous fat, Restylane, Radiesse, and Juvéderm Ultra Plus.

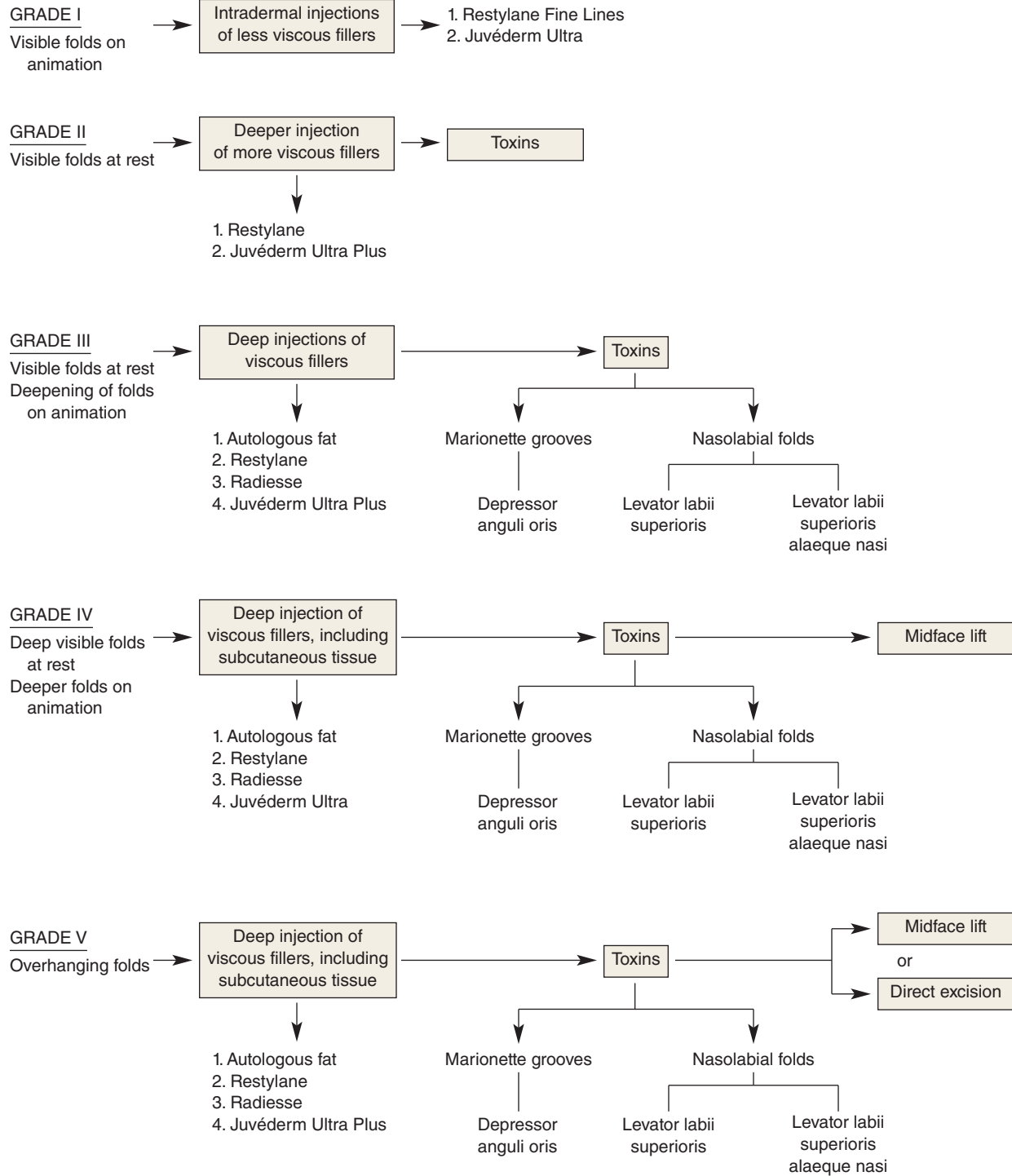
In addition to filler materials, toxins are effective in treating patients of this grade. Toxin injections of the depressor anguli oris for the marionette grooves and the levator labii superioris and the levator labii superioris alaeque nasi for the nasolabial folds.

Although autologous fat is the best filler at this grade, most patients opt for the other fillers rather than go through the more extensive procedure and recovery associated with structural fat grafting. They opt for a less permanent result in favor of expediency.

GRADE IV: DEEP FOLDS AT REST AND DEEPER ON ANIMATION The recommendations are essentially the same for grade IV as for grade III, plus the option of surgical intervention: specifically, a midface lift in addition to autologous fat injection.

GRADE V: OVERHANGING FOLDS The recommendations of filler injections and toxin remain the same for this grade. As far as surgical interventions, I add the option of direct excision as an alternative to a midface lift. Should the patient choose to undergo a midface lift, the direct placement of autologous dermis fat graft or SMAS fat graft is an alternative to autologous fat injections. Most individuals in grades IV and V are more suitable candidates for rhytidectomy procedures, with injectable fillers as an adjunct.

TREATMENT OPTIONS FOR NASOLABIAL FOLDS AND MARIONETTE GROOVES



Periorbital Region

Although toxins are established as the treatment of choice for crow's-feet and periorbital wrinkling, fillers are rapidly gaining in popularity for rejuvenation of the periorbital area. The nonanimal synthetic hyaluronic acids (NASHAs) have an established role in the treatment of tear troughs and are being popularized for additional volume to the upper lid and brow. Some physicians think that fillers and fat are the preferred treatment for volume restoration in the periorbital area, obviating the need for extensive and complex surgical procedures. Care should be exercised when injecting fillers into the tear-trough area. The tissues are thin, and superficial injection may lead to the bluish discoloration referred to as the *Tyndall effect*.

Neck

Light- and medium-depth peels as well as judicious laser resurfacing play a role in rejuvenation of the neck, not only as a primary treatment but also as an adjunct after face lifts and neck lifts. Toxin also has a role in the temporary amelioration of platysma bands. In my practice I limit the treatment of the neck to light peels and toxin injection, because these are effective and relatively risk free. Ablative lasers and other more-invasive skin-rejuvenative procedures carry a great risk of scarring and unfavorable results in the neck.

Body

A number of patients are evaluated for skin changes on the exposed areas of the chest and upper extremity. These patients are candidates for skin rejuvenation. We offer them *body peels* (light glycolic acid peels), bleaching agents, and intense pulsed light (IPL) treatment of areas of dyschromia.

Skin-tightening devices have been advocated for the improvement of stretched, inelastic abdominal skin, and striae in particular. Improvements have been limited, and this treatment would not be an alternative to skin excision.

Hands

Injection of autologous fat into the dorsum of the aging hand is now an established and effective treatment. In addition, fillers have also been shown to rejuvenate the aging hand. Sclerotherapy of prominent dorsal hand veins is also beneficial.

Patient Example

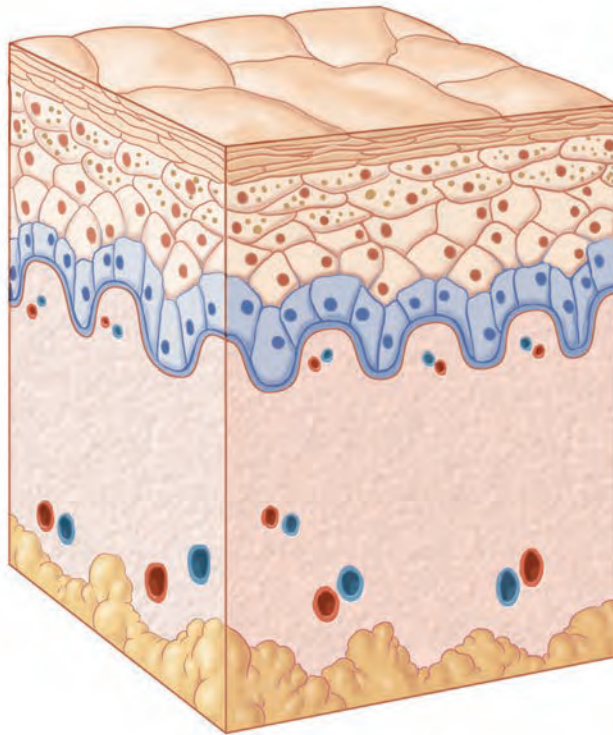


This patient demonstrates lateral brow ptosis, glabellar and transverse forehead lines at rest, periorbital aging with tear-trough deformity, and deepening of her nasolabial folds, marionette grooves, and early jowls. She has had toxin injections to the crow's-feet, glabella and forehead, and the depressor anguli oris and mentalis muscles. NASHA fillers were injected into the lower eyelids, nasolabial folds, marionette grooves, and along the jawline to minimize the jowls. Her only surgical procedure was excision of the mole on the right side of her chin. The effectiveness of this nonsurgical treatment is clearly demonstrated on the split view.

Concluding Thoughts

Noninvasive treatments for facial rejuvenation have become the most popular of all cosmetic procedures, with toxins being by far the most common cosmetic treatment worldwide. Our choice of fillers has expanded so that we can pick and choose the appropriate filler for a given area. The role of injectables has now gone beyond facial rejuvenation and will continue to expand. Injectables have proved safe, effective, and popular with surgeons and patients alike. The search continues for other modalities of treatment that have the same attributes. Cosmetic treatments are not a substitute for surgical facial rejuvenation but are relatively effective stopgap measures that will allow most patients to postpone full surgical rejuvenation until a face lift is really needed or the patient has time to go through the recovery of a face lift. For all cosmetic surgeons, this remains a growth area and an opportunity to attract tomorrow's face-lift patient today. It is also a way to offer patients a full range of options to better meet their needs.

CHAPTER 10



Skin Care and Dermatologic Treatments

INJA BOGDAN ALLEMANN, DAVID J. GOLDBERG

Skin care and dermatologic treatments comprise a range of measures that are applicable to every person, regardless of his or her skin type, age, or underlying problem.

The seven basic goals of skin care are:

- 1. Cleansing
- 2. Protecting
- 3. Moisturizing
- 4. Preventing skin aging
- 5. Slowing the effects of aging
- 6. Reversing the effects of aging
- 7. Treating specific problems

Cleansing is a simple but important aspect of skin care. The skin must be cleansed and protected from harmful exogenous factors and influences. Because the skin is the outermost organ in direct contact with as well as a barrier against the environment, it is also the area in which the aging processes are most clearly seen. Consequently, skin care should also focus on preventing and slowing, or ideally even reversing the visible aging processes of the skin. Finally, dermatologic skin care treatments should address specific skin problems, such as erythema, pruritus, and inflammation.

This chapter focuses on skin care for the healthy individual who seeks medical advice for cosmetic and aesthetic problems. In addition to basic skin care, it will discuss more specific skin care needs that physicians may encounter regularly when treating cosmetic patients.

It presents a logical approach to skin care with a specific focus on protection, prevention, and reversal of cutaneous aging. There are three basic categories to consider when defining a skin care regimen: primary prevention, secondary prevention, and tertiary measures.

Approach to Antiaging Skin Care	
Primary prevention	Measures undertaken before any signs of skin aging or aesthetically bothersome skin changes have developed
Secondary prevention	Measures undertaken when signs of skin aging, such as fine lines and pigment alterations, begin to develop and are visible
Tertiary measures	Measures undertaken to target already progressively aged skin, with clear wrinkles and folds, volume loss, pigment irregularities, or obvious aesthetically disturbing skin changes

Patient Profiles

Following are examples of typical candidates for each category of care.



PRIMARY PREVENTION This 26-year-old patient with no signs of skin aging is a candidate for primary prevention.

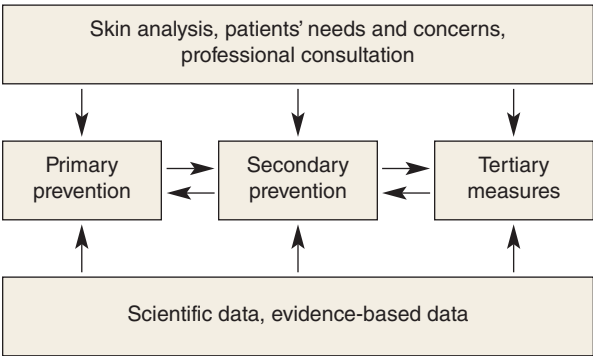


PRIMARY AND SECONDARY PREVENTION This 37-year-old patient has the beginning signs of skin aging, such as fine lines and slight pigment alterations. She is a candidate for primary and secondary prevention.



PRIMARY, SECONDARY, AND TERTIARY CARE This 46-year-old patient has clear signs of skin aging, with medium-depth wrinkles and folds and the beginnings of volume loss and pigment irregularities. She is a candidate for primary and secondary prevention as well as tertiary measures.

Patients’ dermatologic characteristics and their needs and concerns are the central factors directly influencing what treatments should be suggested. Scientific and evidence-based data provide a sound basis for skin care and therapeutic measures.



Although the division of treatments into three categories is somewhat arbitrary, such an approach helps to organize patient needs in a structured way. These approaches should not be regarded as exhaustive and exclusive; they leave room for personal interpretation. The table shows the approach we use.

Approach to Skin Care and Dermatologic Treatments		
Primary Prevention	Secondary Prevention	Tertiary Measures
UV protection	Topical retinoids	Topical retinoids
Smoking cessation	<i>Botulinum</i> toxin	<i>Botulinum</i> toxin
Weight reduction	Fillers	Chemical peels
Healthy nutrition	Antioxidants	Fillers
Regular sports activities	Antiinflammatory agents	IPL laser
Minimal stress	Depigmenting agents	Fractional resurfacing
Topical retinoids	Nutritional supplements	Hair transplantation
<i>Botulinum</i> toxin	Vitamins	Blepharoplasty
Antioxidants	Coenzyme Q10	Face lift
Nutritional supplements	Minoxidil	
	Finasterid	

IPL, Intense pulsed light; UV, ultraviolet.

As can be seen, many of the treatments are listed in more than one category. A good example of this is the treatment of dynamic rhytids with injections of *botulinum* toxin. *Botulinum* toxin ideally prevents the formation of dynamic wrinkles and should thus theoretically be used before wrinkles even appear—hence as a primary preventive measure. One could argue, however, that *botulinum* toxin treats already formed dynamic wrinkles and should thus be employed as a secondary measure. In our opinion, treatment with *botulinum* toxin belongs in all three categories.

Skin Aging

The visible aging process of the skin starts sometime between the twentieth and thirtieth year of life and progresses gradually. Consequently, while still young, individuals need to focus on preserving the youthful qualities of their skin. The older the patient, the more that skin care should focus on slowing down, preventing, or even reversing the skin's aging process. The aging process has some unique characteristics for the skin that differ from those seen in other body organs.

Intrinsic and Extrinsic Skin Aging

There are two distinct processes of skin aging: intrinsic and extrinsic; these must be differentiated. *Intrinsic aging* is the process determined by our genetic predisposition, by the naturally and constantly occurring oxidative metabolism within our cells, and by cellular senescence, characterized by telomere shortening. Consequently, intrinsic aging takes place on the entire skin, progresses chronologically with age, and can probably not be prevented or influenced. In contrast, *extrinsic aging* is driven by exogenous factors, primarily by exposure to ultraviolet (UV) light, but also by such factors as nicotine use, air pollution, stress, and microorganisms. Thus extrinsic aging is not universal but takes place on exposed areas, such as the face, neck, back of the hands, and forearms. Extrinsic aging progresses at an individual pace, depending on the patient's exposure to the various damaging factors, and is consequently preventable to some degree, or at least influenceable. Historically, intrinsic and extrinsic processes were regarded as separate entities. However, newer data show that they share common molecular mechanisms. The two occur in parallel and lead to cumulative changes to the structure of the skin, its function, and appearance.

Causes of Intrinsic and Extrinsic Skin Aging

Intrinsic Aging	Extrinsic Aging
Genetic predisposition	UV light
Oxidative metabolism	Nicotine
Cellular senescence	Air pollution
	Microorganisms

UV, Ultraviolet.

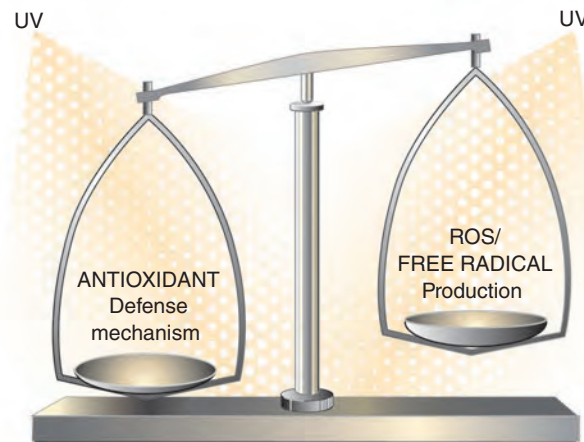
Features of Intrinsic and Extrinsic Skin Aging

Intrinsic Aging	Extrinsic Aging
Chronologic	Individual
Entire skin	Exposed skin
Most probably not influenceable	Influenceable
Physiologic	Pathologic

Oxidative Stress and Reactive Oxygen Species

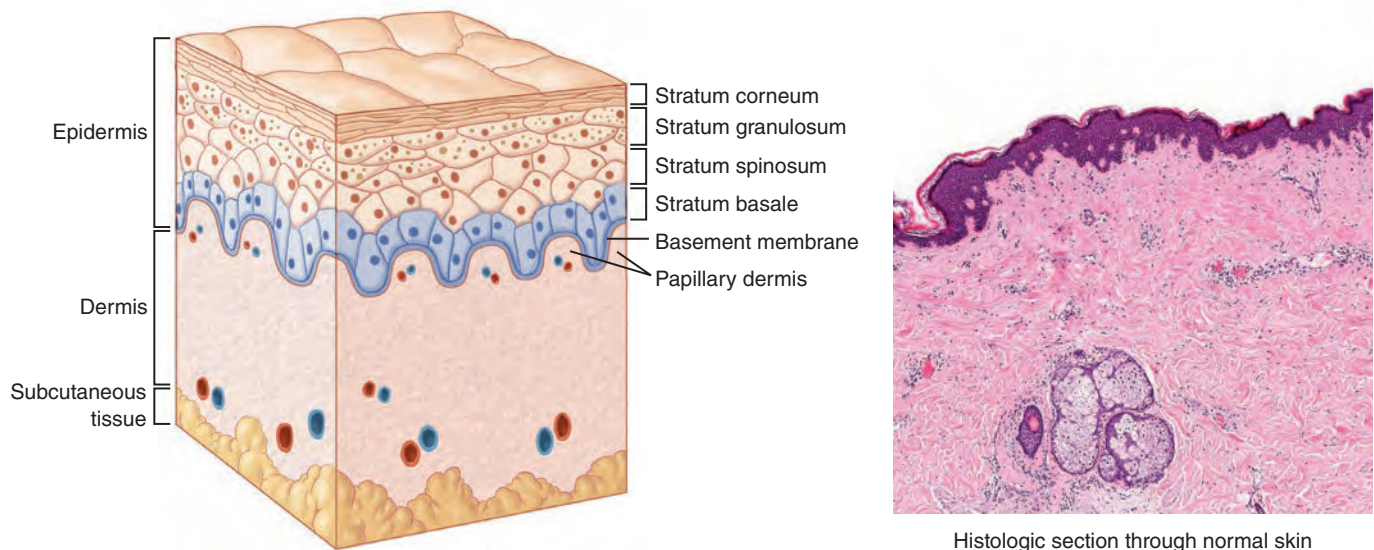
Oxidative stress, which skin is exposed to on a constant basis, plays a pivotal role in intrinsic and extrinsic aging. Oxidative stress is delivered by the creation of *reactive oxygen species* (ROS), also known as *free radicals*. Free radicals are formed naturally through normal human mitochondrial oxidative metabolism as well as through exogenous factors, such as UV exposure, air pollution, smoking, radiation, alcohol, exercise, and inflammation. The free radical theory of aging, which was proposed by Harman in 1956, is currently one of the most widely accepted theories to explain the causes of aging.

Free radicals can damage vital structures, such as DNA, cytoskeletal elements, cellular proteins, and cellular membranes. Recent data further suggest that free radicals can induce various transcription factors, such as activator protein-1 (AP-1) and NF-kappaB, and increase the expression of matrix metalloproteinases (MMPs), in particular collagenase, which degrades skin collagen and plays a central role in the skin's aging process. Clinically, these processes lead to photoaging, wrinkling, inflammation, erythema, edema, preneoplastic lesions, and skin cancer. Fortunately, the body also has defense mechanisms against such free radicals, called *antioxidants* (superoxide dismutase, catalase, glutathione peroxidase, alpha-tocopherol, ascorbic acid, glutathione, and ubiquinone).



As part of the natural aging process, however, the body's endogenous defense mechanisms decrease while the production of ROS increases, resulting in an imbalance and an increased number of unchecked radicals. Furthermore, antioxidant defense mechanisms can be inhibited by UV and visible light, whereas UV light exposure is known to increase the formation of free radicals, which only further tips the balance. These data provide the scientific background for the use of antioxidants, which have recently become very popular. (These are discussed in further detail on pp. 286-287.)

Anatomy of the Skin



The skin is composed of three layers: epidermis, dermis, and subcutaneous tissue, each with its specific function and characteristics.

Epidermis

The epidermis is the outermost layer of the skin and thus is vulnerable to exogenous assault. It is composed of various layers: the deepest is the basal layer, followed by the spinous layer, the granular layer, and ultimately the outermost layer, the stratum corneum, with its desquamating cells. The *stratum corneum* is the skin barrier to the environment and thus is important in protecting the skin from exogenous influences. The stratum corneum is important from a cosmetic standpoint because it is responsible for the texture, smoothness, and glow of the skin, the moisture level of the underlying epidermis, and the skin's pigmentation. The main cells that compose the epidermis are the *keratinocytes*, also called *corneocytes*. As they mature, these cells migrate upward to become the various layers of the epidermis, until they are desquamated on top of the stratum corneum. This keratinization process or cell cycle of the keratinocytes takes approximately 26 to 42 days. Retinoids can accelerate this cell cycle, resulting in younger keratinocytes in the stratum corneum and a smoother skin appearance. In between the keratinocytes is an intercellular lipid bilayer. This entire structure can be thought of as “bricks” (keratinocytes) surrounded by “mortar” (lipids), yielding the “brick-and-mortar” structural organization of the epidermis. The lipids are composed of fatty acids, cholesterol, and ceramides that help reduce transepidermal water loss. A disrupted skin barrier leads to increased transepidermal water loss and dry skin with a rough surface.

Melanocytes with their melanosomes are also located in the epidermis. These determine a person's physiologic skin color (skin phototype defined by Fitzpatrick; see p. 271). The number of melanocytes is relatively constant from one person to another and from one skin color to another. Differences in skin color are thus determined by the number and size of the melanosomes produced and distributed by the melanocytes. Pigmentary disorders can lead to an increased number of melanocytes or melanosomes in the basal layer of the epidermis and the upper layers of the dermis.

Dermis

Below the epidermis lies the dermis, which is composed mainly of fibroblasts, fibrocytes, collagen, and elastin, which together are embedded in an extracellular matrix. The dermis also contains nerves, blood vessels, and a variety of skin appendages. The extracellular matrix is composed mainly of glycosaminoglycans, which can bind their weight in water 1000-fold. This matrix plays a key role in an individual's cosmetic appearance, since it is responsible for the elasticity, flexibility, and volume of the skin. With aging, the extracellular matrix and its thickness decrease, and the arrangement of various dermal components, especially the collagen and elastin, change dramatically. Collagen I is the most important and abundant collagen type in the dermis, followed by collagen type III.

With age, collagen becomes increasingly degraded, reducing the skin's durability and resilience. The amount of elastin decreases and aggregates in chunks, producing the typical histologic solar elastosis of intrinsically aged skin (see the section, *right*, on p. 269). The most cosmetically important glycosaminoglycan is hyaluronic acid. Hyaluronic acid's function is to bind water and help hold the moisturizing level of the skin. Glycosaminoglycans and hyaluronic acid show an age-related decline, leading to dry, saggy skin. Collagen, elastin, and glycosaminoglycans make up the three-dimensional structure of the dermis. As all of these decline and become rearranged, the clinical result is volume loss, reduced elasticity, and decreased suppleness of the skin. Unfortunately, most topical cosmetic treatments do not penetrate into the dermis; thus it is difficult for them to reverse these changes.

Subcutaneous Tissue

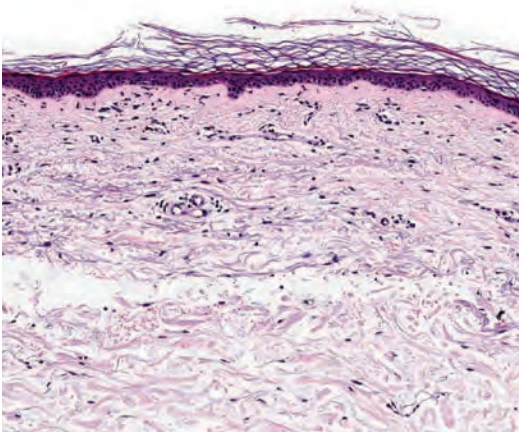
The subcutaneous tissue is located below the dermis and is composed of adipocytes, surrounded by fibrous tissue and blood vessels. The subcutaneous tissue's distribution throughout the body depends at least in part on sex and age; redistribution occurs as the individual ages.

Not only do the changes of intrinsic and extrinsic skin aging differ in terms of their cause, they also differ in clinical and histologic presentation.

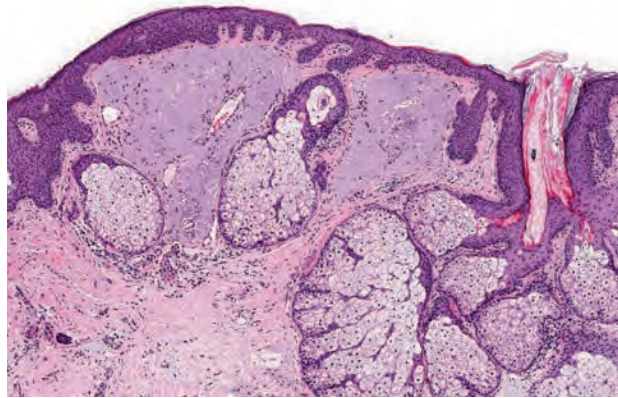
Clinical Features of Intrinsically and Extrinsically Aged Skin

Intrinsically aged skin, seen on sun-protected areas of the body such as the back, buttocks, and abdomen, is dry, thin, and lax. It shows fine wrinkling and regular pigmentation. Extrinsically aged skin, which we can see on sun-exposed areas such as the face, neck, chest, the back of the hands, and forearms, is thickened, shows deep folds and wrinkles, and has irregular pigmentation.

Histologic Changes of Intrinsically and Extrinsically Aged Skin



Histologic section through intrinsically aged skin



Histologic section through extrinsically aged skin

Intrinsically aged skin shows atrophy and thinning of the epidermis, with flattening of the dermoepidermal junction. The dermis also becomes thinner and the amount of collagen fibers, elastin, and extracellular matrix are all reduced.

Extrinsically aged skin shows an increased thickness of epidermis and dermis as a result of cellular hyperproliferation, with qualitatively and quantitatively changed dermal matrix proteins. Impaired fibrous structure is seen, with accumulation of fragmented elastic fibers, mucin, and glycosaminoglycans, leading to the characteristic histologic findings of solar elastosis. Increased melanin production leads to clinically obvious hyperpigmentation.

Functions of the Skin

The skin has numerous functions:

- Barrier against the external environment
- Regulation of moisture
- Production of sweat
- Production of sebum
- Immune defense
- DNA repair
- Wound healing
- Thermoregulation
- Cell growth
- Vitamin D production
- Vascular reactivity

If any of these functions are impaired, as often is the case in aging skin, the problems listed below can occur.

Problems With Impaired Skin Function

- Impaired barrier function → dry skin, pruritus
- Impaired vascular reactivity → disturbed moisture control and thermoregulation → pruritus and abnormal temperature sensation
- Reduced sweat glands → reduced sweat production → disturbed thermoregulation
- Reduced sebaceous glands → reduced sebum production → dry skin
- Reduced number of Langerhans cells → reduced immune control → increased cutaneous dermatoses and infections
- Impaired DNA repair → benign → and malignant neoplasia
- Impaired wound healing → prolonged wound healing and ulceration
- Impaired vascular reactivity → increased telangiectasis

Skin Types

Before recommending any skin care regimen to a patient, the physician must know what skin type the patient has. When considering skin types, one must differentiate between the *skin phototype*, developed by Harvard dermatologist T.B. Fitzpatrick in 1975, and the “cosmetic” skin type. As the name implies, Fitzpatrick’s skin phototype scale classifies the skin by an individual’s response to exposure to UV radiation. Thus the phototype is determined by the individual’s constitutional skin color and ethnicity, the amount of melanin pigment in the skin, and the reaction to sun exposure.

Fitzpatrick’s Classification of Skin Types

Skin Type	Typical Features	Reaction to Sun Exposure
I	White	Always burns, never tans
II	White	Usually burns, tans with difficulty
III	White	Sometimes burns, tans average
IV	Moderate brown	Rarely burns, tans with ease
V	Dark brown	Very rarely burns, tans very easily
VI	Black	Does not burn, tans very easily

Assessment of a patient’s Fitzpatrick skin phototype is important and has implications for two issues of cosmetic relevance: the tendency to develop rhytids and the predisposition to develop postinflammatory hyperpigmentation or postinflammatory pigment alterations. Because individuals with Fitzpatrick skin types I to III have fewer melanin granules in their skin, they are naturally less protected from UV radiation. Hence they develop rhytids at an earlier age and to a greater extent. Fitzpatrick skin types IV to VI wrinkle less; however, in general, they show a higher tendency for postinflammatory pigment alterations (hyperpigmentation and hypopigmentation) after inflammatory dermatosis or minimally invasive procedures, such as peels and various laser treatments.

The cosmetic skin types patients refer to are the designations used by the majority of manufacturers in the cosmetic industry: normal, oily, dry, combination (oily in the T-zone), and sensitive.

Cosmetic Skin Types	
Normal	Balanced skin, neither oily nor dry. It has a translucent, soft, smooth texture and a healthy glow.
Oily	Skin that has an oily shine as a result of overactive sebaceous glands with excess oil production. Often associated with enlarged pores and an irregular, coarse skin surface. Tendency to develop comedones and acne (“blackheads” and “pimples”).
Dry	Skin that does not shine, is dull, and frequently flakes. Skin feels dry and tight, especially after washing.
Combination	Oily shine in the so-called T-zone (forehead, nose, chin) and dry skin in the surrounding skin. This is the most common skin type.
Sensitive	Skin that often shows redness, flakiness, and irritation; may itch, burn, or sting. Skin that frequently reacts to various factors, such as weather and topical products.

Obviously, the cutaneous problems and requirements that cosmetic patients can present with are far more complex than can be reflected within these five categories. We think the most comprehensive approach for categorizing cosmetic skin types was developed and published by Baumann in 2003 (the Baumann skin typing system). Its classification is based on four main skin parameters:

- 1. Oily versus dry
- 2. Sensitive versus resistant
- 3. Pigmented versus nonpigmented
- 4. Wrinkled versus tight (unwrinkled)

To assess one’s individual skin type, Baumann’s book contains a questionnaire with separate questions for each parameter, with a score assigned to each parameter. The various combinations yield 16 potential skin type permutations. The book also provides comprehensive product recommendations and useful tips for physicians as well as consumers.

Baumann’s Sixteen Potential Skin Type Permutations					
	Oily, Pigmented	Oily, Nonpigmented	Dry, Pigmented	Dry, Nonpigmented	
Sensitive	OSPW	OSNW	DSPW	DSNW	Wrinkled
Sensitive	OSPT	OSNT	DSPT	DSNT	Tight
Resistant	ORPW	ORNW	DRPW	DRNW	Wrinkled
Resistant	ORPT	ORNT	DRPT	DRNT	Tight

D, Dry; O, oily; P, pigmented; R, resistant; S, sensitive; T, tight; W, wrinkled.

In discussing pigmented and nonpigmented skin, Baumann does not refer to light or dark skin types, but to an individual's tendency to develop pigmentary disorders, such as ephelides, lentigines, melasma, and postinflammatory hyperpigmentation. Unfortunately for the wrinkled versus tight skin types, most light-skinned people older than 30 years of age will fall into the "W" (wrinkled) category. These patients should use antiaging treatments such as retinoids, sunscreens, and antioxidants.

Baumann differentiates four types of "S" (sensitive) skin:

- S1: Patients prone to acne, with frequent breakouts, comedones, and predominantly oily skin
- S2: Patients prone to developing rosacea who complain of redness and broken vessels
- S3: Patients who frequently feel a stinging or burning sensation of the skin
- S4: Patients who tend to develop contact or irritant dermatitis.

The skin care regimen for individuals in this category, depending on the type of sensitivity, has to be adapted accordingly. The one quality that all of those with "S" skin types share is inflammation. In these patients, the inclusion of antiinflammatory agents into the various skin care products is crucial for a successful therapy and a satisfied patient.

Within the categories described, the basic concepts of skin care—cleansing, protecting, and preventing aging—apply to every patient seen by a physician, regardless of age, skin type, or underlying problems. The overall approach is simply to moisturize, slow down or even reverse aging, and treat specific problems. Two factors do need to be tailored to the patient's specific skin type: the kind of formulation used, and the active ingredients in the product.

From a professional treatment perspective, it makes sense to differentiate among more than the five basic skin types and to consider the aging status of the skin, potential pigmentary problems, and specific aspects of skin sensitivity. From a practical perspective, the treating physician should be aware of the special needs of oily or dry skin, aged skin, skin with pigmentary alterations, and skin with a tendency to sensitivity and inflammation. With knowledge of those features, the physician can formulate a personalized, comprehensive skin care regimen for each patient.



One consideration for sensitive skin applies to any treatment: when recommending or prescribing new products to a patient with sensitive skin, especially one who has a tendency to develop contact dermatitis, the physician should instruct the patient to test the new product for its allergenicity potential by applying it in the cubital area two times a day for 5 consecutive days. If by day 5 the patient does not develop contact dermatitis, the product should be safe for use on the face.

Evidence-Based Skin Care Musts: Retinoids and Sunscreens

As physicians it is our ultimate goal to recommend evidence-based and scientifically supported treatments. Unfortunately, when it comes to skin care and cosmetic products, this is a difficult task. There are only two treatments or substances whose use and biologic effects are backed by good scientific data: retinoids and sunscreens.

The sine qua non of any skin care regimen is the daily use of a sunscreen. In addition, as soon as the aging process starts and becomes a concern, daily application of a topical retinoid is advised. The use of topical antioxidants is also recommended, although currently there is less evidence of its efficacy from well-designed clinical trials than the other two products.

Cosmeceuticals

The cosmetic skin care market, especially products intended to reduce the effects of aging, is a multibillion dollar business. New products with new ingredients are constantly being developed. The sole purpose of “simple” cosmetics is to clean, smooth, and beautify the skin. Not much harm can be done with such products, and their purpose is well defined. However, this is not necessarily the case for another category of cosmetic products, called *cosmeceuticals*.

More and more biologically active ingredients are being included in cosmetic products that are not sold only for a beautifying purpose, but that claim truly biologic effects, such as photoprotection, antiwrinkling, antiaging, and skin tightening. These products all fall into the category of cosmeceuticals.

The term cosmeceuticals was first introduced by dermatologist Albert Kligman two decades ago. Today cosmeceuticals represent the fastest-growing segment of the skin care market. Cosmeceuticals constitute an intermediate between cosmetics and drugs (hence *cosme* from cosmetics and *ceuticals* from pharmaceuticals). In contrast to regulated drugs, these products are not sold for therapeutic purposes, but rather for cosmetic reasons. Thus cosmeceuticals are not regulated by the U.S. Food and Drug Administration (FDA) and consequently are not required to undergo the same rigorous premarket testing as do drugs. Unfortunately, this has led to a situation in which most cosmeceuticals manufacturers can claim various biologic effects for their products. Most cosmeceuticals lack large-scale, randomized, blinded, controlled clinical trials or long enough follow-ups to assess their actual biologic properties. Cosmeceutical manufacturers today assert that their products produce antioxidant, photoprotective, antiinflammatory, and collagen-stimulating effects. A vast array of cosmeceutical products claim antiaging and antiwrinkle activity.

Usually cosmeceuticals do show some effect in vitro. However, in vitro success does not prove in vivo efficacy. In vivo clinical trials of the final formulation are rare. An active compound might perform miraculously in vitro, or even in an in vivo animal model. However, when incorporated into the final formulation with preservatives and fragrances, there are many factors that might influence and change the active compound's biologic activity. Furthermore, for the active compound to penetrate through the stratum corneum, be absorbed into the skin, retain its stability, and stay at the specific structure long enough to exert its biologic effect requires complex processes that cannot be guaranteed by any in vitro data. Thus, even for an expert cosmetic physician, it is very difficult to assess a product's true biologic effects.

BASIC SKIN CARE

A Regimen for Any Skin Type and at Any Age

Cleansing

Cleansing the skin is the first step in every skin care regimen and should be routinely performed every morning and evening, regardless of an individual's skin type or age. The purpose of cleansing the skin is not only the removal of dirt, microorganisms, makeup, and other pollutants, but also the removal of desquamated cells from the skin surface. This allows skin to better absorb other topical therapies and aids in a constant rejuvenation process.

Using water alone for cleansing will remove roughly 65% of dirt and oil from the skin. However, water alone will not remove the oils from makeup and environmental pollutants.

To remove sebum and dirt, skin cleansers have to lower the surface tension of the skin. With this in mind, surface-active substances, the so-called *surfactants*, have to be added to skin care products. Surfactants represent the key active ingredient in cleansing formulations. They are also crucial components that influence a cleanser's degree of mildness or irritancy. The type of surfactant used varies by the type of cleansers, such as bars and liquids.

The main problem associated with the use of cleansers is a potential weakening of the stratum corneum by the surfactant's removal of the lipids required for the structure of the epidermis. When this occurs, the skin barrier is disrupted, leading to a disturbance in moisture level, a change in the skin's surface pH, and ultimately irritation to the skin.

Fortunately, cleansing technology has evolved greatly within the past two decades. At one time basic soap was used, which ultimately led to the introduction of synthetic detergent-based bars or liquids (the so-called *syndets*), which are non-soap-based surfactants. This has greatly helped to reduce the damaging effect of skin cleansers. Today most products recommended by aesthetic physicians are syndet cleansers.

Some cleansers can lead to immediate after-wash tightness, dryness, pruritus, and erythema. It is known that harsh surfactants, especially those contained in soap-based products, interact with proteins and lipids within the skin, which can lead to skin dryness, irritation, scaling, and roughness. Furthermore, a cleanser's pH plays

an integral role as to whether it will irritate the skin or damage the stratum corneum. Soap-based cleansers not only contain harsh anionic surfactants but also are alkaline and thus raise the pH of the skin, whereas syndets are mostly neutral or slightly acidic. Because of their pH, they remove less intracellular lipid. Various studies have shown a higher irritation potential for soap-based cleansers compared with cleansers with syndets.

Besides the main component of a cleanser (surfactants), these products contain various compounds, such as binders for stabilization of the formulation, sensory modifiers, fragrances, and preservatives. In addition, moisturizers (emollients and humectants) are now added to many cleansers; these help to maintain the hydration status and barrier function of the skin.

A cosmetic patient with an ideal skin care regimen will also apply some kind of topical retinoid to the skin. Although potentially helpful for collagen formation, retinoids may also weaken the skin barrier, making the skin prone to irritation. Many of the regularly performed cosmetic procedures, such as chemical peels and laser procedures, intentionally lead to an impaired stratum corneum. Hence the cleanser of choice for a cosmetic patient should be mild, nonirritating, fragrance free, noncomedogenic, and moisturizing so that it will not further exacerbate the already compromised skin barrier from other treatments.

Currently marketed cosmetic cleansing products for the face include soaps, superfatted soaps and beauty bars, dermatologic bars and liquid cleansers, lipid-free cleansers, syndet cleansers, and cleansing creams. Nonfoaming cleansers with no or a low level of surfactants are in general milder and less irritating than foaming cleansers, which contain surfactants. However, all nonfoaming cleansers are somewhat less efficient in cleansing. The lowest irritation potential will be provided by a cleanser that contains both nonionic/silicone-based surfactants and moisturizers.

The best currently available choice of cleanser for cosmetic patients is a liquid facial cleanser. These cleansers have an acidic pH, mostly contain moisturizers, and show a high “rinsibility.”

Patients with dry skin types should avoid foaming cleansers and use oil-based, moisturizing cleansers that are marketed as the following:

- Cleansing creams
- Cleansing milks
- Cleansing lotions
- Cleansing oils
- Hydrating cleansers

Patients with oily skin should avoid these cleansing types and use foaming or gel-based cleansers. Patients with aging skin that is not too sensitive or dry can intermittently use cleansers that contain glycolic acids. Although potentially irritating, such cleansers will increase desquamation and provide a mild antiaging effect.

Moisturizing

A 2004 study by Feldman and colleagues showed that after hydrocortisone (27.6%) and antiinfectives (23.4%), moisturizers (13.4%) are the third most commonly recommended over-the-counter topical product. Moisturizing the skin is a crucial component of every skin care regimen, not just for dry skin, which has been shown to have low levels of moisture. Moisturizers are helpful when there is a disturbed epidermal barrier with increased transepidermal water loss and thus a reduced water content in the epidermis. Skin can only be moisturized when the stratum corneum is intact, which allows the skin to trap the water in the dermis and viable layers of the epidermis. Too little water content in the skin will lead to dry skin with roughness, flaking, and irritation.

The goal of moisturizers is to increase the moisture level (that is, the water content in the stratum corneum), to provide a protective film, and to cover tiny disruptions in the skin while restoring the skin barrier function. Ultimately, this further reduces moisture evaporation from the skin, maintains the hydration level, and leads to both a smoother appearance and increased tactile properties of the skin. This can be achieved in various ways:

- By promoting water retention within the stratum corneum using humectants
- By minimizing water evaporation from the skin using occlusives
- By increasing the integrity of the skin barrier using occlusives

Emollients complement activity of the occlusives and aid in smoothing the surface of the skin. Most moisturizers contain all three components—humectants, occlusives, and emollients—in varying combinations.

Humectants

Humectants are water-soluble, hygroscopic materials with high water-absorption capabilities; they increase the ability of the stratum corneum to hold on to water by attracting and enhancing the water absorption from the dermis into the epidermis. In high-humidity conditions (atmospheric humidity greater than 80%), water can also be absorbed from the external environment into the stratum corneum. The reason moisturizers are formulated to combine humectants with occlusives is to prevent the enhanced water absorption from the dermis into the epidermis from being lost by increased transepidermal water loss.

By drawing water into the skin, humectants lead to a swelling of the stratum corneum, which smooths out fine lines and wrinkles. Many manufacturers of moisturizers use this phenomenon to claim antiwrinkle properties, although these products do not impart these effects long term.

The most effective humectant is glycerol (glycerin). Other commonly used humectants include propylene glycol, gelatin, natural moisturizing factor (NMF), urea, panthenol, sodium, sorbitol, and sodium hyaluronate. One of the newer and widely marketed humectants is hyaluronic acid. Many products containing hyaluronic acid claim its antiwrinkle activities, but as explained earlier, this effect is solely based on drawing water into the skin.

Occlusives

Occlusives are oily substances that reduce transepidermal water loss to the external environment by creating a hydrophobic barrier over the skin, supporting the lipid matrix between the keratinocytes, and thereby increasing the integrity of the skin barrier. Substances with occlusive effects include fatty acids (linoleic acid, lanolin), oils, waxes and wax esters (mineral oil, paraffin, petrolatum, silicone derivatives, squalene, beeswax), phospholipids, and sterols. Two of the best occlusives commonly used are mineral oil and petrolatum. Reduction in transepidermal water loss by petrolatum is 99%, and by mineral oil 50%. Oil-free occlusives include silicones such as dimethicone.

There is a subset of individuals with sensitive skin and a tendency for allergic reaction who develop contact sensitization to lanolin. Patients with known contact allergies should use moisturizers without lanolin. An example might be a moisturizer containing petrolatum, for which virtually no contact dermatitis has been reported.

Emollients

Emollients are mainly oils and lipids that help to hydrate the skin by filling the gaps between desquamating keratinocytes, leading to an increased cohesion of the corneocytic skin barrier. Emollients improve the appearance of the skin, increasing smoothness, softness, and flexibility, resulting in greater light refraction and more even-looking skin. There are various types of substances available with emollient properties. These include astringent emollients (such as dimethicone), dry emollients (isopropyl palmitate), fattening emollients (castor oil, jojoba oil, propylene glycol), and protective emollients (isopropyl isostearate). Various emollients, such as petrolatum, lanolin, and mineral oil, also possess humectant and occlusive properties.

The majority of moisturizers are either creams, which are water-in-oil emulsions, or lotions, which are oil-in-water emulsions. There are also more complex formulations available, such as serums and gels.

Creams are richer and tend to include heavier lipids. Typically creams contain mineral oil, petrolatum, lanolin, and water. Lotions are thinner, and in general, contain water, mineral oil, and propylene glycol.

Patients with dry skin need to apply a moisturizer at least twice a day, in the morning and in the evening. In dryer, less humid environments or in winter, a repeat application during the day might be needed. Ideally, creams are applied at night, whereas lotions can be applied during the day. Patients with markedly dry skin, or in dry climates, might need to apply cream in the morning as well. Moisturizers exert their most pronounced effect when they are applied on slightly dampened skin.

Patients with oily skin might not feel the need to apply moisturizer at all. However, no skin type is static; there are situations in which skin that is usually oily might tend to be drier and thus require a moisturizer. Ideally, patients with oily skin should apply the lighter lotions or even gels. Silicone derivatives in particular are targeted for those with oily skin.

The ideal moisturizer is noncomedogenic, nonirritant, fragrance free, hypoallergenic, and nonsensitizing. Patients with sensitive skin should choose this type of product.

Today newer moisturizers contain additional, mostly active ingredients, such as antioxidants, retinoids, and sun protectants. These moisturizers often claim to have additional effects, such as photoprotectant, antiaging, and sun protectant properties. Such products clearly belong in the category of cosmeceuticals. This antiaging technology is the fastest-growing segment of the facial moisturizer market.

Many moisturizers intended for use during the day contain a sun-protection factor (SPF). In general, the SPFs contained in daytime moisturizers are somewhat low (SPF 12, 15, or 20). Patients using these moisturizers should also apply sunscreen with an SPF 30 on top of the daily moisturizer. Moisturizers intended for nighttime and antiaging use will also often contain over-the-counter retinoids (retinol or retinaldehyde). These are excellent options to introduce the use of a topical retinoid to a patient's skin care regimen. (This is described in more detail on pp. 283 to 286.)

Protection

Photoprotection

Research over the past 40 years has made the association between sun exposure, photoaging of skin, and skin cancer indisputable. It has been clearly demonstrated that UV radiation causes skin aging. More important, UV light is now accepted as

the main etiologic factor in the development of cutaneous malignancy. In the United States, as reported by Ibrahim and Brown, 50% of all malignancies are attributable to skin cancer, and the increased rates of incidence of nonmelanoma skin cancer, as well as melanoma, are the fastest growing rates for any malignancy.

UV light can be divided into UVA (320 to 400 nm), UVB (280 to 320 nm), and UVC (190 to 280 nm). UVA and UVB rays are the clinically relevant radiation, because UVC rays are filtered by the ozone layer in the stratosphere. Acute effects of UV radiation on the skin include inflammation, erythema, sunburn, and pigmentation (tanning). Chronic irradiation with UVA and UVB leads to cutaneous immunosuppression, photoaging, and photocarcinogenesis. It seems that induction of inflammation and loss of skin elasticity can even be induced by suberythematous doses of UV radiation.

The clinical effects of sun exposure on photoaging can be easily visualized when comparing sun-protected body sites with sun-exposed ones. Photoaged skin shows remarkably more clinical changes than sun-protected, chronologically aged skin, such as sallowness, roughness, wrinkles, mottled pigmentation, telangiectasia, and various benign and malignant neoplasms.

Photoprotection is an essential prophylactic and therapeutic element to combat the deleterious cutaneous effects of UV radiation and to prevent and slow the signs of cutaneous aging. Photoprotection goes beyond skin care: in addition to sunscreens conferring photoprotection, sun-avoidance and protective clothing can add significantly to safeguarding the skin from damaging UV radiation.

Sunscreens

Data show that protection of the skin with sunscreen can reduce the development of skin cancer and inhibit photoaging. There have been tremendous developments in the sunscreen industry. In contrast to Europe, where sunscreens are regarded and treated as cosmetics, the FDA regards sunscreens as drugs and requires rigorous clinical trials before regulatory approval. This explains why certain sunscreen filters only enter the U.S. market after they have already been used in Europe for many years.

The SPF rating is used almost universally. However, SPF is primarily an indicator of protection from UVB rays, and the protection provided from the effects of UVA is somewhat difficult to estimate. In fact, commercially available sunscreens will provide reliable protection against UVB rays, whereas many of them will not be equally effective against UVA rays. SPF is defined as the UV dose (mainly UVB) required to develop a minimum erythema dose (MED) after the application of 2 mg/cm² of sunscreen. Hence an SPF 2 absorbs 50% of UV radiation and will allow a patient to stay in the sun double the time before developing erythema, as compared with the same patient who has not used the sunscreen.

With regard to UVA rating, the FDA recently proposed a new four-star grading system and a description (low, medium, high, and highest). The rating system includes in vitro and in vivo measurements and will be based on measuring the sunscreen's ability to reduce the penetration of UVA rays into the skin as well as to prevent tanning.

There are two different types of filters used in sunscreens: organic, also known as chemical filters, and inorganic, or physical filters/blockers.

Organic or Chemical Filters

Organic filters act by absorbing UV radiation and then emitting the absorbed energy as heat. They can be divided into UVA, UVB, and dual UVA/UVB or broadband filters. There are various filters with differing absorption spectra. To protect the skin over the entire UV spectrum, different filters may be combined in the same product. UVB filters include para-aminobenzoic acid (PABA) and derivatives, cinnamates and salicylates. UVA protection was revolutionized with the introduction of butyl methoxydibenzoylmethane (avobenzone); it was the first organic filter that provided some UVA protection. Recently, development has gone toward broadband UVA and UVB filters with the introduction of ecamsule (terephthalylidene dicamphor sulphonic acid, Mexoryl SX), dometrizole trisiloxane (Mexoryl XL), and bemotrizinol and bisotrizole (Tinosorb S and Tinosorb M). Chemical sunscreens can induce contact dermatitis in susceptible individuals. Such compounds include benzophenone, avobenzone, and PABA.

Inorganic or Physical Filters

Inorganic filters, also called *physical blockers*, are made of sizable particles that reflect and scatter UV and visible light. The two most widely used inorganic filters are zinc oxide (ZnO) and titanium dioxide (TiO₂). Another inorganic filter used is iron oxide. Depending on the particle size, such blockers not only reflect and scatter light, but absorb it as well.

The main problem with sunscreens containing inorganic filters is that they tend to leave a whitish discoloration and film on the skin, which is cosmetically disturbing. Newer formulations attempt to overcome this problem by the process of micronization; that is, producing smaller-sized particles, which results in less scattering of visible light and thus less opaque discoloration.

Currently there are no documented reports of sensitization reactions to physical filters. Thus inorganic sunscreens are the best choice for patients with sensitive skin who have a tendency to develop contact dermatitis.

Patients should be instructed to use sunscreen every day of the year, whether the sun is shining or not. Sunscreens should be applied in the morning 30 minutes before leaving the house. All sun-exposed areas should be treated. Patients should develop the habit of reapplying sunscreen at midday.

In our opinion, a daily sunscreen should ideally contain an SPF 30 and should protect from UVA radiation as well. When extended sun exposure is planned, such as on weekends and holidays, an SPF 50+ and high UVA protection may be considered and applied on all exposed areas of the body.

Patients with dry skin should use cream formulations to moisturize the skin. Patients with oily skin should use lotions or gels, since they are lighter than creams. Patients with sensitive skin will ideally use sunscreens with physical filters and avoid sunscreens with chemical filters, such as avobenzone, benzophenone, and PABA.

Patients with such pigmentary disorders as melasma, lentigines, and postinflammatory hyperpigmentation, which are known to worsen on sun exposure, should use an SPF 50+ and high UVA protection every day without exception.

Patients should be advised that a preexisting or acquired tan does not protect the skin from the sun and thus “pretanning” before going on vacations will only add to increased sun damage. Studies have shown that the photoprotection given by an acute suntan is only equivalent to a sunscreen SPF 2 to 3.

Because antioxidants are known to be photoprotective and lessen ROS-induced sun damage, newer sunscreens include antioxidants, such as vitamins C and E, green tea polyphenols, and resveratrol. However, such antioxidant sunscreens are less potent than physical filters in preventing sunburn.

A Regimen for the Prevention and Treatment of Skin Aging

Retinoids

Topical retinoids, together with sunscreens, are the fundamental agents used in topical cosmetic therapies. The term *retinoid* is used as a generic chemical term that encompasses the naturally occurring compounds with vitamin A activity, as well as the synthetic derivatives of retinol (retinoic acid). All retinoids exert their biologic effects by engaging and activating nuclear receptors.

Retinoids are classified into various generations, such as naturally occurring first-generation retinoids and synthetic or second- through fourth-generation retinoids.

Generations of Retinoids	
First-generation (nonaromatics)	Retinol Retinaldehyde Tretinoin Isotretinoin Alitretinoin
Second-generation (monoaromatics)	Etretinate Acitretin
Third-generation (polyaromatics)	Adapalene Tazarotene Arotinoid
Fourth-generation (pyranones)	Seletinoid G

The classic indication for the use of a retinoid is acne. The first anecdotal evidence supporting the positive effects of retinoids on photodamaged and photoaged skin was observed in a study performed by Kligman et al in 1986, when he treated female acne patients with topical tretinoin. The patients commented that their skin felt smoother and less wrinkled. Histologically, a replacement of the atrophic epidermis by hyperplasia, an elimination of dysplasia and atypia, an eradication of microscopic actinic keratoses, a uniform dispersion of melanin granules, and new collagen formation in the papillary dermis, as well as exfoliation of retained horn in the follicles were all noted. These data led to the conclusion that topical tretinoin is at least partly capable of reversing the structural damage of excessive UV exposure and may be useful in decelerating the photoaging process. Other studies followed, which ultimately resulted in FDA approval of tretinoin for the treatment of photo-damaged skin.

Subsequently various double-blind placebo-controlled trials have demonstrated that the topical application of retinoids can lead to improvement in global appearance, reduction of fine lines and coarse wrinkling, improvement of skin texture, and reduction of roughness, pigmentation, and sallowness. Most of the available studies documenting the effects of topical retinoids on photodamaged skin are on the effects of tretinoin, with significantly fewer data on the other retinoids.

Tretinoin

As previously discussed, the benchmark product for use in photodamaged skin—and currently the only FDA-approved topical retinoid for that specific indication—is tretinoin. Tretinoin is available in various concentrations from 0.01% to 0.25% and a variety of different formulations (creams and gels). The drawback of tretinoin is its irritation potential. If not instructed properly on the mode of application, patients can develop retinoid dermatitis with scaling, erythema, pruritus, and stinging.

Retinol and Retinaldehyde

Retinol and retinaldehyde are popular retinoids included in over-the-counter products. They have both been shown to be less irritating than tretinoin but still confer some degree of efficacy against photodamage.

Retinyl Palmitate and Retinyl Acetate

The esters retinyl palmitate and retinyl acetate can be found in various cosmeceuticals. However, they are not considered topically effective against photoaging.

Isotretinoin

Isotretinoin is a prescription retinoid marketed as a 0.05% gel or cream. It is less effective than tretinoin against the effects of photoaging, but seems to be less irritating.

Tazarotene

Tazarotene has been shown to reduce wrinkling and fine lines, skin roughness, and epidermal atrophy. It is a prescription retinoid available as a cream or gel at concentrations of 0.05% and 0.1%. Tazarotene has an irritation potential comparable to that of tretinoin.

Adapalene

Adapalene is approved for the treatment of acne and has been shown to be efficacious in the treatment of photoaging. Adapalene has been demonstrated to be less irritating than tretinoin and is a good choice of a prescription retinoid for patients with dry and sensitive skin. Adapalene is a prescription retinoid and available in cream and gel formulations of 0.1% and 0.3% concentration.

When patients are started on topical retinoids, it would seem reasonable to begin with an over-the-counter retinoid (retinaldehyde, retinol), because they are typically less irritating. This is especially important for patients with sensitive and dry skin. After 1 or 2 weeks with an over-the-counter agent, and assuming no skin irritation is noted, changing to a prescription retinoid would be a logical approach.

Although treatment with prescription retinoids should build up slowly, some patients, especially those with dry, sensitive skin, are at considerable risk of developing irritation and retinoid dermatitis. These symptoms seem to be related to the dose and type of retinoid used and typically occur about the second to fourth day after initiating application of a topical retinoid. There will even be a subset of patients who because of recurring irritation will not be able to apply a prescription retinoid every day. For these difficult patients, adapalene may be the preferred prescription retinoid, since it is much less irritating. On the other hand, patients with resistant and oily skin will be able to use tretinoin in its highest concentration right from the start, without developing any irritation.

Studies have shown that after 6 to 9 months, the frequency of topical retinoid application can be reduced to three times a week without compromising its efficacy. Topical retinoids can also be used on a continuous basis, because there seems to be no limit to the length of time a retinoid can be used.

Topical retinoids appear to be an effective long-term antiaging therapy. In general, the first clinical improvement, often seen after only 1 month of treatment, is an improved smoothness of the skin. After 2 to 4 months of treatment, a lightening of lentigines and mottled hyperpigmentation can be observed. Finally, coarse skin and fine lines are usually improved after 4 months of therapy.

Antioxidants

Although the human body possesses endogenous antioxidants, and certain vegetables and other foods are rich in antioxidants, it is thought that higher levels can be achieved by supplementation. Consequently, the use of antioxidants as oral supplements or topical formulations may lessen the harmful adverse effects induced by free radicals. It is believed that a combination of various antioxidants, orally and topically, may result in sustained antioxidant capacity as a result of synergistic actions of the combined antioxidants. The biologic effects of antioxidants are summarized in the box.

Biologic Effects of Antioxidants	
Antioxidative	Anticarcinogenic
Antiinflammatory	Depigmenting
Photoprotective	

Topical antioxidants are currently marketed for the prevention UV-induced skin damage and aging, as well as the treatment of rhytids and facial erythema. Based on current scientific data on antioxidants, the claim that antioxidants may prevent wrinkles may be justified. However, there are scant data on the use of topical antioxidants for the treatment of existing wrinkles. The box lists the current most popular antioxidants included in skin care formulations.

Agents With Antioxidant Activity

Coenzyme Q10	Grape seed extract	Resveratrol
Coffeeberry and <i>Coffea arabica</i>	Green tea	Rosemary
Ferulic acid	Idebenone	Silymarin
Feverfew	Lycopene	Turmeric/curcumin
Genistein	Mushrooms	Vitamin C
	Pomegranate	Vitamin E

Depigmenting Agents

Patients with photoaged skin often complain about hyperpigmented lesions, such as ephelides, lentigines, and melasma or PIH. A number of products are touted as “lightening creams.” None of them can magically erase such pigmentary lesions; all require months of use for visible improvement. Even with prescription lightening products, success is limited. To enhance efficacy it is best to combine the various available products and procedures that aid in lightening the skin. Optimal treatment requires the combined use of depigmenting agents, retinoids, sunscreens, and regular chemical peels and light- or laser-based procedures.

Topical depigmenting or skin-lightening agents can be divided according to their mechanism of action into tyrosinase inhibitors, melanosome-transfer inhibitors, melanocyte-cytotoxic agents, retinoids, and peeling agents.

Tyrosinase Inhibitors

Hydroquinone is an effective tyrosinase inhibitor that is available in over-the-counter products in a 2% concentration or less, or as prescription drug in a 3% to 4% concentration. Hydroquinone can be concentrated even higher in custom pharmacy formulations. However, higher concentrations are more irritating, leading to side effects such as skin redness. As with most skin-lightening agents, a prolonged application of 6 weeks or more is necessary before any improvement becomes noticeable. There

have been many concerns about the safety of hydroquinone, and in Europe it was banned in 2000 for general cosmetic purposes. Currently there is an ongoing debate in the United States as to whether the FDA will ban hydroquinone in over-the-counter formulations.

Other effective tyrosinase inhibitors found in cosmetic products or prescription drugs are aloesin and arbutin. Many flavonoids, found in various plants or flowers, display depigmenting effects, such as resveratrol, gentisic acid, ellagic acid, kojic acid, hydroxycoumarins, licorice extract, paper mulberry or mulberry extract, and emblicanin. Most of these products are included in cosmeceuticals.

Melanosome-Transfer Inhibitors

Niacinamide, or nicotinamide, is a popular depigmenting agent with additional antiinflammatory, antioxidant, and immunomodulant properties. Two proteins extracted from soymilk, namely soybean trypsin inhibitor and the Bowman-Birk inhibitor, have been shown to induce skin depigmentation. Because melanosome transfer inhibition is reversible, the safety profile of these products is excellent, with virtually no side effects.

Melanocyte-Cytotoxic Agents

Azelaic acid has been shown to be effective in the treatment postinflammatory pigment alteration.

Antioxidants

Many of the previously discussed antioxidants may lighten cutaneous hyperpigmentation in addition to their photoprotective, anticarcinogenic, and antiinflammatory activities. Examples of such antioxidants are vitamin C, vitamin E, pycnogenol, and silymarin.

Other Agents

Alpha-hydroxy acids and beta-hydroxy acid peels can be integrated into a skin care regimen aimed at the reduction of pigmentary lesions. As they are very safe, people with virtually any skin type can be candidates for alpha-hydroxy and beta-hydroxy acid peels.

Retinoids

The effects of retinoids on pigmentation have not yet been fully identified; they seem to involve various mechanisms. It appears that retinoids directly influence melanocytes and modulate melanogenesis. Clearly, by an acceleration of the cell turnover of epidermal keratinocytes, topical retinoids promote a decrease in melanosome transfer

to the keratinocytes and induce dispersion of keratinocyte pigment granules, leading to uniform distribution of melanin content in the epidermis. An increased epidermal turnover further reduces the cohesiveness of keratinocytes and induces their desquamation to an accelerated loss of melanin in the stratum corneum. Indirectly, the retinoid-induced changes in the stratum corneum facilitate the penetration of other depigmenting agents into the epidermis and increase their bioavailability and effects. The most popular depigmenting agents included in skin care formulations are listed in the box.

Agents With Depigmenting Activity

Aloesin	Linoleic acid/alpha-	Rucinol
Arbutin/deoxyarbutin	linolenic acid/oleic acid	Soy proteins (soybean trypsin inhibitor, Bowman-Birk inhibitor)
Azelaic acid	N-Acetylglucosamine	Vitamin C
Ellagic acid	Niacinamide	Vitamin E
Glabridin	Proanthocyanidins	
Green tea	(pine tree and grape seed extract)	
Kojic acid		

Antiinflammatory Agents

Patients who complain about sensitive skin with manifestations of erythema, flaking, tenderness, stinging and/or burning will profit from the inclusion of antiinflammatory agents into their skin care regimen. Most over-the-counter antiinflammatory agents are botanicals, some of which were used for centuries in ancient medicines. The box summarizes the most popular antiinflammatory agents included in cosmeceuticals.

Agents With Antiinflammatory Activity

Caffeine	Licochalcone	Resveratrol
Chamomile	Licorice extract	Silymarin
Cucumber extract	Mushrooms	Turmeric/curcumin
Feverfew	Oatmeal	Vitamin C
Green tea	<i>Polypodium leucotomos</i>	

Concluding Thoughts

Skin care is a multibillion dollar market, yet scientific data to support the biologic effects of various compounds and products are mostly lacking, or studies have not been designed in a satisfactory way. The only two scientifically well-researched topical cosmeceutical substances are retinoids and sunscreens. Sunscreens protect the skin from the detrimental influences of UV radiation. Sunscreens reduce photoaging and the development of skin cancer. Retinoids also prevent and partly reverse photoaging. In addition to the daily cleansing and moisturizing of the skin in accordance with one's personal needs, retinoids and sunscreens are the two most important substances to include in a daily antiaging skin care regimen. The use of antioxidants, depigmenting agents, and antiinflammatory agents is based on a sound rationale. However, most of these products provide only supporting in vitro data.

New ingredients enter the cosmetic market constantly. Unfortunately, clinical data are scarce or lacking for almost all of these products. Nevertheless, topical products are an important part of an effective skin care regimen.

Clinical Caveats

A patient's skin type and needs should be assessed first.

Skin care recommendations should be formulated according to the patient's skin type.

Every cosmetic patient should be educated on the importance of using sunscreen.

Patients need instruction on how to use topical retinoids to avoid irritation.

Light formulations such as lotions or gels should be used for patients with oily skin.

Richer formulations such as creams can be used for patients with dry skin.

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CHAPTER 11



Botulinum Toxin Injections for Facial Rejuvenation

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Since its initial FDA approval in 2002 for the temporary treatment of glabellar lines, Botox Cosmetic has transformed aesthetic medicine. Indeed, the word Botox has entered the vernacular, similar to such icons as Xerox for photocopies and Kleenex for tissues. ASAPS reported that Botox injections continue to outpace the top five plastic surgery procedures combined. With the FDA approval of Dysport (BoNTA-ABO, Medicis Aesthetics, Scottsdale, AZ) in 2009, a second *botulinum* toxin is now widely available commercially. A comprehensive understanding of the distinct differences and similarities between Botox Cosmetic (BoNTA-ONA, Allergan, Irvine, CA) and a non-type A *botulinum* toxin derivative such as Myobloc (BoNTB, Solstice Neurosciences, San Francisco, CA) is essential. The primary aesthetic use of *botulinum* toxin remains in the face and neck, although novel uses are expanding daily for aesthetic and nonaesthetic indications.

The aging face undergoes characteristic physiologic and structural changes that are reflected in the soft tissue layers and skeletal structures. Each region of the face—forehead, periorbital area, midface, lower face, mouth, and neck—ages in a distinct manner. Ultimately it is the contrast between what was and what is that motivates individuals to seek treatment to address this process. Numerous surgical and nonsurgical methods are available to rejuvenate the aging face. The goal of surgery is to address soft tissue laxity, loss of facial volume, and any tissue hypertrophy. Nonsurgical rejuvenation procedures are directed at the texture and quality of the skin and volume deficiencies in the dermis and underlying soft tissue. *Botulinum* toxin treatments address rhytids caused by hyperdynamic muscles of animation and, to some degree, help restore the imbalance created by age. Achieving a balance between dynamic rhytids from hyperactive muscles while maintaining natural facial animation is an important goal of *botulinum* toxin treatment. Naturally, there will be an overlap in the rejuvenation effects of various surgical and nonsurgical treatments. Rhytids caused by extrinsic aging (photodamage and heliodermatitis) and intrinsic chronologic aging and weight loss are common reasons that patients seek nonsurgical rejuvenation. Dermal photoaging, which is caused primarily by actinic damage to the skin, causes dermal thinning at a rate of approximately 6% per decade with thickened, degraded elastic fibers (elastosis), increased ground substance, and reduction in type I collagen. Concomitant changes occur in the epidermis and the subcutaneous adipose tissue. Muscular animation causes facial lines of aging to appear in most people and imprints individual patterns of facial expression. This accounts for the variations in appearance of individuals despite similar muscles of facial animation.

Nonsurgical treatment of facial aging can be described from various perspectives by the nature of the deformity (wrinkles, folds, and furrows), by the skin layer in which the defect occurs (epidermis or dermis), or by the technique used to address it (exfoliation, dermal and subcutaneous fillers, resurfacing, and chemodenervation). Because of the many causes of rhytids, various anatomic locations, individual patient preferences, and the effects of aging, optimal treatment often requires a multifaceted approach. Consequently, treatment objectives should be to prevent, restore, or reverse the cause of the problem. Ultimately the ideal treatment should be individual-

ized according to the causes and the patient's underlying anatomy, and this should be reconciled with the patient's goals and tolerance for the therapeutic options.

Nonsurgical Skin Rejuvenation for Facial Rhytids

Office-based nonsurgical skin rejuvenation for addressing facial aging is performed using one of these three methods, depending on the nature and location of concern:

1. *Botulinum toxin* is used for chemodenervation of the underlying muscles to prevent dynamic wrinkles in the overlying skin. In its absence, repetitive motion of the skin results in rhytids and dermal atrophy. Paralysis of the underlying muscle by *botulinum* toxin prevents continued movement and stress on the skin, improving the appearance of dynamic lines. Treatment can also improve static lines as dermal repair occurs. *Botulinum* toxin treatment also contributes, to some degree, to facial reshaping by decreasing muscle bulk or altering the dynamic balance between elevator and depressor muscles.
2. *Lasers, intense pulsed light (IPL), photorejuvenation, chemical peels, or dermabrasion* are used for softening static lines and the quality of the skin. These resurfacing techniques have their greatest benefit in leveling the epidermis and improving collagen in the dermis. Unlike *botulinum* toxin treatment, these resurfacing methods require varying lengths of recovery as the dermis and epidermis heal. Fractional techniques or subdermal techniques can effectively accelerate recovery time.
3. *Tissue fillers* are used to replace missing dermal components or subcutaneous volume. These injectable materials effectively augment areas of dermal atrophy by supporting the dermal matrix or by enhancing volume. Fillers show an immediate effect, and a plethora of products and applications exist.

Nonsurgical methods are often performed together, depending on the desired goal. These can also be used in conjunction with surgical procedures to complement, enhance, or address a condition that cannot be corrected through surgery. Nonsurgical procedures have broadened the scope of populations and problems that can benefit from them, but they should not be considered a replacement for surgical rejuvenation procedures. Self-applied prescription and cosmeceutical topical agents can also be beneficial and are designed to complement and supplement nonsurgical, physician-administered, in-office facial rejuvenation.

Of the three broad categories of treatments for nonsurgical facial rejuvenation, *Clostridium botulinum* toxin type A (BoNTA-ONA and BoNTA-ABO) injection is the method that most directly affects the underlying cause of the problem. In this chapter we will discuss the role of *botulinum* toxin in the nonsurgical management of facial aging, its advantages and disadvantages, and clinical applications for patients undergoing aesthetic surgery.

Dysport was approved by the FDA in 2009 for the treatment of glabellar lines and joins Botox Cosmetic as the second *botulinum* toxin type A approved in the United States for aesthetic treatment. The goals of and results from Dysport (BoNTA-ABO) treatments are similar to those of Botox Cosmetic (BoNTA-ONA). Nevertheless, it is essential that injectors understand the differences in unit dosing and dilution techniques between Botox Cosmetic and Dysport to achieve reproducible results with these two *botulinum* toxins. We will discuss general reconstitution of Botox Cosmetic and Dysport, dosing and storage guidelines, injection techniques, posttreatment protocols, and potential complications and how to avoid them.

On the horizon is an additional injectable neurotoxin (RT002) made by Revance Therapeutics (Newark, CA) and jointly licensed with Medicis. RT002 is an investigational injectable purified *botulinum* toxin type A that integrates Revance’s patented TransMTS peptide technology. The goal is that this injectable may enhance delivery of the toxin to the target site, which may enhance duration and safety of the drug. Also, Revance recently completed a different U.S. phase 2b trial with RT001, a topical *botulinum* toxin type A gel for the treatment of lateral canthal lines (crow’s-feet wrinkles).

Evolution of Technique

Botulinum toxin has a long history of use in clinical medicine and has been helpful for treating a range of conditions for which the principal therapeutic aim is to reduce undesired or excessive contraction of striated or smooth muscles. Scott is credited with the earliest successful use of *botulinum* toxin in ophthalmology. Thereafter it was used for the treatment of neuromuscular conditions, and indeed, it is considered by many clinicians to be a first-line therapy for focal dystonias. Novel uses are continually developed throughout the spectrum of medical specialties. The box identifies some of the myriad functional and aesthetic applications for *botulinum* toxin; other potential uses of *botulinum* toxin in medicine are yet to be determined.

Partial List of the Uses of Botulinum Toxin in Medical Therapy

Achalasia	Dental procedures	Hyperhidrosis	Spinal cord injury
Anal fissure	Esophageal stricture	Inner ear disorders	Strabismus
Back pain	Essential tremor	Masseteric muscle hypertrophy	Teeth grinding
Benign prostatic hypertrophy	Facial nerve disorders	Neck pain	Tourette’s syndrome
Blepharospasm	Facial spasms	Overactive bladder	Vasospastic disorders
Breast reconstruction and augmentation	Following Mohs micro-surgery repair	Parotid fistulas	Vocal cord disorders
Cerebral palsy	Gustatory sweating (Frey’s syndrome)	Poststroke limb spasticity	Temporomandibular joint dysfunction
Cervical dystonia	Headaches	Pressure ulcers	Wound healing
		Reduced appetite	

Nonaesthetic Uses for Botulinum Toxin Treatment

In 1989 Clark and Berris used *botulinum* toxin to temporarily restore forehead symmetry after a temporal branch motor nerve injury from a face lift. Carruthers and Carruthers, among others, spearheaded the transition in the use of Botox from ophthalmologic to dermatologic and cosmetic applications. They serendipitously observed the effacement of rhytids in patients treated with Botox who had blepharospasm associated with dystonia. Throughout the 1990s, numerous practitioners reported success with *botulinum* toxin for eradication of rhytids in an expanding number of facial regions. By the turn of this century, *botulinum* toxin injections had become the most frequently performed nonsurgical aesthetic procedure, and as the goals of treatment became more sophisticated, its use was expanded to include the entire face and neck and as a treatment for subtly altering facial shape. If the success of a new technology can be measured by its growth and broadening scope of application, then medical and aesthetic uses of *botulinum* toxin injections represent a phenomenon that is rarely seen more than once in a generation.

Chronology of Clostridium Botulinum Toxin in Clinical Medicine

Date	Event	Author
1897	<i>Clostridium botulinum</i> neurotoxin isolated	E. Ermengem
1920	Purification attempts	H. Sommer
1946	Crystallized type A purified	E.J. Schantz
1950	Therapy of hyperfunctional muscles	V. Brooks
1973	Pharmacologic weakening of extraocular muscles in monkeys	A.B. Scott
1979	Crystalline <i>botulinum</i> toxin A; batch 79-11	E.J. Schantz
1980	<i>Botulinum</i> toxin for treatment of strabismus in humans	A.B. Scott
1985	<i>Botulinum</i> A exotoxin used to treat blepharospasm	A.B. Scott
1985	<i>Botulinum</i> toxin used to treat spasmodic torticollis	J.K. Tsui
1989	FDA approves Botox Cosmetic for treatment of strabismus, benign essential blepharospasm, and hemifacial spasm	
1990	<i>Botulinum</i> toxin used to treat dystonias	J. Jankovic
1992	<i>Botulinum</i> A exotoxin used to treat glabellar frown lines	J.D. Carruthers, A. Carruthers
1993	<i>Botulinum</i> toxin used to treat hyperfunction of facial expression	A. Blitzer, M.F. Brin
1997	New lot of Botox reformulated and produced from bulk toxin	
2000	Myobloc (BoNTB) <i>botulinum</i> toxin type B approved for treatment of cervical dystonia	
2002	FDA approves BoNT-ONA (Botox Cosmetic) for treatment of glabellar lines	
2004	FDA approves <i>botulinum</i> toxin for treatment of primary axillary hyperhidrosis	
2007	<i>Botulinum</i> toxin injections are the most common aesthetic procedure in the United States, as reported by the American Society for Aesthetic Plastic Surgery	
2009	FDA approves BoNT-ABO (Dysport) for treatment of cervical dystonia and glabellar lines	

Role of Botulinum Toxin in Nonsurgical Rejuvenation

Botulinum type A is a powerful neurotoxic agent that specifically and physiologically denervates the mimetic muscles of facial expression, thereby eliminating their pull on the overlying skin. The resultant effect is temporary reduction in the appearance of dynamic lines of facial expression and, over time, improvement in static lines as well. *Botulinum* toxin therapy has also evolved from just a “wrinkle treatment” to a method of facial reshaping (elevating soft tissue), because muscular activity causes rhytids and soft tissue malposition. Drooping soft tissue can be manipulated by chemodenervation of muscles in the medial brow, lateral brow, corner of the mouth and jowl by altering the balance between agonist and antagonist muscles. Achieving an aesthetic balance in the muscles of facial expression while reducing the overlying dynamic rhytids is the goal of treatment. For example, the lateral brow has a propensity for ptosis from chronic animation, because of the lateral extent of the frontalis muscle, which ends at the temporal crest line, and the depressor effects of the lateral orbital orbicularis oculi muscle. Consequently, selective treatment of the medial frontalis muscle and corrugators (depressor) and denervation of the orbicularis oculi (accessory brow depressor) provide lateral brow elevation with a concomitant reduction in the appearance of crow’s-feet, resulting in a “chemical brow lift.” *Botulinum* toxin can also be used in conjunction with other methods of nonsurgical facial rejuvenation and/or surgery to achieve a variety of aesthetic goals.

There are eight types of serologically active paralytic *botulinum* toxins; type A (Botox Cosmetic, Dysport) and type B (Myobloc) are the two agents used in clinical practice. They exert their action by preventing the release of acetylcholine at the neuromuscular junction, thereby inhibiting repetitive muscle activity. This leads to the release of the superimposed cutaneous rhytid, which causes the formation of mimetic wrinkles or dynamic lines of facial expression and eventually contributing to dermal atrophy below the wrinkle. Units of biologic activity for different serotypes or formulations are not equivalent and cannot be easily converted to units of other *botulinum* toxins despite comparisons that have been suggested because of unresolved information. Although all *botulinum* toxins have comparable effects, no adequate studies are available for other serotypes such as *botulinum* toxin type B; thus valid conclusions about the efficacy, dosing, and suggested indications are currently incomplete. Currently treatment of glabellar frown lines (Botox Cosmetic 2002 and Dysport 2009) is the only FDA-approved cosmetic use of *botulinum* toxin, and even between these two type A *botulinum* toxins, *it cannot be overemphasized that despite similar treatment outcomes, the dilutions and doses are not equivalent.* In August 2004 Botox Cosmetic was approved for the treatment of hyperhidrosis. All other cosmetic uses for *botulinum* toxin A and B are considered off-label.

Many facial changes associated with the aging face can be attributed to underlying muscular activity, muscle hypertrophy, and patterns of facial expression for which *botulinum* toxin is an appropriate method of treatment. The early focus of *botulinum* toxin therapy was on hyperdynamic upper facial lines. Now its use has been extended to the midface and neck, often referred to as “extended uses.” In these locations, unlike the upper third of the face, the goal is often to weaken but not completely paralyze the muscle to avoid functional loss; for example, softening of vertical “lipstick bleed” lines by weakening the orbicularis oris or the levator labii superioris alaeque nasi to reduce the upper nasolabial crease. It is also now recognized that relaxation of or altering the balance between agonist and antagonist muscles of facial expression can lead to improvement in soft tissue ptosis and muscle hypertrophy.

An expanded use of *botulinum* toxin in aesthetic practices extends beyond the upper face. Nonsurgical reshaping of the lower face can be achieved through injection in the masseter muscles. This is most commonly done in Asian patients. In this indication, the goal is not paralysis, but rather temporary muscle atrophy. The depressor anguli oris or SMAS can also be treated to elevate the corner of the mouth or jowl.

Advantages and Disadvantages

In many respects *botulinum* toxin injection represents the ideal nonsurgical aesthetic procedure. It can be safely and rapidly administered, its effects are profound (essentially 100% successful), it is relatively painless, with no patient down time, it is technically straightforward to use, its effects are reversible within an acceptable period, and complications are uncommon and self-limiting. *Botulinum* toxin appears to be one of those rare therapeutic advances seen periodically over the course of a physician’s career that meets, fulfills, and even exceeds its potential and is destined to have a long-term, sustained impact on the practice of medicine, particularly cosmetic medicine.

Some characteristics of *botulinum* toxin might also be considered disadvantages, such as its reversibility or somewhat short length of therapeutic benefit. The toxin gradually “wears off” 2 to 4 months after treatment. Although some consider this acceptable, others think that its relatively brief duration is a disadvantage. The cost of the toxin is a drawback that can serve as an impetus for overdilution to obtain more volume. In addition, the prolonged consequences, if any, of acetylcholine blocked by *botulinum* toxin are unknown. Some concern has been raised in the media about migration of the neurotoxin into distant sites, including the brain. However, there have been no reported major adverse consequences from the injection of *botulinum* toxin for aesthetic indications using aesthetic dosages.

Indications and Contraindications

Certain patient characteristics and anatomic features help to define good, or conversely, less acceptable candidates for *botulinum* toxin injections. The ideal candidate should:

- Have a good understanding of the cause of his or her “disagreeable biologic condition” and the potential role of *botulinum* toxin in improving it

- Be aware that *botulinum* toxin’s mechanism of action is to address hyperkinetic muscles of facial expression, causing them to relax and therefore releasing the overlying wrinkle rather than filling it in or sanding it down

- Have relatively isolated defects that are not necessarily the result of overlapping conditions (dermal or subcutaneous fat atrophy, excess skin), in addition to the rhytid

- Understand the chronology of *botulinum* toxin’s onset of action and need for continued dosing to maintain the effects, although there is some “retraining” of muscles with repeated *botulinum* toxin use, resulting in intrinsic improvement

- Recognize the value of different surgical and nonsurgical treatments and their various timelines of effectiveness (for example, fillers, 6 months or more, versus *botulinum* toxin, 3 months)

Botulinum toxin should be used cautiously in patients with a propensity to bleed excessively (those with thrombocytopenia; a bleeding disorder such as hemophilia; or patients receiving anticoagulation therapy such as warfarin [Coumadin], clopidogrel [Plavix], or aspirin). Studies are lacking and there is an insufficient number of treated patients 65 years of age or older to make valid statements about the efficacy and safety of *botulinum* toxin in the elderly. Because of the greater frequency of comorbid medical conditions in this population, therapy should be initiated with low initial doses within the recommended dosage range. Despite any evidence of adverse effects, *botulinum* toxin should not be used in pregnant or lactating women or in women who are attempting to get pregnant. Currently the safety and efficacy of *botulinum* toxin have not been established in the pediatric and adolescent populations.

Finally, careful patient selection and counseling are important, because patients who are ill prepared for the paralytic effect and changes in facial morphology can experience untoward psychological adjustment following treatment. As with any aesthetic procedure, pretreatment photodocumentation is recommended to help resolve any issues raised by the patient following treatment.

Common Facial Aesthetic Applications of Botulinum Toxin

Upper third of the face (frontalis, corrugator supercilii/procerus, orbicularis oculi muscles)

Middle third of the face (levator labii superioris alaeque nasi, nasalis muscles)

Lower third of the face and neck (orbicularis oris, masseter, mentalis, depressor anguli oris, platysma muscles)

Following surgery (such as residual corrugator activity after excision), after liposuction of neck or submentoplasty with platysma muscle bowstringing or residual banding

Abnormal muscular hypertrophy (such as the temporalis or masseter muscles)

Combined with other rejuvenating procedures (injectables/fillers, in conjunction with resurfacing and soft tissue augmentation)

Contraindications to Botulinum Toxin Treatment

Patients with hypersensitivity to the ingredients (albumin, sodium chloride, *botulinum* toxin)

Patients with neuromuscular disease (myasthenia gravis, Easton-Lambert syndrome, motor neuron disease)*

Patients treated with *botulinum* toxin concurrent with other drugs that interfere with neuromuscular transmission—antibiotics (certain aminoglycosides, lincosamides, polymyxins), penicillamine, quinine, calcium channel blockers, neuromuscular-blocking agents (atracurium, succinylcholine), anticholinesterases, magnesium sulfate, and quinidine—all of which may increase the paralytic effect of the toxin (also potentially other serologic types of *botulinum*)*

Pregnant or lactating women

Patients receiving anticoagulation therapy/aspirin (a relative contraindication)

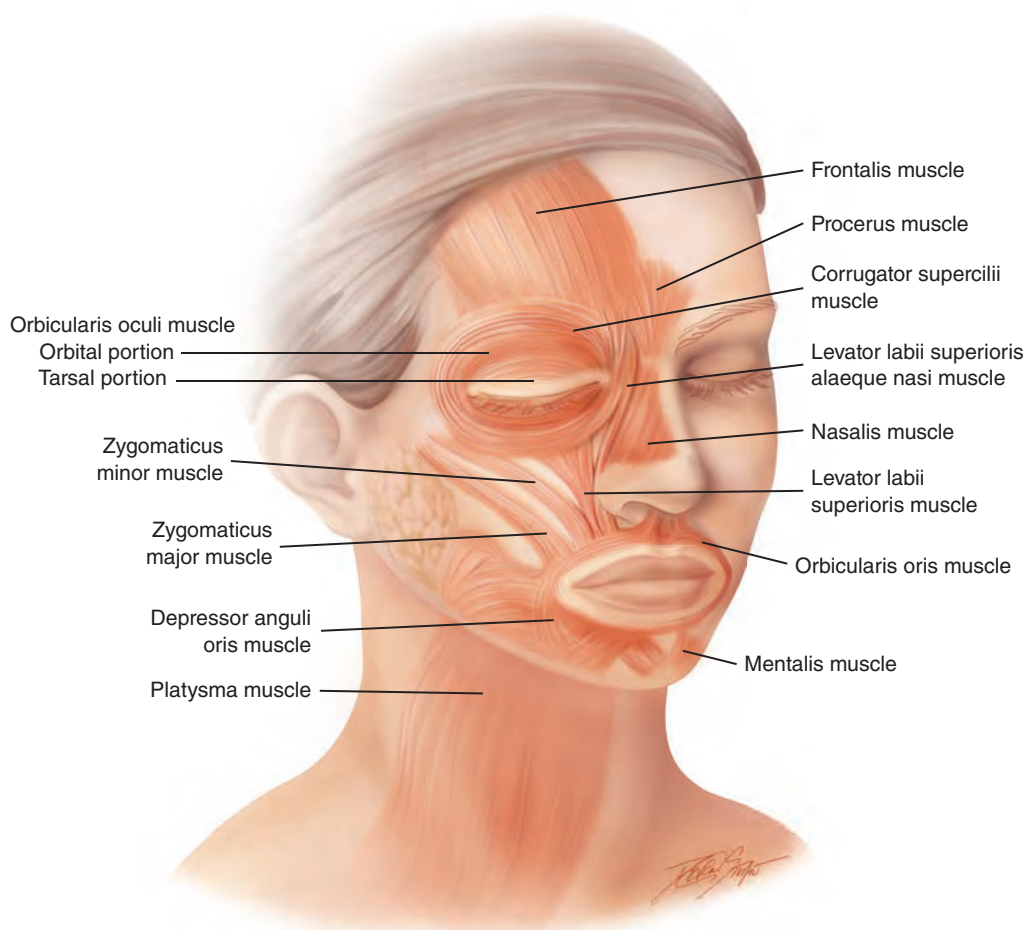
Patients with inappropriate anatomy (skin laxity, photodamage)

Patients with poor psychological adjustment or unrealistic expectations

Patients who are allergic to cow's milk protein (BoNTA-ABO: Dysport)

*These contraindications are based on interactions with drugs and intrinsic muscle disease, which could prolong the neuromuscular blockade effect of *botulinum* toxin.

Pertinent Anatomy



This illustration of relevant facial muscular anatomy shows the most common of the 44 facial muscles in which *botulinum* toxin is injected. The use of *botulinum* toxin for rhytids or to reshape or reposition structures requires an in-depth understanding of the function and location of the muscles of the face, their interactions (agonist versus antagonist), and the unique anatomic features of each region of the face. It is essential to precisely locate the muscles that are to be treated either clinically or by means of electromyography (EMG). We prefer to have the patient activate the muscle to be treated by a forced, exaggerated contractile motion intended to mimic the action of the muscle. The surface topography of that muscle will then be evident by the rhytid that is perpendicular to the body of the muscle (for instance, the orbicularis oculi) or enlargement of the muscle (for instance, the platysma). Anatomic landmarks, danger zones, or areas of altered anatomy from previous surgeries should be identified, along with the specific dosages appropriate to common muscle sites of *botulinum* toxin injection.

Botulinum Toxin: General Dosing Guidelines*

Area (corresponding rhytid)	Muscle	Botox Cosmetic (BoNTA-ONA) Units	Dysport (BoNTA-ABO) Units	Anatomic Landmarks or Danger Zones†
Forehead (horizontal forehead lines)	Frontalis	20-60	30-60	Inject in gridlike pattern; lateral portion of frontalis for 1-2 cm above brow injection will result in inability to raise eyebrow, or “brow ptosis.” To avoid this, inject above lowest fold produced by muscle action and M point. This will cause wrinkle to remain, maintaining brow elevation.
Glabellar complex (vertical and transverse glabellar lines)	Corrugator supercilii/procerus/orbicularis oculi (medial fibers), depressor supercilii	20-40	50-80	Inject in V pattern, staying medial to mid-pupillary line and avoiding injection below 0.5 cm from medial edge of eyebrow.
Bunny lines (side of nose)	Nasalis (transverse portion)	2.5 (per side)	6-15 (per side)	Inject just transverse portion of nasalis muscle.
Crow's-feet (lateral canthal rhytids)	Orbicularis oculi (lateral fibers)	5-15 (per side)	20-60 (per side)	Stay 1 fingerbreadth lateral to orbital rim and 3-4 injections in fan-shaped pattern. Avoid injection too far inferior (to zygomaticus major muscle) and possibly elevate cheek to demonstrate lines caused by zygomaticus muscle as opposed to pure orbicularis oculi muscle (squint).
Upper third of nasolabial fold	Levator labii superioris	2-5 (per side)	5-7	Confine injection to region of piriform aperture between nasolabial fold and nasal ala.
Upper lips (vertical rhytids)	Orbicularis oris	3-10	4-24	Inject small aliquots in lower third (for upper lip) and upper third (for lower lip) of orbicularis oris muscle.
Marionette groove	Depressor anguli oris	2-5 (per side)	20 (per side)	Identify muscle with patient actively pursing lips/chin 1 cm lateral and 1 cm inferior to angle of mouth.
Chin (cobblestoning)	Mentalis	5-10	10-20	Have patient project lower lip and chin upward. Inject at 3-5 sites intramuscularly into “cobblestoned” chin, just inferior to mental sulcus.
Neck (vertical bands)	Platysma	20-40 (per band)	40-80 (per band)	Isolate muscle cords with nondominant hand and inject entire length of body of muscle at 1-1.5 cm intervals from clavicle to its insertion in mandible. Inject subcutaneously for horizontal necklace lines. Avoid sternocleidomastoid muscle.
Masseter hypertrophy (infero-lateral facial fullness)	Masseter	25-30 (per side)	100-300 (per side)	Inject 5-6 points into body of muscle at mandibular angle. The goal is selective muscle atrophy, not paralysis.

*It cannot be stressed enough that Botox Cosmetic and Dysport do not have equivalent dosing on a unit-per-unit basis and that dosing guidelines for Dysport have not been firmly established.

†The surgeon must be aware of the effect that surgically altered anatomy has on muscle position. Dosage should be individualized according to muscle mass, patient response, sex, age, the desired effect, the time interval since the previous exposure, and the condition being treated.

Fundamentals

Pharmacology and Reconstitution



Botulinum neurotoxin type A (BoNTA-ONA: Botox Cosmetic and BoNTA-ABO: Dysport) is one of eight serologically distinct and species-specific toxins produced by the anaerobic bacterium *Clostridium botulinum*. It is a gram-positive, spore-forming, obligate anaerobe that is found naturally in the soil. It is produced by fermentation of strain *C. botulinum* type A grown in a culture medium.

The culture solution is purified and dissolved in sterile sodium chloride containing human albumin and is then sterile-filtered before filling and vacuum drying. It is commercially available as a sterile, lyophilized powder without preservatives. Each single vial of Botox Cosmetic contains 100 units (10% variation) of *botulinum* type A neurotoxin complex, 0.5 mg of human albumin, and 0.9 mg of sodium chloride. A 50-unit vial of Botox Cosmetic is also available.

Each vial of Dysport contains 300 units of *botulinum* type A complex, 125 μ g of human serum albumin, 2.5 mg of lactose, and trace amounts of cow's milk protein. A 500-unit vial of Dysport is also available for cervical dystonia. *It is important to note that Botox Cosmetic and Dysport are not equivalent on a unit-per-unit basis—100 units of Botox Cosmetic is not equivalent to 100 units of Dysport.* Each product is kept refrigerated at 2° to 8° C (35.6° to 46.4° F). At the time of use, it is reconstituted with 0.9% sodium chloride injection, resulting in a clear, colorless, odorless solution that the manufacturer recommends be used within 24 hours.

The rubber stopper can be removed from the vial before mixing to prevent foaming, which anecdotal reports state can potentially denature the toxin, and the saline solution is introduced by means of a 1 ml Luer-Lok syringe with a 22- or 25-gauge needle. The same needle is used to withdraw the reconstituted solution and is then replaced with a 1/2-inch 30- or 32-gauge needle, which is used for injection.

Mechanism of Action

Both BoNTA-ONA (Botox Cosmetic) and BoNTA-ABO (Dysport) are composed of *botulinum* toxin type A, each with a unique toxin/protein complex. The different complexes result in the differences in unit dosing between the two products. Once injected, the *botulinum* toxin core quickly dissociates from the complex and diffuses to its site of action. The toxin produces chemodenervation by preventing release of acetylcholine at the neuromuscular junction of the peripheral nervous system and at ganglionic nerve terminals of the autonomic nervous system within 6 to 36 hours of exposure to muscle with maximum effect up to 7 to 14 days. The neurotoxic effects of *botulinum* toxin occur in three phases:

1. Binding
2. Internalization
3. Neuromuscular blockade

Following these phases, a chemical denervation results, with associated clinically flaccid paralysis of the targeted muscle. At therapeutic doses the toxin induces paralysis limited to the injected muscle; however, the toxin has the potential to cause paralysis or weakness of adjacent muscles by diffusion and spread. The extent of muscular paralysis and atrophy correlates directly with the amount of toxin injected (concentration and volume of toxin solution). Diffusion results from toxin moving down its concentration gradient, which is affected by local receptor concentration. The spread depends on the solution volume and injection technique (physically pushing the toxin from the area of injection). There is an ongoing turnover (redevelopment) of neuromuscular junctions so that muscular function gradually returns after approximately 3 months, and axonal sprouting and reorientation of muscle fibers prevent permanent paralysis of muscles that are treated repeatedly.

Toxicity

Botulinum toxin is one of the most potent and neurospecific toxins known. It is estimated that in a 70 kg adult, the lethal dose of crystalline *botulinum* type A would be approximately 0.09 to 0.15 mg by the intravenous or intramuscular route, 0.7 to 0.9 mg by inhalation, and 70 mg if ingested orally. Considering the type available in the United States, it would be inaccurate to consider it as a potential bioterrorism agent, because each vial contains only about 0.3% of the estimated human lethal inhalation dose and 0.005% of the estimated lethal oral dose. The toxin does not penetrate intact skin, and person-to-person transmission does not occur.

The lethal dose of Botox Cosmetic is measured in units, with 1 unit being the lethal dose of toxin, causing death in 50% of a group of 18 to 20 g female Swiss Webster mice within 3 days of intraperitoneal injection. The median lethal dose (LD₅₀) has been estimated to be 2700 (2500 to 3000 units) in a 70 kg human, based on the median lethal dose of approximately 40 units/kg in primates. Species-specific sensitiv-

ity to the toxin precludes precise calculation of the human LD₅₀. The normal dose that does not produce toxicity is not known; however, single doses exceeding 500 units of BoNTA-ONA may produce acute symptoms and signs of botulism.

Dosages

The manufacturer's recommendations and initial FDA approval of Botox Cosmetic for treatment of the glabellar area were based on 2.5 ml (0.1 ml = 4 units) of unpreserved normal saline solution per 100 units of Botox Cosmetic for reconstitution. The maximum total recommended dose is 300 to 400 units at any one session and not more than 400 units over a 3-month period. The maximum dose of Dysport is 1000 units over a similar period. The dosage should be altered according to anatomic location, muscle mass, age, and sex of the patient, the patient's prior experience with *botulinum* toxin, the desired effect, the time interval since the previous exposure, and the condition being treated. Male patients may have a less profound and long-lasting result with *botulinum* toxin.

An acute awareness of the differences in dosing between Botox Cosmetic and Dysport is essential, since the "units" are not interchangeable. In general, Dysport is less active on a unit-per-unit comparison with Botox Cosmetic, which means that more units of Dysport are required to achieve similar clinical effects. With normalized clinical dosing, similar results can be achieved. Some studies, with electromyographic evidence, show that Dysport may achieve a clinic effect faster and maintain results longer than Botox Cosmetic. Continued clinical experience is required. Additionally, some practitioners have raised the concern of the smaller complex size of Dysport leading to a higher risk of diffusion. However, studies show that the toxin quickly dissociates from the complex under physiologic conditions once it is injected, precluding complex size from resulting in differences in diffusion. Perhaps because of this, some have claimed that Dysport produces a softer, more natural appearance. A distinction should be made between diffusion and spread. *Diffusion* is attributable to the total dose and receptor concentration because the toxin moves down its concentration gradient. *Spread*, on the other hand, is dependent on the volume injected and the injection technique; injecting a higher volume leads to increased physical distribution of the product as the fluid is pushed through the tissues from the point of injection. So diffusion or spread is a function of concentration gradient and physical force and is not attributable to the specific brand or formulation of toxin.

Dilution and Storage Considerations

There are two areas of frequent controversy regarding *botulinum* toxin that have yet to be determined: (1) the appropriate dilution of the toxin and (2) the method and length of storage of the reconstituted toxin. The manufacturer provides a table of 1 to 10 ml of dilution; however, physician preference remains the deciding factor. The glabella is the only area for which the FDA has approved injections and that is based on a dilution of 2.5 ml into a 100-unit vial of Botox Cosmetic or 2.5 ml and 1.5 ml

dilutions into a 300-unit vial of Dysport. Large dilutions with lower concentrations of toxins require larger volumes of injections to achieve the desired result, which can increase the potential for spread of the toxin to unwanted surrounding areas. For that reason we prefer a low volume and high concentration of *botulinum* toxin.

Type and Concentration of Botulinum Toxin

Type of Botulinum Toxin	Concentration (units/ml)
Dysport 300-unit vial	
1 ml	30/0.1
1.5 ml	20/0.1
2.5 ml	12/0.1
3 ml	10/0.1
Botox Cosmetic 100-unit vial	
2 ml	5/0.1
2.5 ml	4/0.1
4 ml	2.5/0.1
Botox Cosmetic 50-unit vial	
1 ml	5/0.1
2 ml	2.5/0.1

The length of viability of reconstituted toxin and the method of storage are also subject to controversy. We prefer using the toxin within 24 hours of reconstitution, during which time the unused toxin is kept refrigerated at 2° to 8° C. Some physicians refrigerate the toxin after reconstitution and have demonstrated a viable, albeit progressive, loss of drug efficacy over a 30-day period. If the toxin is stored, it should be reconstituted with bacteriostatic 0.9% sodium chloride preserved with benzyl alcohol to avoid bacterial contamination. Once the cap has been removed, the vial contents are no longer sterile.

Pretreatment Assessment

Physical Examination and Patient Education

A staff member interviews and evaluates the patient, who is given an informational packet to read before consultation with the physician. The medical history includes the patient's prior treatments with *botulinum* toxin, topical agents, or injectable fillers. The patient is asked to actively contract the intended muscle to be treated in front of a hand mirror, which helps to identify the muscle and serves as a tool for patient education. The patient is instructed to accentuate the specific facial lines to be treated by frowning (glabellar lines), squinting (lateral canthal lines), or elevating the brow (horizontal forehead lines). Patients never scrutinize their faces as much

before a procedure as they do after it has been completed; therefore it is important to identify and point out to patients the naturally occurring asymmetries that are present before treatment and to possibly obtain photographic documentation of baseline status. For example, there can be more aging on the left side of the face in general, and crow's-feet in particular, because of exposure to the elements while a person is seated on the driver's side of an automobile, and this side may need more toxin. Coexisting conditions in the field of treatment that will not be improved with injections (such as loose skin in the neck and static lines in the periocular region) should be identified and discussed with the patient. Planning for concurrent dermal filler or subsequent surgical treatment can be discussed. Unless one has prior experience that the patient has significant enough dermal atrophy to require correction with filler, we prefer to denervate the muscle with *botulinum* toxin and await the therapeutic benefit before determining the need for dermal filler supplementation.

Before treatment, the patient should be examined for preexisting ptosis. There are three types of "ptosis" that can be encountered before or subsequent to treatment:

1. *Drug-induced eyelid ptosis* results from diffusion of the toxin to the upper eyelid levator aponeurosis after injection of the corrugator muscle or crow's-feet. The cause and effect of this are largely unknown and speculative, since studies with direction injection of *botulinum* toxin into the levator muscle have occasionally failed to achieve ptosis. The treatment is medications that stimulate Müller's muscle, such as Naphcon A eyedrops 3 to 4 times daily or apraclonidine 0.5% after consulting with the patient's ophthalmologist. These drops provide approximately 1 to 2 mm of elevation and require continued use for sustained effect. Patients should have an eye examination before the agents are used; they should not be administered in patients with glaucoma.
2. *Preexisting eyelid ptosis* reflects the unmasking of preexisting upper lid ptosis that had been compensated for by frontalis muscle activity; treating the frontalis muscles with *botulinum* toxin unmasks this. The treatment is careful preoperative identification with administration of Müller's muscle agonist agents as indicated.
3. *True brow ptosis* is caused by loss of frontalis muscle activity, which is attributed to injection of the lower border of the lateral frontalis muscle 1 fingerbreadth below or above the brow. Patients may present complaining of heavy eyelids despite a lack of eyelid ptosis or inability to put on eye shadow. The correct treatment is to avoid this area and/or inject the antagonist depressor muscles, known as the *M point* of the orbicularis oculi. Before treatment, the efficacy against all forehead lines and the effect that has on brow position are discussed with the patient, including not treating the lower forehead lines to allow eyebrow movement. This is frequently the area of greatest patient concern. Moreover, surgical procedures to elevate and stabilize the lateral brow enable patients to have the lower rhytids treated with *botulinum* toxin. In addition, with elevation of the lateral brow there is less stimulus for the patient to contract the brow upward. Thus even without *botulinum* toxin the surgery alone improves the wrinkles.

Patients are instructed to cease using the following, if feasible, for 10 to 14 days before treatment to minimize ecchymosis: aspirin products, compounds containing vitamin E, nonsteroidal antiinflammatory agents, and dietary supplements that predispose them to bleeding or coagulation problems. As with any medical procedure, patients are asked to sign an informed consent form and HIPPA forms before treatment. Photographic documentation is beneficial. In addition, it is important to discuss the benefits and limitations of *botulinum* toxin treatment and review the alternatives or supplemental treatments that are valuable. Patients' questions are answered before treatment. We have an in-depth discussion with the patient about specific concerns, the cause of their "disagreeable biologic condition," and the therapeutic options available. We explain the specific role of *botulinum* toxin, the intended results, the length of its effectiveness, and potential complications. We are also careful to point out that unlike most filler materials, with which patients see an immediate result, the response to *botulinum* toxin is delayed (up to 14 days for final results).

Pretreatment Planning

Patient Preparation

Before treatment and the application of topical anesthesia, all areas of the face are cleansed of makeup and lipstick. Because patients want maximal benefit with minimal adverse effects or complications and a rapid recovery, every effort should be made to reduce patient discomfort. Therefore a topical analgesic is applied (lidocaine 4% [LMX4; Ferndale Laboratories, Ferndale, MI]) if requested; the patient is offered an anxiolytic agent if warranted; and cold compresses are applied to the intended sites to lessen discomfort. With the patient in an upright position, the product is injected into the region of the muscle according to its precise anatomic location. The dose of *botulinum* toxin varies, depending on the factors mentioned. Injecting a local anesthetic mimics the effect of the *botulinum* toxin action, which can serve as an educational tool for the patient.

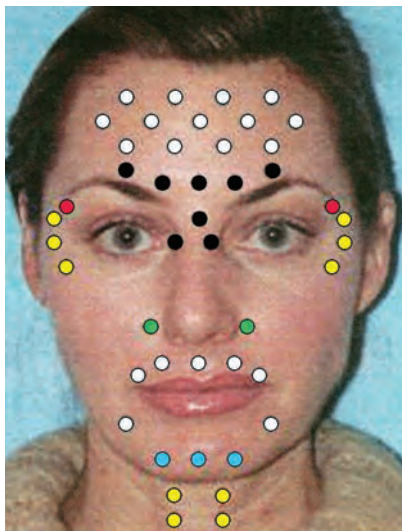
Markings

For a typical office treatment, surgical markings are unnecessary, because in contrast to a surgical procedure, the patient is asked to repeatedly contract the muscle to identify sites for injection. The upright position does not distort the injection area. If the patient is having *botulinum* toxin injections intraoperatively, markings are made over the presumed body of the muscle, not necessarily over the deepest dermal rhytid.

Technique



11-1 Botox Cosmetic and Dysport: anatomy, supplies, techniques, and results



GENERALLY RECOMMENDED INJECTION SITES

Forehead	White dots	Frontalis muscle
	Black dots	Glabellar complex
Eyelid	Yellow dots	Orbicularis oculi muscle
	Red dots	M point of orbicularis oculi
Midface	Green dots	Upper nasolabial fold
Lip	White dots	Vertical lip lines
Chin	Blue dots	Mentalis muscle (cobblestoning)
Neck	Yellow dots	Platysma bands

With the patient in a seated position and after suitable preparation, each muscle of concern is identified and isolated. The intended muscle is isolated and stabilized or grasped with the nondominant hand. Injections are made into the region of the muscle according to its precise anatomic location.



Injection proceeds using proper injection techniques (injecting slowly perpendicular to a noncontracted muscle). Botox can be injected into various levels, such as the body of the muscle (corrugator, platysma), deep subcutaneous tissue overlying the muscle (frontalis), or superficially (orbicularis oculi). A serial puncture technique is preferred, rather than a bolus that is spread by massaging. Some physicians use EMG guidance to identify and isolate muscles, but this may have limited benefit in areas in which muscles are palpable, visible, and easily identified, such as those in the face. The purported advantage of EMG guidance is that it allows more accurate identification of the neural motor endplate, facilitating more precise injection and improv-

ing the effectiveness of lower doses of *botulinum* toxin. However, for general aesthetic indications this is rarely necessary. A postinjection protocol is then initiated.

The muscles are sequentially injected (intramuscularly [deep], or superficially [subcutaneously]). The solution is withdrawn in aliquots of 2.5 to 5 units of Botox Cosmetic or 5 to 10 units of Dysport (smaller increments for nasolabial and lip areas) at intervals of 0.5 to 1.5 cm apart, depending on the muscle and the intended result. With familiarity, the clinician performing the injections develops a sense of the necessary volume of injectate without observing the volume markings on the syringe. Some clinicians believe that *botulinum* toxin has a 3 cm target of spread (not unwanted diffusion from movement). Although this may be so, it may vary in different regions, and the perimeters of the zone of spread should not be relied on for chemodenervation; instead, sites beyond 1 to 1.5 cm require their own injection for reliable paralysis (wider zones of injection are feasible in the frontalis muscle). When completing each injection, the surgeon withdraws the hub of the syringe slightly by the thumb to prevent unnecessary spillage of the toxin. Alternatively, an insulin syringe can be used. These syringes do not have a Luer-Lok, so less toxin will be wasted. The disadvantages of an insulin-type syringe are that it is difficult to draw the solution into the syringe with the single-use needle, and the needle dulls quickly.

The fundamental principles for a successful outcome with *botulinum* toxin include the following:

- Proper reconstitution and storage of toxin
- Proper patient education, consent, and pretreatment preparation
- Proper muscle identification and isolation, and matching of the toxin dose to each individual patient's needs to achieve the intended result
- Proper injection technique
- Proper posttreatment protocol
- Frequent needle changes (the needle dulls with repeated use from multiple injections)

Combination Treatments

Botulinum toxin is commonly injected alone as monotherapy, although combination treatments during the same or subsequent sessions (fillers and resurfacing) can be used as necessary to treat the different layers of the skin and various conditions. For example, *botulinum* toxin can be injected into the frontalis muscle for dynamic forehead lines while avoiding the 1 to 2 cm above the brow so that muscle activity remains; substituting a filler in this area can help ameliorate the residual static lines. For deep glabellar lines (static and dynamic), a combination of *botulinum* toxin and

dermal filler may be necessary to achieve an optimal result. Numerous combinations are also possible. For example, *botulinum* toxin may be injected into the orbicularis oris muscle in conjunction with resurfacing (not simultaneously) or fillers to the lip and/or to the vertical lip lines. *Botulinum* toxin can also be used for crow's-feet, with laser resurfacing to the lower lid skin and fillers to the lower crow's-feet to avoid paralysis of the zygomaticus major muscle. When *botulinum* toxin is combined with a filler, it tends to prolong the longevity of the filler by decreasing the metabolism in the surrounding tissue. *Botulinum* toxin also has the potential to enhance the effects of laser resurfacing by improving collagen reorganization while the skin is paralyzed. In some areas, such as the upper third of the face, the physician can delay injecting filler material until the *botulinum* toxin is fully effective before resorting to the use of a filler. However, with nonsurgical rejuvenations, mixing and matching of products is common. One must keep in mind the differing timelines for longevity of the products or techniques used. Moreover, *botulinum* toxin can be used in conjunction with various depth peels and laser resurfacing.

Posttreatment Care

The most common adverse sequelae, ecchymosis and erythema, can be managed by applying gentle pressure with or without cold compresses to the treated site immediately after each site is injected. Patients are advised to actively contract the treated muscle in an attempt to (theoretically) enhance toxin uptake by causing more rapid internalization of the toxin (however, the usefulness of this technique has not been proved). Patients are instructed to resume normal activities immediately after their treatment session but are advised to remain upright and to avoid lifting, bending, or straining for 3 to 4 hours, particularly when the treated site is in the upper third of the face, to help prevent unwanted spread of the toxin. Essentially, the patient should hold his or her head upright as if balancing a book on it. Thereafter all activities are unrestricted. The consensus is that flying in an airplane and heat exposure do not have an adverse impact. The application of camouflaging agents or makeup is unrestricted.

Although adverse sequelae are self-limited, they do occur, and it is best to counsel the patient reassuringly. For the occasional patient who complains of headaches, nonaspirin products can be given. Vitamins and nutritional supplements can be administered as indicated, although whenever possible it is helpful to avoid these for 10 to 14 days before treatment to help prevent ecchymosis. Patients can return for a postinjection examination after 2 weeks and within the first 4 to 6 weeks if they suspect a therapeutic failure; beyond that it cannot be ascertained whether the muscle activity represents normal wearing off of the toxin or a therapeutic failure. Otherwise, patients are advised to return after a minimum of 3 months for additional treatments if they want to maintain the results.

Presumed therapeutic failures can often be attributed to the following:

1. A misunderstanding of the intended effect
2. The recruitment of surrounding muscle that was not intended to be affected
3. The patient's not being informed that residual static lines will not be improved by *botulinum* toxin treatments
4. A persistent rhytid resulting from dermal atrophy in the absence of underlying muscle activity

The effects of *botulinum* toxin injections can be observed as early as a few days later or up 14 days after treatment, depending on which muscle is treated and a variety of other factors. It is therefore advisable to wait 14 days, but within 4 to 6 weeks, and then examine a patient who believes he or she has had an inadequate response. If there is still residual muscle activity, additional *botulinum* toxin injections may be indicated. We usually do not advise "booster injections" within the 3 months after injection as the toxin is naturally wearing off.

Muscle activity begins to return gradually and waxes and wanes until approximately 3 to 4 months after injection, when full muscle mobility resumes. When proper precautions are taken to prevent complications of individual procedures, *botulinum* toxin can be administered before, during, or after surgical or resurfacing procedures without any adverse effects attributable to the combined modalities. However, consideration must be given to two situations related to *botulinum* toxin in a surgical patient:

1. If *botulinum* toxin is used intraoperatively or immediately postoperatively, the patient is potentially less likely to maintain the recommended inactivity to prevent spread.
2. In a postsurgical patient, the injector should be made aware of any anatomic (muscle) alterations related to the surgery.

Problems and Complications

Complications fall into three general categories: local, regional, and systemic. In addition, toxin "deactivation," immunologic responses, and therapeutic failure can be considered complications. Normal sequelae that are not true complications but that the patient may consider complications include needle marks, swelling, bruising, and mild erythema, or an earlier onset in one anatomic site versus another. Many of these normal effects that patients may consider abnormal are related to their preconceived expectations. The time of onset is an important indicator of a complication versus a normal sequela, because technical reactions are likely to be observed earlier than true complications.

Local, Regional, and Systemic Complications

There can be a fine line between what is considered normal sequelae and local complications. Local complications can include injection site pain, swelling, edema, erythema, rash bruising, ecchymosis, tenderness, headache, and short-term hypesthesias and can be related to the injection sites. S.L. Matarasso has summarized techniques to minimize these local complications.

The most notable and disfiguring regional complications occur when the toxins diffuse or migrate, spreading the neuromuscular blockade to unintended adjacent sites such as the zygomaticus major, which could be inadvertently injected during treatment of the orbicularis oculi, creating upper lip asymmetry or dysphagia or neck muscle weakness from platysma muscle injection. Other regional complications include loss of facial expression (a masklike countenance) from excessive paralysis, rendering the patient expressionless, or incomplete muscle paralysis with residual rhytids (similar to that which occurs in local complications).

Systemic reactions can include nausea, fatigue, severe generalized muscle weakness (only reported for patients in whom it was used in larger doses for noncosmetic purposes), malaise, flulike symptoms, distant rashes, respiratory arrest, and death. At therapeutic doses, *botulinum* toxin is not expected to be present in peripheral blood at measurable levels following intramuscular injection, nor does the amount of drug administered in a typical session appear to induce systemic effects. Distant neuromuscular effects have been documented but only from single-fiber EMG studies. The significance of these findings remains unclear. Isolated nervous system, respiratory, ocular, gastrointestinal (in patients with cervical dystonia—oral dryness, nausea, dysphagia, and dyspepsia), musculoskeletal, cardiovascular, dermatologic, and genitourinary complications have been reported with general (noncosmetic) uses of *botulinum* toxin and rarely if ever from the dosage range required for cosmetic usage. In fact, most of the literature on complications is from noncosmetic sources. It is suggested that practitioners report adverse events with Botox Cosmetic to the Medical Affairs Division of Allergan at 1-800-433-8871 or the FDA at 1-800-FDA-1088.

Immunologic Reactions

Immunologic complications include acute type I reactions and may be attributable to human serum albumin. This may result from the presence of circulating immunoglobulin G antibodies and is reported to occur in 3% to 5% of patients treated for cervical dystonia where large volumes of toxin are used. Since 1997, with a reduction in protein content to 20% of the original volume in the solution, there have been no reports of this complication. The development of antibodies seems to correlate with an increasing number of injections, frequency of treatment, and total cumulative dose of toxin. Since we began using *botulinum* toxin for aesthetic indications, we have encountered only two patients who were resistant to treatment, presum-

ably because of the neutralizing effect of antibodies. Limiting the total amount of toxin to less than 300 to 400 units of Botox Cosmetic per session and avoiding booster injections for a minimum of 3 months are recommended to prevent formation of these antibodies. Serum analysis can be performed to analyze for circulating antibodies, but is rarely indicated (*PacificBiolabs.com*). Injecting 15 units of Botox Cosmetic into one side of the frontalis muscle to observe for asymmetrical clinical effect can be used as a simple clinical test for resistance. *Botulinum* toxin type B (Myobloc/Neurobloc) may be considered as an alternative in patients with immunologic resistance to *botulinum* toxin type A as well as for other purposes. It is unlikely that another *botulinum* toxin type A (Dysport) would benefit a patient resistant to another *botulinum* toxin type A (Botox Cosmetic).

Therapeutic Failures

Therapeutic failures can range from no effect whatsoever after an injection to an unintended effect. A therapeutic failure can originate at various stages in the treatment process. Improper mixing (foaming), improper dilution or storage (wrong temperature), incorrect muscle identification, or failure to distinguish a static from a dynamic rhytid can also result in a therapeutic failure.

Botox “signs” are considered an unintended result caused by recruitment of untreated adjacent muscles, or an abnormal appearance resulting from loss of function in a treated muscle can be interpreted as a failure.

Outcomes

Results with *botulinum* toxin as a primary monotherapy or in conjunction with fillers, resurfacing, or surgery, when injected appropriately, are generally excellent. Indeed, unlike almost any other surgical or nonsurgical procedure used for facial rejuvenation, *botulinum* toxin can provide an “all or none” response (unless weakening of the muscle is the goal), making it 100% effective.

The most common causes of patient dissatisfaction with *botulinum* toxin treatment include the following:

- Inadequate understanding of the role of *botulinum* toxin in facial rejuvenation.
- Unpreparedness for the effects of *botulinum* toxin treatment, including temporary paralysis or altered balance of the muscles of facial expression.
- The psychological consequences of altered facial appearance.
- Suspected therapeutic failure that can be attributed to the recruitment of surrounding untreated muscles.
- Short-term local complications.

Rare general, systemic, or immunologic complications.

In the face, the most common concerns occur with treatment of the lateral third of the frontalis muscle over the brow, where injection will ameliorate rhytids but will also limit the patient's ability to elevate the eyebrows.

Results



This 57-year-old woman complained of forehead and glabellar wrinkling and cobblestoning of her chin. She underwent Botox Cosmetic injections to her frontalis (forehead), corrugator, procerus, and mentalis muscles. She is seen 4 weeks after treatment, with reduction in the appearance of her rhytids and cobblestoning in the mentalis area.



This 38-year-old woman presented with perioral rhytids and upper facial rhytids. She underwent *botulinum* toxin injections to her forehead, glabella, crow's-feet area, and her upper lip. She is seen 6 weeks after treatment. The results of her perioral treatment reveal a reduction in the vertical lip lines. Treatment here must be tempered with an awareness of the potential for loss of function and lip symmetry.



This 46-year-old woman presented with upper facial rhytids and cobblestoning of her chin and neck cords. She was treated with Botox Cosmetic injections to her frontalis muscle (forehead), corrugator muscle complex, orbicularis oculi muscles, and mentalis and platysma muscles. She is seen 1 month after treatment.



This 62-year-old woman presented with hypertrophic platysma cords and horizontal necklace lines. She was treated with *botulinum* toxin injections to her vertical platysma muscles and horizontal neck creases. She is seen 1 month after treatment. Improvement is evident in her hypertrophic right neck muscle cord, and the necklace lines have softened.



This 52-year-old woman presented with periocular and glabellar rhytids. She was treated with Botox Cosmetic injections to her corrugator-procerus muscle complex and the lateral orbicularis oculi muscle. She is seen following injection at the onset of the therapeutic benefits. The reshaping in the arch of her lateral brow is evident; this was produced by deactivating the depressor muscles in this area and allowing the elevator (frontalis) muscles to act unopposed.

Concluding Thoughts

Botulinum toxin injection is an aesthetic procedure that is essentially 100% effective. Its use has been enthusiastically embraced by physicians and patients, to the extent that the name of the first product approved for use in the United States, Botox, was rapidly incorporated into the popular vernacular. There are two types of type A toxins, Botox Cosmetic (BoNTA-ONA) and Dysport (BoNTA-ABO), that are FDA approved for the treatment of glabellar creases; all other indications are considered off-label.

The dilution and dosage of the two products are distinctly different. Practitioners must thoroughly understand the reconstitution, indications, technique, therapeutic benefits, and complications and their management for each of these agents. A type B alternative is also available for use (Myobloc), or for type A-resistant patients. Although the primary aesthetic use of *botulinum* toxin remains in the face and neck, additional applications are being developed for aesthetic and nonaesthetic indications.

Clinical Caveats

A new sterile needle and syringe should be used to enter the vial when reconstituting the drug and for withdrawal of each dose. The manufacturers consider each *botulinum* toxin vial to represent a single use.

If alcohol is used to cleanse the patient's skin or the rubber stopper on the vial, it should be allowed to dry before proceeding with the injection to avoid potential denaturation of the toxin.

The interval between full *botulinum* toxin treatment sessions should be at least 3 months.

The lowest effective dose of the drug should be administered.

Appropriate supportive care and therapy (epinephrine) should be available and initiated immediately if anaphylaxis or another severe allergic reaction occurs.

An anatomic data sheet or some other record is a helpful means of recording the date of injection, the sites of injection, the number of units used, any concomitant use of fillers, and the patient response (duration).

Dilution of the toxin with preserved (benzyl alcohol) 0.9% sodium chloride will help to relieve pain on injection. Injecting when the muscle is relaxed is also less painful. The toxin can also be reconstituted with lidocaine, which "previews" the effect of *botulinum* toxin, but also impedes the ability of the patient to contract the muscle after treatment, which may enhance toxin uptake.

Continued

Clinical Caveats—cont'd

Unlike fillers, the skin layer into which *botulinum* toxin is injected is not as critical, and results are less potentially operator dependent than with fillers.

Regularly repeated injections may render the muscle mass smaller, resulting in a faster onset of action and a longer response, or this effect may result in behavioral modifications (muscle “retraining”), causing the patient to avoid certain facial movements, thereby naturally improving the area.

Precise identification of muscular anatomy and needle placement is essential for a successful outcome. The injector must consider that any effect that *botulinum* toxin could have on anatomy may be altered if prior surgery has been performed.

Problems with dilution occur with greater volumes of diluent, such as more than 5 ml of saline/100 units of Botox Cosmetic, because spread becomes more dependent on excess volume of solution rather than on the drug itself.

When treating one of the agonist-antagonist muscle groups (frontalis and corrugator), for example, for facial reshaping, it may be advisable to counterbalance the opposing muscle with a small amount of toxin to avoid an imbalance when movement of an opposing muscle is lost. When counterbalancing muscles is not an issue (for example, in the orbicularis oris), one should consider the effect that paralysis of the treated muscle will have on function.

Facial anatomy (musculature) is similar from one patient to another; the degree of soft tissue malposition and rhytid formation will vary according to patterns of muscle usage (animation), resulting in different types of deformities that require different treatment approaches.

“Extended” areas of treatment such as the lower half of the face (nasolabial folds, upper lip lines, marionette grooves, jowls, chin dimpling, and the masseter) should be weakened rather than paralyzed to avoid a functional imbalance from loss of muscle activity. In these regions, adjunctive use or primary use of fillers is more common than *botulinum* toxin alone as monotherapy.

Softening the glabellar frown muscle complex that depresses the brow will help lessen the pull of the antagonist frontalis muscle and reflexly slightly improve transverse forehead lines.

Nonresponders who may require additional toxin should be evaluated to determine whether the response appears to be ineffective because the patient is recruiting surrounding muscles (the “shelf” that appears with smiling below a treated orbicularis oculi muscle from zygomaticus muscle activity) or a remaining rhytid that is caused by dermal atrophy, as opposed to an actual therapeutic failure.

At the end of the day, if there is not enough *botulinum* toxin left in the reconstituted vial to effectively treat a site and there is “one more patient” or site to be treated, a new bottle should be opened to provide adequate treatment, even if the bottle will contain leftover toxin and potentially wasted drug.

When there is leftover toxin, it may be refrigerated, preferably for not more than 24 hours. The next day it can be combined with a “fresh” solution of similar toxin.

Annotated Bibliography

American Hospital Formulary Service (AHFS). Botulinum toxin monograph. American Society of Health System Pharmacists (ASHP), 2003.

This is an extensively researched and referenced monograph detailing the biology, chemistry, toxicity, and extensive medical uses for botulinum toxins. It does not contain clinical examples but is an important, easily readable resource for in-depth information on botulinum toxin in all areas of medicine.

Matarasso A. Clinical usage of Botox. In Aesthetic Surgery Video Journal. New York: American Society for Aesthetic Plastic Surgery, TRT Productions, 1999.

This videotape provides live patient examples of Botox injections. Accompanying the treatment is a discussion by the surgeon about techniques and dosages. The video concludes with a discussion of complications and their management. It is a useful and practical guide.

Matarasso A, Shafer D. Botulinum neurotoxin type A-ABO (Dysport): clinical indications and practice guide. *Aesthet Surg J* 29:S72-S79, 2009.

A comprehensive overview of the clinical uses of Dysport in practice, including reconstitution and injection techniques and a discussion about the important differences in unit dosing between Botox Cosmetic and Dysport.

Matarasso SL. Complications of botulinum exotoxin for hyperfunctional lines. *Dermatol Surg* 24:1249-1254, 1998.

This article reviews the common areas of Botox Cosmetic use—the technical aspects of injections to avoid complications and the management of problems associated with botulinum toxin. This is a handy reference with which practitioners should familiarize themselves.

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A comprehensive overview of the aesthetic indications, techniques, suggested doses, and examples of botulinum toxin use. This article serves as a useful template for learning how to use Botox Cosmetic.

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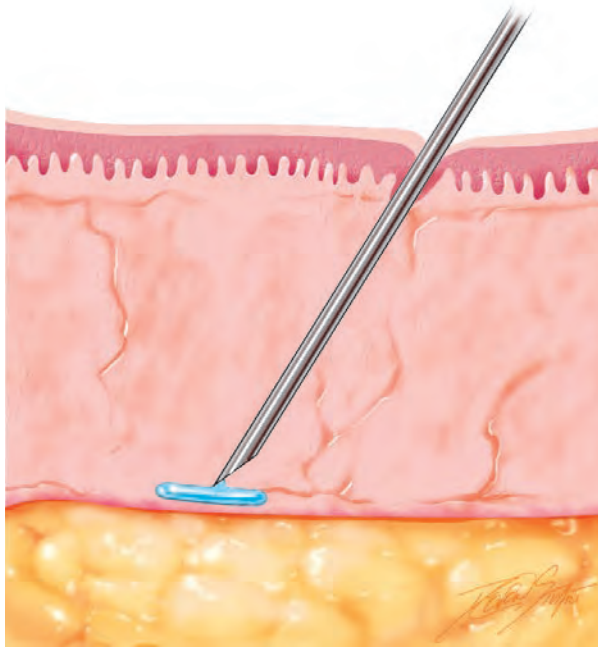
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CHAPTER 12



Soft Tissue Fillers in Aesthetic Facial Surgery

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Soft tissue fillers are an exciting tool for cosmetic surgeons striving to meet the growing patient demand for facial rejuvenation that requires minimal down time. For younger patients, these materials offer the potential for staving off the first visible signs of aging without the morbidity associated with more invasive surgical procedures. These materials are also appealing to individuals who want to look refreshed but do not want to take the time that a major lift would involve. Fillers also serve as an initial therapy for a young to middle-aged patient population with minimal to moderate signs of aging who regard fillers as the first step in the rejuvenation process. As these patients age, surgery, often combined with fillers and other surface treatments, becomes the next logical step in their quest to restore and maintain a youthful, refreshed appearance.

Today the number and variety of products available are impressive. Yet the ideal filler has not been found; neither have we agreed on the properties that would be appropriate for all fillers. For example, although permanence would clearly be a virtue, it could also be a negative if the filler used did not age appropriately as the patient’s soft tissues became ptotic and attenuated. Therefore reversibility is an important characteristic. Despite these reservations, there are certain basic qualities that we seek in the ideal filler material.

Ideal Filler Characteristics	
Nontoxic	Predictable (permanence, bulk, and behavior)
Biocompatible	Not discernible by touch/appearance
Long lasting (if not permanent)	Produces positive, natural, discernible change
Reversible	Involves minimal down time
Off the shelf	Offers multiple levels of placement (could be placed through dermis at subcutaneous, intramuscular, or periosteal levels)
Autologous	Performs well as a person ages
Easy to use	
Safe	

The worldwide search for the ideal soft tissue filler continues. It is exciting to see new products as they are introduced, but a balance is needed between embracing new devices and products and ensuring the safety of our patients. This chapter is intended to guide surgeons in making these judgments. Divided into two sections, it begins with an overview of currently available tissue fillers and provides information on their applications and approval status in the United States and internationally. The second section provides information on the clinical characteristics, applications, and techniques for sculpting with the more popular and commonly available fillers.

OVERVIEW OF CURRENTLY AVAILABLE TISSUE FILLERS

A variety of excellent products have been introduced into the market over the past few years, and an expanding range of new products are in the pipeline. Some of them are limited in their applications, working only in defined sites and planes of the soft tissue layers of the face. They all have short-term and long-term benefits as well as potential risks.

For plastic surgeons evaluating these products, staying abreast of the vast array of new fillers, the marketing information, the clinical reports, and the regulatory status can be an overwhelming task. The material that follows provides an overview of available products. For the purpose of this discussion, fillers will be classified in the following categories:

- Autologous materials
- Biologic materials
- Synthetic materials
- Off-label materials

Autologous Fillers

Autologous materials are derived from the patient's own tissue. They come closest to matching the description of the ideal soft tissue filler in terms of safety, but they are not as convenient to use as some other fillers. They have to be harvested from another site on the body, which may produce a scar, and the process of harvesting and then inserting these materials elsewhere requires a two-step procedure. Toxicity, allergenicity, immunogenicity, carcinogenicity, and teratogenicity are not issues, but there can be problems with infection, migration, inflammatory reactions, loss of persistence, and reproducibility. Autologous fillers include the following:

- Dermis, fascia, cartilage, SMAS, breast implant capsule
- Fat grafts
- Platelet-rich fibrin matrix (PRFM)

Dermal, fascial, and cartilage grafts have a long history of use in plastic surgery, and with careful handling and placement in an appropriate recipient bed, these grafts may produce very good, long-lasting results. Deepithelialized skin can be used to correct deficient contours on the nasal dorsum, depressed scars, and deficient facial outlines. Their bulk is increased by folding the graft onto itself, and it is recommended that no portion of the graft be more than 5 mm from the blood supply. When the re-

recipient bed is optimally vascularized and the “take” is successful, approximately 80% of the bulk of the graft will be maintained permanently. Less volume survives when lipodermal grafts are used, because it is the dermal surface that must derive the blood supply from the host and serve as a vascularizing carrier for the fatty elements. Similarly, fascial grafts from the fascia lata of the thigh, the temporalis, and the superficial musculoaponeurotic system (SMAS) can be used as slings or sheets to smooth nasal irregularities or fill facial contours. In a good recipient bed, fascia is permanent and persists through a combination of creeping replacement by host fibroblasts and continued viability of fascial fibroblasts. Although these autografts work well, they require incisions to harvest the tissue and must be used in sheets, strips, or tubes.

Fat grafts as free en bloc transfers of tissue have the disadvantage of losing at least half of their volume after transplantation, and cysts, calcifications, and necrotic lumps can develop. However, with the introduction of liposuction, a readily accessible semiliquid form of fat became available, which in turn gave rise to injectable autologous fat grafting. Along with correction of liposuction deformities, facial contouring with microfat grafts became very effective in the hands of some plastic surgeons. The principles of injectable fat grafting include harvesting small, intact parcels of fatty tissue as atraumatically as possible. The aspirate is refined to separate the viable cells from nonviable oil and cell debris and is then reinjected under gentle pressure by depositing small parcels of fatty tissue in tiny amounts along multiple tracts, as the needle is withdrawn. The purpose is to keep the fat near a blood supply for survival and integration. This can be time consuming, and there is significant edema in the short term as well as some loss of volume over the long term. The great advantage of fat grafting is that it is permanent if the fat survives. The disadvantages are the unpredictability of the survival, the need for a donor site, and the time required to process and inject the tissue.

Selphyl (Aesthetic Factors LLC, Princeton, NJ) is a new, patented system that allows the extraction of a platelet-rich (and growth factor-rich) fibrin matrix (PRFM) from the patient's own blood. This novel technology allows processing of blood in the office in a three-step procedure that includes centrifugation and takes approximately 20 minutes. The collected PRFM is then injected into the patient's wrinkles. Collection of a 9 ml blood sample provides 4 ml of PRFM. The development of collagen and dermal matrix increases over a 3-week period, and there is early evidence to suggest long-lasting wrinkle correction (up to 20 months). Possible applications include correction of nasolabial folds and glabellar lines, panfacial rejuvenation, and treatment of acne scars and other scars. Selphyl has been cleared by the FDA for use in the United States and in Europe with a CE mark. Although additional long-term data are still required to prove its efficacy, this product represents the first practical modality for collection of fibrin matrix as an autologous wrinkle treatment.

Biologic Fillers

Biologic materials derived from organic sources (humans, animals, or bacteria) offer the benefits of ready off-the-shelf availability and ease of use, but these introduce issues of sensitization to foreign animal or human proteins, transmission of disease, and immunogenicity. Often, as the tissue is processed to reduce these untoward side effects, the molecular structure is destabilized, resulting in lack of persistence at the recipient site. The focus in the past few years has been on finding new materials that are better tolerated, have greater longevity, and do not need prior skin testing to rule out sensitivity to animal proteins. Still, biologics provide only a temporary effect and typically do not completely correct the wrinkles or creases. The three major types of biologic tissue fillers are acellular soft tissue matrix, collagen, and hyaluronic acid products.

FDA-Approved Biologic Fillers

Filler	Type
Cymetra	Human dermis
AlloDerm	Human dermal matrix
Dermolagen	Human collagen matrix
Surgisis	Porcine collagen matrix
Fascian	Human tensor fascia lata
Zyderm/Zyplast	Collagen (bovine)
CosmoDerm/CosmoPlast	Collagen (human-based)
Restylane	Hyaluronic acid (bacterial)
Eleveess	Hyaluronic acid (bacterial)
Juvéderm	Hyaluronic acid (bacterial)
Hylaform	Hyaluronic acid (animal)

Cymetra (LifeCell Corp., Branchburg, NJ) is lyophilized acellular collagen matrix derived from human cadaver dermis. It is FDA approved for subcutaneous injection and is used for lips, nasolabial folds, and deep wrinkles and lines. It requires rehydration before injection, and there is no lidocaine in the product, although it can be added to the reconstituted product. Its longevity is reported to be about the same as that of bovine collagen.

Fascian (Fascia Biosystems, Beverly Hills, CA) is a preserved particulate human fascial graft that is marketed in syringes with different particle sizes ranging from 0.1 to 2.0 mm; it is injected through 14- to 27-gauge needles, depending on the particle

size. Prepared from prescreened human cadaver fascia lata, Fascian is freeze dried, irradiated, particulated, vacuum sealed, and stored at room temperature. It requires rehydration before use and is injected intradermally, subdermally, or in deep tissue, depending on the application. In some cases, native collagen may replace the fascial graft, and it is reported that Fascian particles tend to last two or three times longer than bovine collagen products. Use of the product is technique dependent, and lumpiness has been reported, as have rare local reactions and herpetic activation.

AlloDerm (LifeCell Corp.) is an acellular, structurally intact sheet of human dermal graft that was first used clinically in the treatment of full-thickness burns. Processed from prescreened human cadaver skin, the cells responsible for immunogenicity are removed; the matrix structure and biochemical components are left intact. The grafted material then acts as a template or blueprint for recipient cell repopulation, resulting in soft tissue regeneration. AlloDerm is supplied in freeze-dried, sealed foil packets in various sizes and thicknesses and is stable for 2 years with refrigeration. It has been available for several years as an implant for cosmetic and reconstructive soft tissue augmentation. Some of its applications include augmentation of the lips, correction of nasolabial folds, softening of glabellar wrinkles, rhinoplasty (dorsum and tip) as well as septal perforation, Frey syndrome, correction of defects from liposuction, and treatment of scars. Complications can include infection, persistent palpability or lumpiness, and variable take of the grafted material. Reports of volume diminution in mobile graft areas range from 30% to 40% at 1 year to 70% retention after 18 months.

Surgisis (Cook, Inc., Bloomington, IN) is a lyophilized collagen matrix that is porcine derived and marketed in sheets of various sizes and thicknesses. Although it is used as a fascial replacement, there is less information about its use for aesthetic applications at this time.

Bovine collagen, marketed as Zyderm and Zyplast (Allergan, Irvine, CA), became available in 1981 and is a unique product. It was the first commercially marketed injectable approved by the FDA for soft tissue augmentation; it has been used in millions of patients and is the standard against which all other injectables are compared. CosmoDerm and CosmoPlast (Allergan, Irvine, CA) contain human collagen and do not require a pretreatment skin test. Isolated and purified from human dermal tissue and grown under controlled laboratory conditions, the fibroblasts are screened for pathogens and the collagen is subjected to viral inactivation. Although the use of all the above collagens has been discontinued in Canada, they are still available for use in the United States.

Hyaluronic acid (HA) is a glycosaminoglycan common to most living organisms and is a component of connective tissue of the skin, cartilage, bone, and synovial fluid. In human skin, hyaluronic acid adds bulk and acts as a shock absorber and lubri-

cant. Hyaluronic acid binds water and after injection maintains a bulking effect as it is degraded, a process that has been called *isovolemic degradation*. Restylane (Q-Med Esthetics, Uppsala, Sweden) is a hyaluronic acid soft tissue filler that received FDA approval in December 2003 for use in the correction of facial wrinkles. It is marketed as three products that differ in the size of the constituent particles: Restylane Touch (Fine Lines), Restylane, and Perlane. Restylane Touch (Fine Lines) is available in Canada, but not in the United States. The Restylane products are manufactured by recombinant technology in bacteria, thus eliminating the need for skin testing. The shelf life of Restylane is 1.5 years, and its longevity is 6 to 12 months, depending on the location treated and the injection technique. Eleveess (Anika Therapeutics, Inc., Bedford, MA; FDA approved in 2006) contains higher concentrations of hyaluronic acid as well as lidocaine and is intended for medium wrinkles and deeper folds. Prevelle Silk (Mentor, Santa Barbara, CA) was introduced in the United States in 2008 and is equivalent to Restylane. In 2006 Allergan's Juvéderm series of hyaluronic acid fillers received FDA clearance. Juvéderm fillers come in various concentrations and viscosities. In Europe they are labeled as Juvéderm Ultra 2, 3, and 4 and Juvéderm Voluma; in North America they are marketed as Juvéderm Ultra and Juvéderm Ultra Plus. Formulations containing lidocaine are also available (Juvéderm Ultra XC and Juvéderm Ultra Plus XC). There are a large number of non-FDA-approved biologic fillers that are available in the rest of the world. These are mainly HA-based products with various sources, processing, and cross-linking.

Non-FDA-Approved Biologic Fillers

Filler	Type	Approved In
R-fine	HA	Canada, Europe, Asia
Hyaluderm	HA	Europe
Revanesse/ReDexis	HA (cross-linked)	Canada
MacDermol S/MacDermol R	HA (avian, cross-linked)	Europe
Varioderm	NASHA	Europe
Amalian	NASHA	Europe
Macrolane	NASHA	Europe
Teosyal	NASHA	Europe, Canada
Zetaderm/Zetavisc	NASHA	Europe, Canada, Russia
HydraFill	NASHA (cross-linked)	Europe
Esthélis/Fortélis/Belotero	NASHA (CPM technology cross-linked)	Europe, Canada, Asia
Puragen	NASHA (DXL technology cross-linked)	Europe, Canada
Rofilan/Piloderm/Beautygel/ Esthirase/Coilingel	NASHA (cross-linked)	Europe, Canada, Brazil
HyalSkin	NASHA (BDDE cross-linked)	Europe

BDDE, 1,4-butanediol diglycidyl ether; CPM, cohesive polydensified matrix; DXL, double cross-linked; HA, hyaluronic acid; NASHA, non-animal-stabilized hyaluronic acid.

Filler Characteristics*			
Filler	Category	Composition	Viscosity†
Zyplast	Biologic	Bovine collagen	++
Zyderm I and II	Biologic	Bovine collagen	+
CosmoPlast	Biologic	Human collagen	++
CosmoDerm	Biologic	Human collagen	+
Perlane, Juvéderm Ultra Plus, Puragen	Biologic	HA (bacterially derived)	+++
Restylane, Juvéderm Ultra, Elevers, Hylaform	Biologic	HA (bacterially derived)	++
Restylane Fine Lines	Biologic	HA (avian culture derived)	
		HA (bacterially derived)	+
ArteFill (Artecoll outside the U.S.)	Synthetic/biologic	Polymethylmethacrylate (PMMA) beads covered with bovine collagen	+++
Radiesse	Synthetic	Calcium hydroxylapatite	+++
Sculptra	Synthetic	Poly-L-lactic acid (PLLA)	++

*Table courtesy Lisa Airan, MD.

†Viscosity is not measured by most companies in terms of flow: + = Least thickness, easiest/best flow; ++ = In between; +++ = Most thickness, more difficult flow.

‡Level of placement is also dependent on amount/type of desired correction.

HA, Hyaluronic acid.

Level of Placement‡	Advantages	Disadvantages and Complications
Superficial to deep dermis	Less swelling (~24 hr); easy to use	Skin test required; more inflammatory; very short-term correction
Dermoepidermal junction	Less swelling (~24 hr); easy to use	Skin test required; more inflammatory; very short-term correction
Superficial to deep dermis	Less swelling (~24 hr); less inflammatory; easy to use	Length of correction variable
Dermoepidermal junction	Less swelling (~24 hr); less inflammatory; easy to use	Short- and long-term correction
Deep dermis	Long lasting; can be used in deep tissue and along bone; minimal reactions; no skin test needed	More swelling—up to 3 to 5 days
Superficial dermis	Long lasting; can be used in deep tissue and along bone; minimal reactions; no skin test needed	More swelling—up to 3 to 5 days
Dermoepidermal junction	Excellent for use in glabellar region and fine lines; do not use along bone	Shorter term longevity than Restylane or Perlane
Deep dermis or subcutaneous	Long lasting in deep folds and acne scars	Requires skin test; associated with bumps, which may require treatment with steroids or surgery to remove; risk of granuloma; collagen reactivity
Deep dermis or subcutaneous	Long lasting; can be used in deep tissue and along bone; minimal reactions; no skin test needed	More swelling—up to 3 to 5 days; irregularities (technically dependent)
Deep dermis or subcutaneous	Long lasting; can be used in deep tissue and along bone; minimal reactions; no skin test needed	More swelling—up to 3 to 5 days; irregularities (technically dependent); inflammatory reactions; multiple treatments required

Synthetic Fillers

Synthetic materials can offer permanence. Many injectable and surgically implantable synthetic products have been used over the years, and many have been condemned for such complications as granulomas, acute and delayed infections, migration or displacement, and deformities that can result from complications or removal of the material. It is with these products that the difference between the regulatory process in the United States and that in the rest of the world is highlighted. The FDA controls access to the U.S. market and enforces strict labeling practices, which means that the manufacturer must spell out the exact applications for which the material has been approved. Although a number of products have been available for years in Europe, South America, and Asia, only ArteFill (Suneva Medical, Inc.), a polymethylmethacrylate (PMMA)-containing product, is marketed in the United States for permanent facial augmentation. ArteFill is FDA approved for use in the correction of nasolabial creases. Several other permanent synthetic fillers, such as Bioplastique (Uroplasty BV, Netherlands), are in clinical trials in the United States. Synthetic fillers approved by the FDA are listed in the table below.

FDA-Approved Synthetic Fillers	
Filler	Type
AdatoSil 5000	Silicone
Silikon 1000	Silicone
ArteFill (Artecoll)	Polymethylmethacrylate (PMMA)
Radiesse	Calcium hydroxylapatite
Sculptra (NewFill)	Poly-L-lactic acid (PLLA)

AdatoSil 5000 and Silikon 1000 are silicone gels with improved viscosity that have been approved by the FDA for use in treating detached retinas. Although they are permanent, they are not approved for cosmetic use in the United States, and caution is advised with these products. Historically, injectable silicone products have tended to harden, migrate, and cause inflammation and skin necrosis. Bioplastique is composed of solid silicone microparticles (100 to 400 microns) that have been vulca-

nized, texturized, and placed in a polyvinylpyrrolidone carrier. Injected dermally, the carrier is resorbed and the silicone microparticles are encapsulated in host collagen, which prevents migration and effects permanent correction. It is used in many parts of the world but is not approved by the FDA for use in the United States because of concerns about granulomatous reactions and permanent lumps that can be removed only through surgery.

ArteFill is a permanent injectable implant consisting of polished polymethylmethacrylate (PMMA) microspheres suspended in bovine collagen in a 20% to 80% ratio. After injection, the collagen is resorbed and the round, smooth microspheres are encapsulated by host collagen where they are stabilized and become permanent. Used in Europe for the past decade as Artecoll, ArteFill was approved by the FDA in October 2006.

Radiesse is a mixture of calcium hydroxylapatite (30%) and polysaccharide gel (70%). The polysaccharide gel is very white, which makes Radiesse inappropriate for use in the dermis. At present, Radiesse is FDA approved (December 2006) for nasolabial and labiomental crease correction. Potential concerns about its use as a soft tissue filler include clumping, lumping, granulomas, and migration of the microspheres. It is reported to last from 1 to 2 years.

Sculptra is composed of poly-L-lactic acid (PLLA). Because it is not made from human or animal sources, it does not require a skin test. PLLA is a biocompatible, biodegradable material that has been used in surgical products for more than 20 years as a component of dissolvable sutures. Sculptra has been safely used outside the United States since 1999 in more than 30 countries under the trade name of NewFill for a variety of facial volume and contour deformities. It was approved by the FDA in August 2004 as the only product for the correction of HIV-associated facial lipoatrophy and was approved in 2009 for cosmetic use in the United States. It is injected subcutaneously in the area of fat loss/volume loss and provides a gradual and significant increase in volume. It is reported to last up to 2 years after the third treatment session.

A large number of other synthetic fillers are available in various parts of the world; a few of these are listed in this chapter. It is difficult to comment on the effectiveness and safety of these products, because results of clinical trials using these products have not yet been reported in the literature.

Non-FDA-Approved Synthetic Fillers

Filler	Type	Approved In
Bioplastique	Silicone	Europe
Aquamid	Polyacrylamide	Europe and 40 countries worldwide
Beautical	Polyacrylamide	Europe
Bio-Alcamid	Polyacrylamide	Europe
Outline	Polyacrylamide	Europe
Evolution	Polyacrylamide	Europe
Formacryl	Polyacrylamide	Russia
Argiform	Polyacrylamide	Russia
Bioformacryl	Polyacrylamide	Ukraine
Amazing Gel	Polyacrylamide	Asia
DermaLive/DermaDeep	Polyacrylamide	France
Metacril	Methylmethacrylate	Brazil
ArteSense	Methylmethacrylate	Europe, Canada, Asia
Arteplast	Methylmethacrylate	Discontinued
Rhegecoll	Methylmethacrylate	Pending worldwide
Laresse Dermal Filler	Carboxymethylcellulose/ polyethylene	Europe
Atléan BTCP	Tricalcium phosphate	Europe
Bioinblue	Polyvinyl alcohol	Europe
Reviderm	DEAE Sephadex	Europe, Canada, Asia
Matridex	DEAE Sephadex	Europe

BTCP, Beta tricalcium phosphate; DEAE, diethylaminoethyl.

Off-Label Use of Fillers

“Off-label” use of synthetic materials is technically possible but does carry some risk. A number of synthetic fillers are approved for use for conditions unrelated to plastic surgery. For example, AdatoSil silicone oil and Silikon 1000 are used for tamponade of retinal detachment. Such products are available, clearly approved for other soft tissue applications, and can be purchased and used off-label to treat wrinkles or augment the face. But is this wise? The manufacturer is strictly prohibited by the FDA from advertising or promoting off-label use and can incur stiff penalties for doing so. The plastic surgeon is not subject to these FDA controls but is vulnerable from a liability standpoint and would have a difficult time defending the use if the product does not perform well.

THE ART OF SCULPTING WITH INJECTABLE FILLERS

Soft tissue fillers have provided aesthetic surgeons with an effective means of addressing patient requests for nonsurgical facial, hand, and body rejuvenation. Today a plethora of excellent products are available that are appropriate for filling, augmenting, and recontouring. However, as with any aesthetic product or procedure, success depends on an understanding of the specific applications for the material and the technical nuances to ensure that these materials are used appropriately. Therefore this section will serve as a primer for using the commonly available injectable fillers. It will provide specific information on the following:

- Product characteristics and composition
- Indications and applications
- Injection technique
- Average volumes used in each area
- Level of placement
- Ease of injection
- Combinations
- Longevity
- Adverse effects, reactions, and complications
- Results

Hyaluronic Acid Products

We begin our discussion by focusing on hyaluronic acid products because of their widespread popularity and range of applications. The viscoelastic properties, stabilizing role, and protective action on cell membranes afforded by hyaluronic acid make it an ideal material with which to fill skin depressions. Approval for use in Canada was granted in 1998, and very quickly hyaluronic acid products surpassed collagen to become the new benchmark for soft tissue fillers. Approval in the United States was granted in late 2003.

Medicis, Allergan, Biomatrix, Anika Therapeutics, and Mentor are five of the companies offering approved hyaluronic acid products in the United States. Other companies, such as Anteis, have new products in use in Europe and Canada, but these are awaiting FDA approval. To offer the most appropriate fillers for different types of wrinkles and skin, these manufacturers generally offer several products with different viscosity and particle sizes.

Features

The three products available from Medicis are Perlane, Restylane, and Restylane Fine Lines/Touch. As mentioned above, the latter is available in Canada (Restylane Fine Lines) and Europe (Restylane Touch), but not yet in the United States. These products are composed of hyaluronic acid and differ from each other in molecular size. Perlane is the largest hyaluronan, and Restylane Fine Lines/Touch is the smallest. Indications for the level of placement in the tissue depend on the particle size. Perlane is injected at the deepest level in the deep dermis or subcutaneous tissue; Restylane is injected in the mid-dermis, and the needle should not be visible; and Restylane Fine Lines/Touch is injected at the dermal-epidermal junction. The Restylane injectables are non-animal stabilized hyaluronic acids (NASHAs).

Allergan's Juvéderm is another hyaluronic acid product. Juvéderm is available in different concentrations and viscosities: 18 mg/ml, 24 mg/ml, and 24 mg/ml high viscosity (HV), 30 mg/ml, and 30 mg/ml HV. In the United States and Canada, Juvéderm is available in 24 mg/ml HV (Juvéderm Ultra) and 30 mg/ml HV (Juvéderm Ultra Plus). Formulations with 0.3% lidocaine (Juvéderm Ultra XC and Juvéderm Ultra Plus XC) are also available, helping decrease the pain and discomfort that is often associated with filler injection. Juvéderm Ultra Plus is more cross-linked than Juvéderm Ultra, thus making it more viscous; it is intended for use in deeper folds. Juvéderm, similar to the Restylane group of fillers, is produced in bacteria and then purified.

Prevelle Silk, a lidocaine-containing formulation of hyaluronic acid produced by Mentor, has recently become available in the United States. Mentor's Puragen is a similar product with higher cross-linking; it is intended for injection in the deep dermis. Puragen is available in Canada and is not yet approved by the FDA.

Eleveess (Anika Therapeutics, Inc.) has the highest concentration of hyaluronic acid (28 mg/ml) and contains 0.3% lidocaine, offering peri-injection analgesia. Eleveess is also derived from bacteria and thus its injection results in virtually no hypersensitivity reactions.

Esthélis Soft, Esthélis Basic, and Fortélis Extra, produced by Anteis (Geneva, Switzerland), are hyaluronic products analogous to Restylane Fine Lines/Touch, Restylane, and Perlane, respectively, and are in use in Europe and have recently become available in Canada. These fillers are not FDA approved at present.

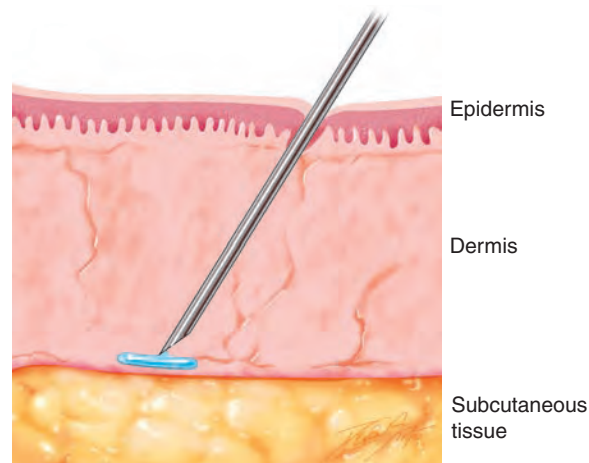
Indications and Applications



Hyaluronic acid fillers are useful for deeper folds, lips, and irregularities such as soft acne scars, nasal deformities, and areas that require more sculpting. One of the main indications for hyaluronic acid is augmentation of the lips. These tissue fillers are also useful for augmentation of the nasolabial folds, marionette grooves, the mental fold, and the hollow of the anterior jowl line. Overall complete facial sculpting may be performed with combinations of these products. Perlane/Juvéderm Ultra Plus/Puragen can be used interchangeably with Restylane/Juvéderm Ultra/Prevelle Silk/Elevess in most situations, and the larger particle sizes yield better longevity. Less bruising may result if these tissue fillers are injected as the needle is advanced.

In the subsequent discussion, we will refer to Restylane, but Juvéderm Ultra or Prevelle Silk could also be used in the same manner.

Restylane



Restylane represents the middle-sized particles of hyaluronic acid products produced by Q-Med. It differs from Juvéderm in that it is made up of particles of hyaluronic acid molecules, whereas Juvéderm is a syrup. Restylane has a lower level of cross-linking and a lower level of reported foreign protein. It is provided in 1.0 cc syringes with a 30-gauge needle. Restylane can be used in many areas of the face and brow

with excellent longevity. Because it can be molded and massaged to a degree, precise results can be achieved with minimal complications. Prevelle Silk is similar to Restylane but contains anesthetic, requiring anterograde injection.

Indications and Applications

Restylane can be injected in the lips, nasolabial folds, glabellar creases, forehead lines, infraorbital and supraorbital hollows, and temporal hollows. It can also be used to raise the eyebrows, soften the chin fold, correct scars from acne or traumatic injuries, improve nasal deformities, and reconstruct contour deformities arising from trauma, reconstructive surgery, or acquired soft tissue atrophy syndromes. As previously mentioned, it is often combined with Restylane Fine Lines/Touch and Perlane to achieve the best results.

Lips

Contouring the lips may be accomplished with Restylane alone or with Restylane in combination with other fillers. However, Restylane on its own produces an excellent result. The procedure may be carried out using infraorbital and mental nerve blocks (separate block for the corners of the mouth) or with topical anesthetic. Direct infiltration of the tissues with lidocaine with epinephrine may also be done to limit the degree of bruising.



Center: 1, The vermillion border is enhanced to define the shape of the lip. 2, The Cupid's bow (philtral columns) is narrowed with injection. 3, The site of injection from the wet-dry junction to the vermillion border is used to increase lip show at the lateral aspects. 4, Restylane is injected posterior to the wet-dry junction to enhance lip projection.

Ideal candidates have a good shape to their lips to begin with. In these patients, just augmenting the vermillion is enough to produce an excellent result. In addition, proper dental occlusion aids in getting a more symmetrical result. The left and right sides of the lips differ in length and thickness; this must be observed and demonstrated to the patient before augmentation. Achieving symmetry can be a challenge, but the patient should be aware of these pretreatment asymmetries so expectations for improvement are realistic.

In patients with long, thin lips, results may be limited because of tissue tension. For patients with lips that are tight to the dentition or who have a class II occlusion, aug-

mentation volumes should be conservative, because irregularities of dentition may be reflected in the upper lip and will appear too prominent or “ducklike.” Scars may not respond to the volume addition and can leave an irregularity. The Cupid’s bow becomes wider with age and should be made narrower (see 2 on the center photo). The depth of the mental fold increases with age and may require softening; it can add to the result of the lip contour. Patients with a history of herpes should be given prophylactic treatment, because the procedure may cause a herpetic outbreak and scarring.

Augmentation in patients with long, thin lips and very broad smiles is difficult. Often patients complain that their lips are too thin when they smile; this is a dynamic change that cannot be corrected with fillers or implants. The physician must clearly explain that the result these patients desire may not be achievable with one or even subsequent injections, no matter what product is used.

INJECTION TECHNIQUE AND LEVEL OF PLACEMENT When Restylane is used for lip augmentation, the injection process generally starts with augmentation of the vermilion border of the lip to enhance its definition and provide increased projection. The philtral columns may also be augmented, and the placement of Restylane at this level is usually in the mid-dermal level and for the vermilion border is along the “pseudotunnel” of the lip border. Restylane must not be placed too superficially, because it will appear as a light blue color (Tyndall effect). Palpation of the tissue as the Restylane is injected is important. Occasionally it can track in a direction perpendicular to the direction of injection as a result of weakness in the tissue and the vertical lip lines. If this occurs, the Restylane needs to be massaged immediately to eliminate this irregular contour.

Injection of the lip proper from the wet-dry junction to the vermilion border may also be carried out at a level that is just deep to the mucosa within the orbicularis oris muscle. If it is placed immediately beneath the mucosa, it will appear blue. Placement posterior to the wet-dry junction along the wet mucosa may enhance the lip volume as well as the projection. Again, the depth of the injection is below the orbicularis oris muscle to make the product undetectable. Placement of the product must be varied, depending on the desires of the patient and the starting shape of the lips. Care must also be taken to observe any previous asymmetries, scars, weakness, herpetic infections, dentition (including occlusal classification), the length of the philtral column and upper lip, the width of the Cupid’s bow, and the depth of the mental fold, all of which can affect the results. Photographs should always be taken before the treatment and discussed with the patient, along with a full explanation of the potential risks and benefits for all injections.

VOLUMES Approximate volumes for augmentation of the lips may range from 0.5 to 1.0 cc per lip with Restylane. There may be immediate swelling with the placement due to the trauma of needle, bruising, or immediate swelling from Restylane

absorbing water. Immediately after injection, the lip size should be equivalent to the final result; however, some patients develop swelling from bleeding and needle-stimulated histamine release. In the patients who develop immediate swelling, lip shape will be consistent with final results from days 3 to 5. The lips will not increase in size beyond the volume placed. If subsequent injections are indicated, less volume may be required to achieve the desired correction.

LONGEVITY Longevity is dependent on the metabolism of the individual as well as the amount of movement with animation. In general, patients who are more animated have a shorter duration of filler. The filler remains in the tissue for up to 16 months, although with diminished intensity. For most individuals, more augmentation may be achieved at secondary and tertiary injections, which build on the remaining filler. This allows for further shaping, enhancement of volume, and contouring of the lips when subsequent injections are performed. The filler should last for a period of 4 to 6 months; however, when it is repeated, the results may last for 8 months up to 1 year. In some individuals, the filler may disappear after as short a period of time as 3 months and require repeat contouring. Juvéderm and Prevelle have similar longevity to Restylane.

EASE OF INJECTION For the lips, Restylane is more difficult to inject than collagen because of the higher viscosity of the material and the same-sized needle (30-gauge). Use of Restylane may result in more bleeding or bruising, which needs to be controlled during the injection process to limit the extent of bruising after injection.

TECHNICAL NUANCES Care must be taken to inject Restylane with an even flow and movement of the needle so that it does not deposit as lumps or bumps in the tissue. If lumps or bumps are detected, they must be massaged out immediately. Preexisting asymmetries should be corrected when possible. Care must be taken to balance the projection of the upper and lower lips so that a ducklike deformity does not result.

Frequently the upper lip is atrophied above the vermilion border, particularly the lateral aspects; restoration is done with Restylane placed at the mid-dermal level to improve volume and projection of the upper lip. One should use minimal volume in the upper lip above the vermilion border, because any added volume may cause lengthening of the upper lip. (It can push the upper lip farther down over the upper dentition.) Care must be exercised to limit the amount of filler placed in the upper lip skin adjacent to the nasolabial fold, because excess infiltration will result in awkward animation of the upper lip and nasolabial fold, particularly when the individual is smiling, and can give the appearance of a “joker-type” upper lip or create an unusual fold at the lateral edge of the upper lip.

If the patient has implants, the filler may be added around the implant without removal unless the patient desires this. The risk of infection is minimal but is still pres-

ent. If the patient wants the implant removed, filler may be added at the same time as the removal, with a plan for the patient to return for reassessment.

COMBINED TREATMENT Some physicians combine Restylane injections with that of other tissue fillers. Collagen may first be injected along the vermilion border, which provides local anesthesia and augmentation of the white roll. Restylane Fine Lines/Touch may also be used to enhance the white roll; however, Restylane itself works very well in this area. The individual vertical lines of the lips may be corrected with Restylane Fine Lines/Touch or collagen injection.

Restylane can also be used with *botulinum* toxin. In this situation the neurotoxin may be used in the upper and lower lip orbicularis oris muscle to limit the pinching of the lip and the formation of vertical lip lines. The amount of *botulinum* toxin will vary, starting with 2 units per side in the upper lip, avoiding the midline, and up to 3 or 4 units per side in the upper and lower lip. Rarely, after neurotoxin injection in the upper lip, patients have difficulty with pronunciation of *P*'s and *B*'s and an inability to drink through a straw or out of a cup. If this occurs, the patient may do active puckering of the lips for 15 minutes at a time, several times a day, to help alleviate these symptoms. *Botulinum* toxin will help prolong the longevity of the Restylane in the lips and will increase lip projection and shape. The neurotoxin may be placed at the vermilion border or approximately 5 mm from the vermilion border. It must not be placed too far away from the vermilion, which will result in diminished shape of the lips. The closer the neurotoxin is placed to the vermilion border, the greater the lip projection. Restylane may also be placed in areas where ArteFill (Artecoll) has been placed previously after a minimum waiting period of 2 to 3 months.

Nasolabial Folds

As with the lips, the nasolabial folds may be of different shapes, lengths, and depths. Some patients have preexisting telangiectasia that can be made worse with injections. The classification system described by Lemperle is useful in evaluating patients and discussing their goals.

Lemperle Nasolabial Fold Classification

Class	Description
0	No wrinkles
1	Just perceptible wrinkles
2	Shallow wrinkles
3	Moderately deep wrinkles
4	Deep wrinkles, well-defined edges
5	Very deep wrinkles, redundant folds

The amount of change in the average patient should be approximately 50% correction of the depth of the fold. Restylane can be used to soften the broader portion of the fold, which is usually the upper two thirds down to the lateral oral commissure. The product is placed at the level of the mid- to deep dermis. If the nasolabial fold has a superficial line etched into it, this can be softened with Restylane Fine Lines/Touch. Alternatively, Perlane may be used in place of Restylane. The product is placed at angles to the fold, and layering may be done to enhance longevity. Also, Perlane may be placed deep to the Restylane for the very deep folds. When Perlane is used instead of Restylane for correction of the nasolabial folds, the difference in longevity may be slight with the Perlane lasting longer. As with all repeated injections of hyaluronic acids, the product lasts longer and less volume of product is needed to achieve the same volume and contour change. Care must be taken not to overfill the fold because this will give patients an odd appearance when they animate or smile. Taping of the fold after the injection for a few days allows the product to be bound into place with scar tissue and can prevent the lateral displacement of the product to the nasolabial fold when the patient smiles.

VOLUMES Fold depth is variable; thus the amount of filler may range from as little as 0.5 cc to as much as 1.5 cc of Restylane or Perlane. Complete correction of the fold on the first visit is not recommended because this may give the fold an unnatural appearance. For the first-time treatment, the patient should be instructed that the fold will initially be corrected by filling one half of the depth and further correction will be done at a subsequent injection. This is done to avoid overcorrection; excessive filler placed at one time can cause telangiectasia. This approach has several benefits: it keeps the patient's expectations at a reasonable level, the degree of change is not too drastic, and the fold does not feel as firm. It allows precise correction of the fold depth and avoids overcorrection, particularly at the lower third of the fold. If too much dermal filler is placed in the fold that overlies the dentition, then it may appear as a bump. This is particularly true of the fine but deep marionette lines lateral to the commissure.

Scars and Deformities

Many deformities of soft tissue can be corrected with Restylane. It is important that the scar/tissue be soft and distensible. The product should not be placed under high pressure, because this may result in tissue necrosis. More than one treatment may be required for full correction. Excellent results can be achieved in acne scars, chickenpox scars, and traumatic scars, and these can be very long lasting. Simultaneous release of the scar with an 18-gauge needle may improve the results. The use of Restylane Fine Lines/Touch for the treatment of steroid atrophy is helpful, but it must be used with caution, because the atrophy may be permanent. The patient should be warned of this so that residual atrophy is not attributed to the use of the hyaluronic acid.

VOLUMES AND TECHNICAL NUANCES The volumes may be variable. Very small amounts (0.05 cc) are needed for acne or chickenpox scars; these are placed at a superficial level (dermal-epidermal junction). For larger soft acne scars, up to 0.2 cc is placed at the mid- to deep dermis. Layering of the fillers may be needed but not commonly. The use of *botulinum* toxin in conjunction is helpful for scars located in mobile areas such as the glabella, forehead, and chin, where the mimetic action may be reduced. This may also increase the longevity of the filler. Restylane can be injected with a 32-gauge needle in lieu of Restylane Fine Lines/Touch for fine scars. Care must be taken with the amount of pressure applied to the plunger and the needle being firmly attached to the syringe.

Glabellar Folds

The folds of the glabella are ideally treated in combination with *botulinum* toxin. If the fold is easily effaced, the neurotoxin may soften the fold on its own. The glabellar fold may be a fairly superficial line with a deeper etched component that is best treated with Restylane Fine Lines/Touch at the dermal-epidermal junction; the filler is placed in a pinpoint manner and with serial linear injections at the same level, thereby undermining the line and placing the filler in a crisscross fashion. If the fold is broader, Restylane may be used; this is placed at the mid- to superficial dermis with a linear threading technique. Small amounts must be injected to avoid tissue necrosis. When combined with *botulinum* toxin, the effect can last from 8 months to much longer as a permanent correction. This area tends to have deep, dilated pores; occasionally some filler is lost in the pore, and it is difficult to achieve complete correction.

VOLUMES A range of 0.2 to 0.4 cc of Restylane and up to 0.2 cc Restylane Fine Lines/Touch may be needed for correction of the fold. Layering of these fillers may be needed on occasion. Care should be taken in a patient with very thin skin, because the filler may cause lumps or bumps.

Forehead Lines

The injection technique in this area is similar to that used for glabellar lines. If the patient has a very dynamic forehead, *botulinum* toxin will be very helpful in achieving a better result and increasing the longevity. If neurotoxin is not used, the filler may last for only a short period. Caution with the neurotoxin should be exercised in patients with moderate to severe brow ptosis. More commonly, Restylane Fine Lines/Touch is used and is placed at the dermal-epidermal junction by pinpoint placement or in a linear threading technique.

VOLUMES Volumes will vary markedly, anywhere from 0.2 to 0.8 cc of Restylane Fine Lines/Touch. Restylane may be used for the deeper and broader folds.

Eyebrows

The eyebrows may be elevated 1 to 2 mm by the addition of Restylane to the deep tissue layer of the lateral eyebrow. The volume of the temples generally decreases with age, and the placement of 1 cc of Restylane on the deep layer will help restore the youthful contour and raise the eyebrow. Surgical removal of the fat of the upper eyelid is sometimes done to such a degree that it results in a hollow or skeletonized orbital rim, or this characteristic may be seen in some individuals as a consequence of the aging process. The hollow appearance may be corrected by placing Restylane on the inferior aspect of the supraorbital rims. This also gives the illusion of raising the eyebrows while restoring a more youthful appearance to the upper lid and eyebrow region.

VOLUMES AND LEVEL OF PLACEMENT Volumes may range from 0.2 to 0.5 cc per side. A similar volume for the hollowed orbit can be used. In these two areas the filler can be molded to achieve a high-quality result with minimal risk. Care must be taken to inject small volumes with each pass to prevent emboli and injury to the sensory nerves. The filler is placed at the level that is not mobile. Caution is necessary in the central eyebrow, where the supraorbital nerves emerge.

LONGEVITY Restylane is a good deep filler; Perlane is a longer-lasting alternative and is used in a similar fashion. With the product placed on the deep layer, the longevity is increased to 6 months to 1 year, because where there is no movement, there is no displacement of the product.

Facial Lipoatrophy

Restylane and Perlane are ideal fillers for softening the appearance of lipoatrophy associated with antiretroviral therapy for HIV. The areas that are best treated are the concavities adjacent to the zygomatic-temporal bone, the zygomatic arch, and to a lesser degree, the inframalar hollow. In the temple and adjacent to the arch, it is important to place the filler deep within or under the periosteum, taking care to inject slowly to ensure even placement and minimize bruising. The product is easily massaged, but if massaging is too aggressive, the entire effect will be minimized. The injector should not completely fill the entire area of atrophy but should use a limited volume to soften the contours so that the wasting does not appear too severe. For the inframalar hollow, the goal of correction should be kept to a third to a half of the hollow. Linear threading or a fanning technique may be used to achieve a gradual, consistent result.

VOLUMES On average, volumes of 0.5 to 1.5 cc per area may be used. This will vary among individuals, depending on their requested goals. Repeat injections on a 2- to 4-week basis may help to contour areas that have a large volume deficiency.

Comparison of Restylane With Other Fillers

For the lips, Restylane is more difficult to inject than collagen because of the increased viscosity of the material and the larger needle size (30-gauge). Use of Restylane may result in more frequent bleeding or bruising, which needs to be controlled during the injection process to limit the extent of postinjection bruising. Collagen, in comparison, will cause minimal swelling and a smaller needle is used, therefore limiting the bruising. Restylane is easier to inject than ArteFill and has less associated bruising (a smaller needle [30-gauge] is used, compared with the 27-gauge for ArteFill), because it is less viscous.

Restylane Fine Lines/Touch is a softer product and much easier to inject than Restylane. Once injected, it can be molded very easily, thus making it more useful for superficial injection than Restylane. Perlane has a larger molecule and is firmer than Restylane. It does not flow as easily through the tissue despite the larger needle (27-gauge). Perlane can be used instead of Restylane in many cases. Restylane gives a more subtle result and is better used in individuals with more delicate tissues and fine features.

Postinjection Care

Postinjection treatment includes cooling with ice packs, 20 minutes on, 20 minutes off, for the first 24 hours, and oral administration of antihistamines (Claritin, Zyrtec, or Allegra in usual daily doses; these may be taken before the treatment). Oral supplements such as *Arnica montana*, bromelain, and others may help with bruising. The patient should be informed that swelling will occur in the first 3 to 5 days after injection, which may make the lips appear overdone. This will resolve, and there is possible bruising that could last up to 1½ weeks. There is initial swelling, which almost invariably is of concern to the patient immediately after the injection and for the first 3 to 5 days as he or she becomes accustomed to the new size and loses some volume (particularly with the first injection). If a local anesthetic or a nerve block is used, there will be some muscle paralysis, which creates asymmetrical movement and may make the lips appear to be completely asymmetrical. The patient should be alerted in advance to this possibility. Even with the advance warning, the patient will still question the symmetry after the injection. Augmentation is difficult in individuals with long, thin lips and very broad smiles. Care should be taken in providing adequate consultation and information that the result they desire may not be achievable with one or even subsequent injections. The patient is seen 1½ to 2 weeks after the initial injection to assess for any irregularities, lumps, bumps, or asymmetries. If a bump is discovered, it may be physically massaged down. If this does not alleviate the irregularity, hyaluronidase may be injected if available.

ADVERSE EFFECTS, REACTIONS, AND COMPLICATIONS When larger volumes of filler are injected at the same setting, a sterile abscess may occur that will require drainage. This may happen up to 1 to 2 weeks after the initial injection. The abscess is treated with local incision and drainage using an 18-gauge needle. Immediate drainage of clear fluid mixed with yellow-white debris resolves the problem, with rapid resolution of the symptoms.

Other complications that may occur are lumps, bumps, and irregularities, numbness of the lip, pain, hematoma, and overcorrection. Uncommonly, the patient may experience intermittent swelling in the treated region. This usually resolves 2 to 6 weeks after injection. Occasionally an individual will have massive swelling in response to the injection, and use of a Medrol Dosepak may be considered to alleviate this immediate swelling. The risks associated with steroid use should be explained to the patient. If he or she has preexisting telangiectasia or rosacea, more telangiectasia may develop, and this should be discussed before injection. This is particularly common at the nasal base for nasolabial fold correction.

Rarely, individuals may develop erythema of the overlying skin for the first several weeks. Clinically it does not behave like an allergy. A light topical steroid may be used as an initial treatment. In general, this reaction resolves without therapy over a short period. Even rarer is embolization of a vessel with necrosis of the tissues. Immediate blanching of the tissues is a bad sign and should be treated with massage, warm compresses, nitropaste, and if needed, hyaluronidase to remove the hyaluronic acid.

Results



This 51-year-old woman requested lip augmentation. Restylane was injected into the vermilion border (1) and philtral columns (2) to achieve a narrower appearance. The Restylane was injected from the inside of the lip from the vermilion border to the wet-dry junction (3). She is shown 3 months after injection with good persistence of the filler. This patient is a good candidate for treatment with Restylane and maintains good volume correction for 6 to 7 months, requiring less volume when she returns for a touchup with Restylane. With care, irregularities can be avoided. The patient was started on acyclovir for herpes prophylaxis.



This 30-year-old woman had concerns about the irregular appearance of her nasal tip cartilage. Restylane was used to fill in the hollows and shape the tip of her nose. Restylane 0.4 cc was used to soften the appearance of the nasal cartilage. The patient had inquired initially about rhinoplasty with tip alteration. She had not had previous surgery, and the nasal tip had not changed other than the irregularity becoming more noticeable with time. The skin at the tip of the nose was very thin, and any slight surgical irregularity may have been noticeable; additionally, the skin may have been compromised by an open rhinoplasty. The new tip contour was achieved under a block with local anesthetic and Restylane 0.4 cc in the office in 10 minutes. It took 5 days for the patient to recover, and she has shown persistence of the contour for more than 5 months. She is seen 5 months after injection (*far right*).

Perlane

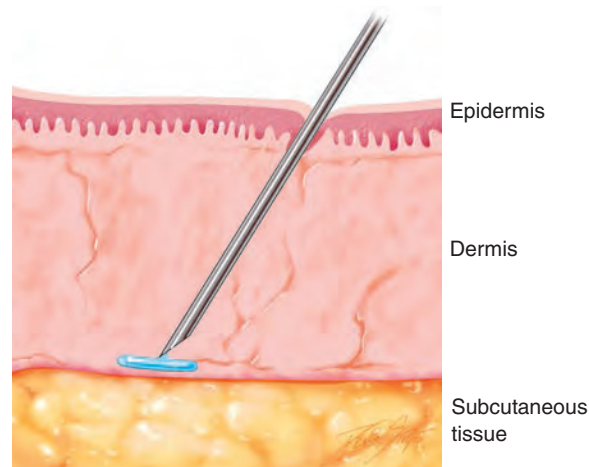
Indications and Applications



Perlane is a very good filler for the deeper folds of the face. These include the nasolabial folds, deep marionette lines, and the hollow adjacent to the jawline along the jawline as shown (comparable products include Eleveess and Juvéderm Ultra Plus). Perlane is also an excellent filler for use in the periorbital region to soften the nasojugal groove as well as the periorbital hollow and can be used to achieve a “nonsurgical eye lift” (see p. 357). It must not be placed at the superficial or mid-dermis level, because there will be a light reflection off the material, giving it a blue color. Also, a superficial injection may cause irritation to the skin, resulting in local redness and swelling.

Lip Augmentation

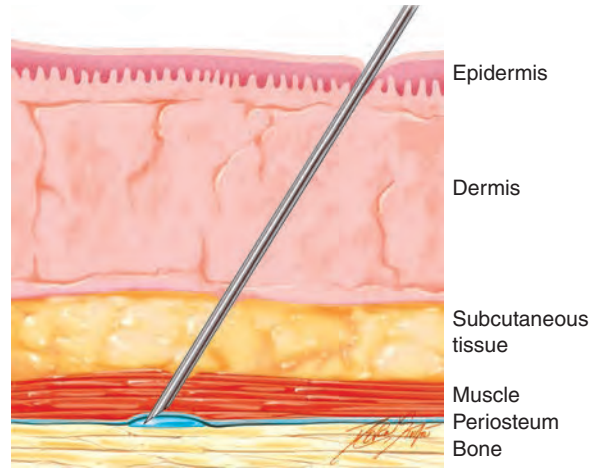
Perlane may be used as an alternative to Restylane for lip augmentation and contouring. Perlane can be placed along the vermilion border and along the wet-dry junction of the submucosal plane or the intramuscular injection plane. It is best used in patients with lips that are not very mobile, because the material is stiffer than Restylane and will not allow proper movement of the lips if larger volumes are used. Care must be taken in using Perlane for persons with soft, supple lips that move a lot with animation; these patients may not respond well to Perlane augmentation, and their lips may appear too stiff.



LEVEL OF PLACEMENT AND INJECTION TECHNIQUE Perlane is placed in the deep dermal layer with a 27-gauge needle. When injecting Perlane, one must avoid the formation of lumps or bumps, because these are difficult to massage out of the tissue. With the larger needle size in comparison to that used for Restylane, there is a greater chance of bleeding and bruising.

VOLUMES For the lips, volumes may range anywhere from 1.0 to 2.0 cc with excellent results. Occasionally an individual may need less or more; the remainder may be placed in other areas, such as the nasolabial folds. For the marionette grooves, 0.5 to 1.0 cc per side may be used.

Deep Tissue (Periorbital and Jawline Contouring) Augmentation



In the areas along the jawline (filling the hollow anterior to the jowl) and in the periorbital region (nasojugal groove and periorbital hollowing), Perlane is best placed on the very deep plane on the bone (beneath the periosteum) to augment the soft tissues similar to a solid implant. Perlane (or Restylane) may be used as a nonsurgical option instead of microfat grafting.

VOLUMES FOR THE JAWLINE The volume may range from 0.5 to 1.5 cc per side. Placement of the material in the deep dermis may be required for complete correction of a jowl deformity.

VOLUMES FOR THE PERIORBITAL HOLLOW AND NASOJUGAL GROOVE The volume will range from 0.5 to 1.5 cc, depending on the extent of the desired projection of the cheek and malar region. This region is difficult to overcorrect, and with the material being placed on the deep layer, it can be massaged down for a relatively long time after the injection (2 to 3 weeks).

TECHNICAL NUANCES It is important to mark the patient before injection of the local anesthetic and to wait for at least 10 minutes to allow for the epinephrine effect to take place. Perlane is placed in the deepest point of the hollow on the bone; this will correct most of the deformity. When the needle is passed through the skin down to the bone, it is advanced along the bone, placing small amounts of Perlane along the depth of the hollow. The injector must watch for immediate bleeding and swelling. Pressure is applied to prevent a large bruise. After the correction is complete on one side, the patient should be shown the result with the mirror. Patients are immediately impressed with the dramatic improvement.

Nasolabial Folds

Correction of the nasolabial fold with Perlane is similar to correction of this area using Restylane. The exception is a deep nasolabial fold that extends past the commissure inferiorly. Care must be taken in this area when estimating the amount of Perlane to be placed; too much may make the tissues appear stiff (particularly during smiling) and can create a peculiar appearance.

VOLUMES In the nasolabial folds, the volumes may vary from 0.5 to 1.0 cc per side, depending on the depth of the fold. Very deep nasolabial folds or severe nasolabial folds are very difficult to correct and will not respond any better to Perlane than to Restylane, collagen, or ArteFill.

LONGEVITY Perlane lasts from 6 to 8 months in soft tissue, depending on the mobility of the tissues. Perlane lasts from 6 months to a year in the deeper plane of injection and along the bone, because there is little movement of the tissue.

EASE OF INJECTION Perlane is slightly more viscous than Restylane, but with practice it is really no more difficult to inject. It requires a deeper placement, but the volume used will be similar to that of Restylane.

TECHNICAL NUANCES Perlane can be used to correct deeper folds and hollows, and when used in combination with Restylane or Restylane Fine Lines/Touch, more detailed and precise correction can be achieved. It is important to remember to use the layering concept with these products to maximize their effect.

Combination With Other Fillers and Implants

As noted earlier, Perlane can be used safely and effectively to achieve excellent results over fixed implants or permanent fillers such as ArteFill. Restylane may be layered on top of the Perlane to maximally reduce the appearance of a fold. If the fold has a superficial line etched into it, Restylane Fine Lines/Touch is placed at the dermal-epidermal junction.

Postinjection Care

See postinjection information for Restylane.

Adverse Effects, Reactions, and Complications

Complications and adverse effects are similar to those for Restylane. If too much Perlane is placed in one area, it may become mobile (like a marble) in the deep layer. If this occurs, the material may be massaged down or removed through a puncture with an 18-gauge needle.

Results



This 48-year-old woman had periorbital hollowing as well as prominent periorbital fat in the central and medial aspects of her lower lids. She described this as her “polar bear” appearance and sought a more normal look and contour in her orbital and midface areas. A nonsurgical eye lift was planned as well as a midface augmentation. The malar bone was augmented with Perlane to increase malar projection and camouflage the prominent lower lid. Perlane was placed at the depth of the periorbital hollow on the bone and was also placed on the malar bone to augment cheek projection and minimize negative vectors. A total volume of 1.1 cc was placed per side, mainly in the periorbital hollow (1), but a smaller amount was placed on the malar bone to increase malar projection relative to the globe (2). The patient is seen 6 months after treatment. She is pleased with the improvement around her eyes and the increased projection and contouring in the midface.

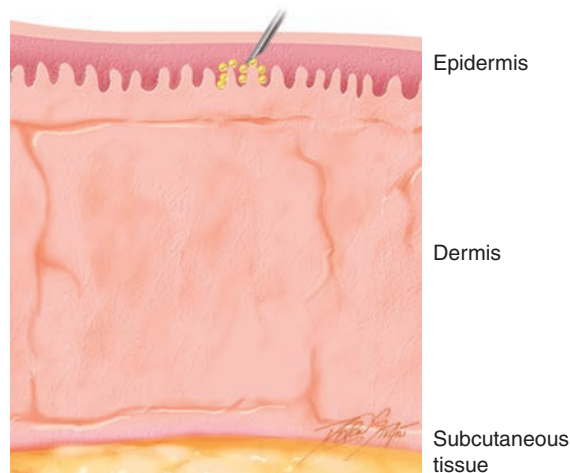
Restylane Fine Lines/Touch

Indications and Applications



Restylane Fine Lines/Touch is the smaller cousin of Restylane and is comparable to Juvéderm 18. Although it is available in Canada, it has not yet received FDA approval. It is excellent for filling of the vertical lines of the lips as well as the fine lines of the glabellar region. It can also be used for superficial dermal lines that occur on the cheeks and for small soft scars, as seen on the left.

INJECTION TECHNIQUE AND LEVEL OF PLACEMENT



Restylane Fine Lines/Touch is placed at a very superficial level of the dermis or the dermal-epidermal junction with a 31-gauge needle with a very fine tip (supplied with a 30-gauge needle in Canada). The needle is placed just beneath the skin surface, and the material is injected to raise the bleb; this is then massaged smooth. The application is done along the length of the visible line. If needed, the material may be injected at the same depth along the length of the line in a linear fashion. The skin may appear blanched at the local site of injection initially, but this resolves within 5 to 15 minutes, unless local anesthetic with epinephrine has been injected. If there is any

concern about local skin ischemia, nitropaste 2% should be applied (a small amount only). In a patient with a great deal of sun damage, superficial placement may lead to long-term residual lumps or bumps (9 months to more than a year). These may be improved with massage, ultrasound treatment, and the application of hyaluronidase. Crow's-feet may be treated, but very fine lines should be approached with caution because of the potential for long-term bumps and possible bruising.

VOLUMES The volume of Restylane Fine Lines/Touch needed will vary, depending on the areas and depth of the lines. In general, for forehead lines 0.5 to 1.0 cc is used. For the fine marionette lines 0.2 cc is recommended. Care should be taken when this is placed in the vertical lip lines; if too much product is placed, it may make the lip appear stiff.

LONGEVITY This product will last 3 to 4 months, depending on the region, and 5 to 6 months in less mobile areas. Permanent scar correction can be obtained with Restylane Fine Lines/Touch, depending on the size and shape of the scar.

EASE OF INJECTION Restylane Fine Lines/Touch is very easy to inject, and care must be taken not to inject too much in the area of treatment. It generally takes less than 0.05 cc of material per placement of the needle. If the skin is thick and has multiple pores, injection may be more difficult, with small amounts of the product leaking into pores. If excess Restylane Fine Lines/Touch is injected, this can be corrected quite easily with massage.

TECHNICAL NUANCES Care must be exercised in patients with very thin skin, because superficial injections can result in long-term scarring that may not resolve. Another caveat is to avoid injecting Restylane Fine Lines/Touch in areas that are anatomically thin (the lower eyelid skin and lateral rhytids caused by the orbicularis oculi muscle). A topical anesthetic may be used, but this and local anesthetic can cause distortion (swelling) of the skin; therefore the line must be marked.

Combined Treatment

In the glabellar region, lines can be softened or eliminated for 8 months to a year when Restylane Fine Lines/Touch is injected in combination with *botulinum* toxin to limit corrugator function. Restylane may be needed to augment the deep layer of the dermis to attain maximal correction of the glabellar folds.

Postinjection Care

Postinjection bruising is less likely to occur than with Restylane Fine Lines/Touch, but treatment with cold packs and antihistamines is very helpful in reducing the recovery time.

Adverse Effects, Reactions, and Complications

Long-term scarring or bumps may occur rarely (0.1%) with very superficial injections. In our experience, in all cases to date, these have resolved almost completely, with the longest present for 1 year. As with any filler, good preinjection photographs are necessary, and documentation of other treatments (other fillers, laser, dermabrasion, and infections) will help to make the patient aware of preexisting deformities and improve long-term satisfaction for the patient and physician.

Results



Center: 1, This line lies over the dentition, and if too much filler is placed in this area, it will show as a bump.
2, A perioral line in this area is generally easier to correct than in position 1.

This 39-year-old woman presented with perioral lines that she wanted to improve or eliminate. Such lines are difficult to correct. Restylane Fine Lines/Touch is the best filler and must be placed very superficially. Postinjection taping with clear tape for the first 3 to 5 days can also help. It serves as a reminder to limit expression while the fibroblast and inflammatory response is taking place in order to prevent product migration. The patient is shown before treatment and 3 months after injection of 0.1 cc of Restylane Fine Lines/Touch. Note that the lines lie over the teeth, and if too much product is placed, it will give the mouth an odd appearance and may persist as a bump for a long time. Undermining of the line with an 18- or 20-gauge needle may help to soften it. This is done at a separate visit after the injection with a warning of possible bruising. This patient is very satisfied with the result and returns every 4 to 6 months for a touchup. Because of the repetitive movement of the fold, a permanent correction is very difficult to achieve.

Collagen

Features

The collagens include Zyderm and Zyplast, and CosmoDerm and CosmoPlast. Zyderm comes in two concentrations, 3.5% purified bovine collagen (Zyderm 1) or 6.5% purified bovine collagen (Zyderm 2). Similarly, there is CosmoDerm 1 (3.5% human fibroblast culture–derived collagen) and CosmoDerm 2 (6.5% human fibroblast culture–derived collagen). All collagens come premixed with 0.3% lidocaine, but lidocaine can be safely added to the latter. Two advantages of collagen over other injectable fillers are less pain with injection and less short-term swelling. So if a patient needs to attend an event the evening after an injection, short-longevity collagens would be an excellent choice of filler.

Indications and Applications

Zyderm and Zyplast are bovine collagen products; CosmoDerm and CosmoPlast are human collagen products. Although all products above are no longer available in Canada, they are still in use in the United States. Zyderm and Zyplast require two skin tests: the first test is followed 2 weeks later by a second test. Three to 4 weeks after the second test, if the patient does not have a reaction, the bovine product can be injected. Even with two negative skin tests, one in 1000 patients may still react to the bovine collagen injection. Skin reactions to bovine collagen can be debilitating. At their extreme, they can last for up to a year, with very little improvement with either topical or oral corticosteroids. For this reason many injectors are using bovine collagen only in patients who have previously had it and are requesting it. Zyplast is used in the mid-dermis in the nasolabial folds, melolabial and mental folds, angles of the mouth, vermilion border, and body of the lip to correct volume deficiency in these areas. Zyderm is used more superficially at the dermal-epidermal junction to correct fine lines. Zyderm would be used, for example, to correct the lines in the glabella that remain after a neurotoxin treatment. Additionally, Zyderm can be layered over Zyplast to give a more polished, longer-lasting effect than could be achieved with Zyplast alone.

Since the introduction of human collagen (CosmoDerm and CosmoPlast), it has become the choice of most injectors, because there is no risk of adverse allergic reactions. CosmoDerm is the equivalent product to Zyderm, and CosmoPlast is the equivalent product to Zyplast. CosmoPlast can be injected into the nasolabial folds to reduce the appearance of a valley between the nose and the mouth. Additionally, CosmoPlast can be injected into the vermilion border and the body of the lip to restore volume that the lips may have lost over time. CosmoPlast can also be used in the melolabial folds and mental folds to increase the volume and reverse the effects of aging in these areas. CosmoPlast may be injected into acne scars to correct them.

This effect can last up to 1 year. For the glabellar region, CosmoDerm and Zyderm would be used exclusively because of the risk of skin necrosis. Also, when attempting to correct the smile lines at the corners of the mouth, the injector should use CosmoPlast or Zyplast in the deep layer and would inject CosmoDerm or Zyderm more superficially over these lines to give maximal correction in an area in which typically a 50% correction is considered very good. These lines are difficult to correct because of the tissue pressure of folding created by smiling; we certainly do not want our patients to stop smiling to preserve the appearance of no lines.

VOLUMES All of the collagen products are supplied in 1 cc aliquots, and the volumes needed can vary from patient to patient. The lips may require a minimum of 1 cc and up to 3 cc, whereas the nasolabial folds may require 1 to 2 cc per side. Melolabial folds will require 1 to 3 cc total for correction. Usually 1 cc is more than enough to correct the mental fold, and often 0.5 cc is sufficient. Also, 1 cc is usually more than enough volume for all of a patient's acne scars. Adjustable needles are supplied to aid in injecting collagen to a precise depth, either to the mid-dermal region or at the dermal-epidermal junction.

LEVEL OF PLACEMENT CosmoDerm/Zyderm is placed at the most superficial level of the dermis (dermal-epidermal junction) with a 30-gauge needle; an overcorrection of 10% to 20% may be required. CosmoPlast/Zyplast, in comparison, is used for deeper folds and lines. This includes the nasolabial folds, marionette lines (melolabial folds), and mental folds. Injection to the glabellar area should be approached with caution because necrosis may result and has been reported with Zyplast, but has not been reported with CosmoPlast. This filler is placed at the mid- to deep reticular dermis, and care should be taken with the amounts injected so that lumps and bumps do not occur.

LONGEVITY CosmoDerm/Zyderm may last up to 4 months, with a shorter duration of 4 to 6 weeks on the lips. CosmoPlast will last from 4 weeks to 3 months.

EASE OF INJECTION Both Cosmoderm/Zyderm and CosmoPlast/Zyplast are relatively easy to inject compared with the hyaluronic acids, and with an experienced injector, good results can be achieved.

TECHNICAL NUANCES The human collagens are slightly easier to inject compared with the bovine collagens because the human collagens have an ease of flow that is probably unparalleled in comparison with any other filler. Additionally, both human and bovine collagen are prepackaged with lidocaine; as injection proceeds, the pa-

tient is more comfortable and experiences less pain. Massage is not a critical component of injection with collagen. Vigorous massage after collagen injection may actually result in decreased longevity; thus minimizing massage to the injected area is recommended. Unless the material has clearly resulted in a lump or bump, massage is not needed. Additionally, both collagens do not have much associated swelling and this is usually completely resolved within 24 hours in most cases. This added benefit translates into patients having injections in the morning and attending events in the evening. Technically the collagens are easier to use, although the correction achieved in patients with very deep folds may not rival the correction that can be achieved with the hyaluronans. For beginners, we suggest using the short-lasting collagens, perfecting their results, and then moving on to the hyaluronans, which have a steeper learning curve.

Combined Treatment

CosmoDerm/Zyderm is very useful in conjunction with Botox in the correction of vertical lines of the lips and for softening of crow's-feet and fine lines of the face and neck area. CosmoDerm may be used in combination with the hyaluronic acids to attain longer-lasting correction. There is little advantage in using CosmoDerm over Restylane Fine Lines/Touch. Both products have similar use and level of injection in the dermis. Restylane Fine Lines/Touch has much greater longevity than CosmoDerm and less chance of causing an inflammatory response.

Postinjection Care

Immediately after injection, if the patient takes 15 to 20 minutes to ice the face, very little swelling should result. If a bruise does develop as a result of the injection, it should resolve within 5 to 7 days. Provided that the patient does not ingest anticoagulants and anti-inflammatory agents before injection, the occurrence of bruising should be minimal and certainly less than that seen with the hyaluronans. Otherwise the patient should be able to carry on with the day's activities.

Adverse Effects, Reactions, and Problems

It must be noted that allergic reactions to the collagen products may occur. Skin testing is not required for CosmoDerm and CosmoPlast; however, patients receiving Zyderm and Zylast require at least one skin test. We perform two skin tests; the first test is at the first visit and the second is performed 2 weeks later. The second skin test is evaluated 4 weeks after it is placed. In evaluation, one is looking for redness, swelling, and plaques. Reactions can occur even if the test result is negative. It has been reported that a patient with two negative skin tests to bovine collagen can still have a 1:1000 chance of a reaction with subsequent injections. In our experience reactions to bovine collagen are rare but can be prolonged and incredibly difficult to

manage. Patients may experience redness, plaques, and scaling dermatitis that is unresponsive to application of topical steroids. The response to steroid injection is unpredictable, and sometimes patients are required to take oral prednisone for control of inflammatory responses. Scarring may be the end result. For this reason, we primarily inject CosmoPlast and CosmoDerm, the human collagen products, which have been shown to have low immunogenicity.

Repeated injection may result in scar formation in the soft tissues providing some longer-term permanent augmentation. With bovine collagen (Zyplast/Zyderm), inflammation was thought to contribute to long-term improvement. Human collagen (CosmoPlast/CosmoDerm) will not stimulate as much inflammation, because it is species compatible. In some patients, bovine collagen is not long lasting, and reactions still may occur. There have been reports of necrosis in the glabellar region when Zyplast was injected.

Radiesse

Features

Radiesse (BioForm Medical, Inc., San Mateo, CA) consists of 30% calcium hydroxylapatite (CaHA) and microspheres surrounded by a carboxymethylcellulose gel carrier. The technology is similar to that of ArteFill, but there are some differences. Radiesse is a little more biocompatible, because calcium hydroxylapatite is the same mineral component found in bones and teeth. This is a synthetic product, and the aqueous carrier gel is composed of glycerin and sodium carboxymethylcellulose and constitutes 70% of this product's volume. The carrier gel is replaced with the patient's own connective tissue 3 to 6 months after injection. Therefore no sensitivity testing is required. The carrier gel makes it a little bit thicker and a little more cohesive.

Indications and Application

Radiesse has been injected into the lips (not recommended), nasolabial folds, glabellar region, marionette grooves, and the mental fold. It has been approved by the FDA for the treatment of nasolabial/labiomental folds, HIV lipoatrophy, vocal cord insufficiency, radiographic marking, and facial skeletal reconstruction. It is also particularly appropriate for treating glabellar lines, acne scars, posttraumatic/poststeroid atrophy, and achieving cheek/chin/mandibular augmentation, and correction of nasal depressions or nasal augmentation. Injection of this product in the lips or superficial rhytids should be avoided, because doing so results in high rates of visible nodularity (20%). CaHA can also be used in hand rejuvenation.



Preoperative and 6-month postoperative results are shown after injection of 1.3 cc of Radiesse to the left hand in a 60-year-old woman.

Level of Placement and Injection Technique

Radiesse is supplied in 1 cc syringes. The placement is at the deep dermal level similar to ArteFill. The technique for injection and the planning for volume and line correction are much different than with the other fillers. The material is placed as the needle is withdrawn in a linear injection technique. Layering of the product at the deep level may help for areas such as the nasolabial folds. Cutaneous subcision will aid for very deep lines. Postinjection massage should be carried out to attain proper soft tissue contouring.

Similar to ArteFill small amounts of Radiesse must be placed with care to avoid irregularities, lumps, and bumps. Unlike with ArteFill most of the correction is achieved from the calcium hydroxylapatite particles within the product rather than tissue ingrowth around the particle matrix.

Volumes

This product is available in 0.3, 1.3, and 1.5 cc syringes and does not require reconstitution, as Sculptra does. Since it does not contain anesthetic, lidocaine 1% can be added at varying volumes, depending on the desired viscosity (this is an off-label use). Usually, in areas that require structural support, such as the cheek, 0.1 to 0.5 ml of lidocaine is used, whereas in areas of thinner skin, such as the tear trough, 1.0 ml of lidocaine is preferable. A 27- or 28-gauge needle can be used without clogging problems. The volume placed is similar to that of other fillers. Initially the injector should be conservative, because the material is long lasting; a relatively small volume provides a little larger correction than some of the other products. Approximately 1 cc of this product is comparable to the corrections that can be attained with 3 cc of Zyplast. The volume of augmentation is maximal at 4 to 6 weeks. Care must be taken with the amount of filler placed and that it is placed very evenly. For hand rejuvenation the recommended injection volume is 0.7 to 1.0 cc injected in small boluses subcutaneously and massaged to provide an even distribution. Lidocaine 1% 1 ml can be mixed with each 1 cc of CaHA injected to provide anesthesia.

Longevity

Radiesse has less long-term clinical follow-up in the soft tissues of the face compared with ArteFill and the hyaluronic acids, since its original indication was for use as a radiologic marker. It has a reported longevity in soft tissue of 1 to 5 years and in some reports up to 7 years, but the declared persistence is 1 year. An incidence of lump or bump of 8% to 10% has been reported by experienced injectors for contouring of the lips.

Ease of Injection

Radiesse has a higher viscosity and requires a larger needle size; however, the manufacturer supplies a special 28-gauge needle that facilitates injection, making it similar to that for hyaluronic acid fillers; injection is even easier if lidocaine is added. Injectors should start with the easier areas of correction, such as the nasolabial folds.

Technical Nuances

Care should be taken with injections, because the incidence of irregularity is higher than that of other fillers in the hands of new injectors. Deep dermal placement is important, since superficial placement may cause local irritation, bumps or rare granuloma formation. Furthermore, small-volume injection (less than 0.1 cc) and a uniform injection technique may help to prevent granuloma formation. After injection, massage will help to create a uniform contour; the product is pastelike and can be manipulated for several days following the injection.

Combined Treatments

Radiesse may be layered with other nonpermanent fillers. Taking preinjection photographs is as important for all patients having tissue filler injections as for patients undergoing cosmetic surgery.

Postinjection Care

Lumps, bumps, or irregularities may be treated by injecting them with dilute triamcinolone (Kenalog) on a monthly basis until they have resolved. Avoidance of blood-thinning medications and supplements before injection and topical icing for the first 24 hours after injection are also important.

Adverse Effects, Reactions, and Problems

Complications occur most often in the lips where there can be a 10% to 20% early nodularity rate. If a lump, bump, or irregularity occurs, it may be treated with a dilute steroid injection and massage. However, irregularities may require excision if they persist and do not respond to steroids. It has been found that when the volume injected into the lips is adjusted to 0.6 cc in the upper lip and 0.4 cc in the lower lip, the rate of nodularity decreases to half, or approximately 5%. *Radiesse is radiopaque, so patients should be informed of this to avoid surprises during routine dental x-ray examination.* The volumes required with Radiesse are similar to or somewhat less than those needed with other fillers.

Results



Preoperative



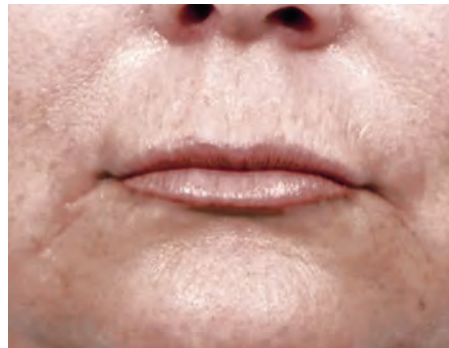
6 months postoperatively



15 months postoperatively

Courtesy Miles Graivier, MD

Preoperative and 6-month postoperative results after lip augmentation with 1 cc of Radiesse are shown. At 15 months the patient exhibits only a small amount of volume loss.



Courtesy Miles Graivier, MD

This woman underwent injections of 1.4 cc of Radiesse to her radiating lip lines, nasolabial folds, and white roll. The close-up view (*lower right*) clearly shows her more youthful appearance.

Sculptra

Characteristics

Sculptra (Sanofi-Aventis, Bridgewater, NJ) is an injectable filler composed of a suspension of poly-L-lactic acid (PLLA) microparticles (40 to 63 μm). This is the same type of material used in absorbable sutures such as Vicryl, or absorbable plates. It is a biocompatible and biodegradable polymer that breaks down, eliciting an inflammatory reaction, which contributes to collagenogenesis and fibrous tissue formation. Soft tissue augmentation is accomplished initially by the direct deposition of PLLA particles as well as the diluent. PLLA particles are suspended in carboxy-cellulose, mannitol, and normal saline solution. Once the diluent is absorbed, the volume-enhancing effect is partially lost; the PLLA particles remain to undergo a much slower degradation that takes place over a year. Macrophages break these particles down to lactic acid, water, and carbon dioxide, and the inflammatory process attracts fibroblasts, which in turn result in particle encapsulation and increased collagen tissue deposition. Therefore the final effect is somewhat delayed (weeks to months); that delay should be kept in mind while injecting Sculptra. As a result, multiple conservative sessions may be required. The longevity of PLLA can range from 1.5 to 2.5 years; however, additional injections may be required once the desired result starts to diminish.

Indications and Applications

PLLA has been successfully used in more than 30 countries under the name of New-Fill for a variety of facial volume and contour deficiencies including facial aging. In the United States, Sculptra is approved for the treatment of facial lipoatrophy seen with antiretroviral therapy in HIV-positive patients, and it recently received FDA approval for cosmetic use (Sculptra Aesthetic, approved July 2009). It is indicated for the correction of shallow to deep wrinkles, such as the nasolabial folds and marionette grooves, as well as contour deformities. Injection should be either in the deep subcutaneous planes or deep dermal layer or on the skeleton (forehead, malar region, jawline, and the base of the nose), avoiding more superficial deposition. The use of PLLA in superficial rhytids and the lips is contraindicated, because it can easily lead to visible and palpable inflammatory nodules.



Preoperative and 1-year postoperative results are shown after augmentation to the brow, cheeks and jawline with three sessions of Sculptra (2 vials per session) in a 51-year-old woman. The dilution of each vial of Sculptra consisted of 7 ml of sterile water and 3 ml of 1% lidocaine with epinephrine.

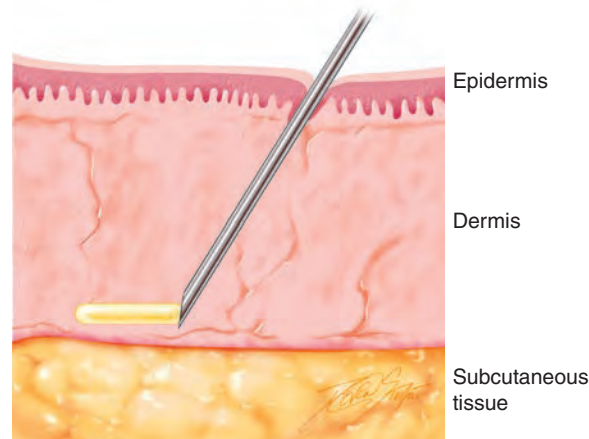
Product Preparation

Sculptra is a crystalline, amorphous, freeze-dried mixture with a 2-year shelf life in the unconstituted form. Dry PLLA is reconstituted with sterile water. The volume is 5 cc on average, but volumes as low as 3 cc (not recommended) and up to 20 cc have been reported, usually depending on the location being injected. Unlike other fillers, this product requires preparation by reconstitution at least 2 hours before injection. Some physicians prefer reconstitution 12 to 24 hours before injection. Once the water has been added, the vial is allowed to stand without shaking or agitation for at least 2 hours. The reconstituted suspension is stable for up to 72 hours and does not require refrigeration. After the 2 hours and immediately before injection, the vial must be agitated or rolled to ensure a uniform, translucent suspension. Although the manufacturer recommends discarding any unused product after 72 hours, there are reports of PLLA use 30 days after it has been reconstituted and kept at room temperature. Lidocaine 1% or 2% (1 ml), with or without epinephrine, can be added when preparing Sculptra to decrease the discomfort associated with injection. Injection is carried in the deeper layers first, usually by a depot technique. Then a more superficial layer is injected to provide a more “polished” volume augmentation. Postinjection massage is necessary to prevent nodule formation and optimize the outcome. Sculptra, a synthetic, is not derived from animal or human tissue; therefore it is not very immunogenic, and skin testing is not required.

Injection Technique

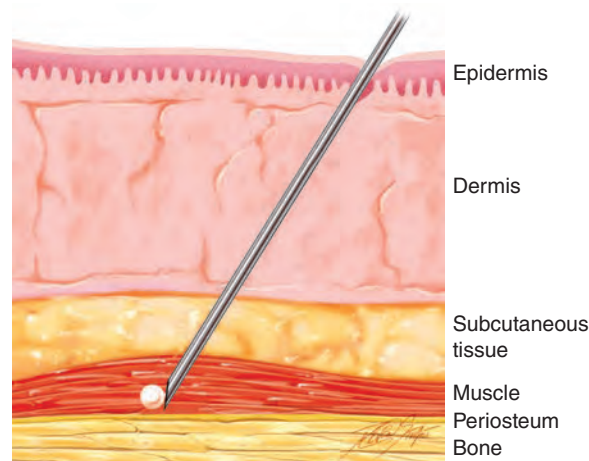
There are two basic injection techniques: tunneling and depot. The tunneling technique for deep dermal and subdermal injection is most suited for the lower face, cheeks, and nasolabial folds. The depot technique is for deeper placement of the product directly over the periosteum, such as the periorbital area and rim zygoma.

Tunneling Technique

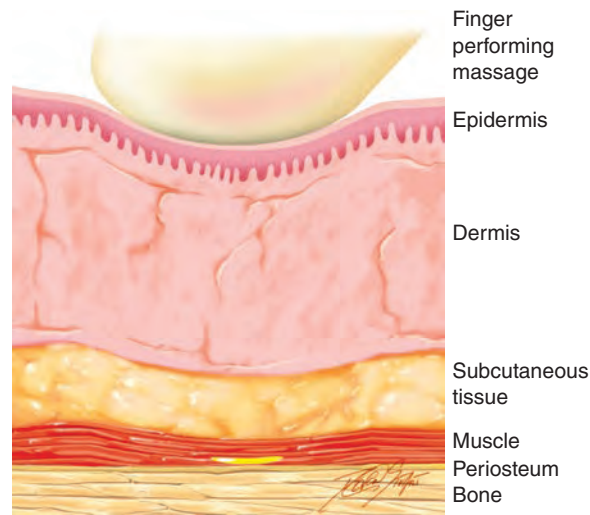


For the tunneling technique, used for placement of the product in the deep dermis or subcutaneous tissues, the needle is placed at the appropriate level and the Sculptra is deposited as the needle is withdrawn, leaving 0.1 to 0.2 cc per injection or needle pass. In the cheeks, 20 such passes may be needed for contour correction.

Depot Technique



The depot technique allows product placement deep into the tissues just above the periosteum. The needle is guided through the tissues to the periosteum of the underlying bone, and then a depot of 0.05 cc is deposited. This should produce a visible and palpable elevation of the area.



In the depot technique, the area should be massaged to spread the product evenly over the bone, and then a second injection is performed. This is the technique for zygomatic enhancement and periorbital correction over the orbital rim deep to the orbicularis muscle. (Caution must be exercised in this area, because if nodules occur, they can persist for a long time.)

Volumes

The volume of injection will vary from individual to individual and area to area. Typically, for the nasolabial folds, volumes of 1 to 2 cc per side may be required. For correction of lipoatrophy of the cheeks and temple area, several milliliters per side may be needed and, in fact, multiple injection sessions may be required.

Longevity

Sculptra is a relatively long-lasting soft tissue filler. There have been reports of persistence of the product and volume correction up to 2.5 years in patients who suffer from lipoatrophy of the face.

Ease of Injection

The ease of injection depends on the consistency of the reconstituted product, which depends on the dilution with 5 to 10 ml of sterile water. Sculptra requires a 26-gauge needle or larger. Unlike most other fillers, it cannot be injected through a 30-gauge needle. If difficulty is encountered with the 26-gauge needle, a larger-gauge needle such as a No. 25 or 23 (rarely) should be used.

Technical Nuances and Tunneling Techniques

First, the entire area to be injected is marked; then the skin is stretched opposite to the direction of injection to facilitate skin penetration. The syringe plunger is drawn back to ensure that a blood vessel has not been entered, and then a thin trail of Sculptra is injected as the needle is withdrawn, no more than 0.1 to 0.2 cc per tunnel. This injection will produce a visible and palpable skin elevation in the area of injection. The injected area is massaged, and then another injection is made next to the previous one. Multiple injections in a crisscross pattern produce the best results. In patients requiring large volumes, it is best not to do the entire volume correction at one time. The injections can be repeated during a second session a week or two later. It is important not to overcorrect and to massage the area to distribute the Sculptra evenly.

Combination Treatments

Because Sculptra is designed for deep dermal or subcutaneous use, it is not a suitable product for correction of perioral, periorbital, and facial lines requiring deposition of a product more superficially. Deep treatment with Sculptra could be combined with the more superficial treatment with other suitable products.

Postinjection Care

Immediately after the completion of the injection, moisturizer is applied to the area and at least 5 minutes of massage is performed by the physician. Ice packs are then applied to the area to minimize bruising. The patient is also instructed to massage his or her face daily at home. The patient should be advised that much of the initial injected volume will be lost within the first weeks as water and postinjection edema are absorbed, leaving the microparticles of PLLA within or under the skin; that the full effect of the treatment may take a few weeks or months to be visible; and that a number of treatment sessions may be needed, depending on the severity of volume loss.

Adverse Effects, Reactions, and Complications

As with most injectables, bruising, swelling, and inflammation can develop after injection with Sculptra. More specifically, inflammatory nodules or papules can develop and are usually associated with injection at the superficial dermal/epidermal layers or injection in the lips. Skin discoloration can accompany such superficial nodules. The role of massage is critical in preventing such inflammatory nodule formation. Some data suggest that certain conditions, such as connective tissue disease or sarcoidosis, may predispose to a more pronounced inflammatory reaction (extensive granuloma formation and facial edema) with Sculptra injection.

ArteFill

Features

ArteFill (Artecoll in Europe and previously in Canada) has been used extensively in Europe and Canada for many years for soft tissue augmentation. It is comprised of collagen-covered PMMA beads, which are 40 microns in size. The particles of PMMA are noncharged and therefore they are found to have minimal (if any) reactivity in the tissue. They constitute 20% of the filler, while the bovine collagen component constitutes the rest 80%. The collagen is the transport vehicle for the PMMA beads and is absorbed over a 4- to 6-week period (or sooner), and the volume of the tissue is increased by the body making connective tissue around the PMMA beads in that time period.

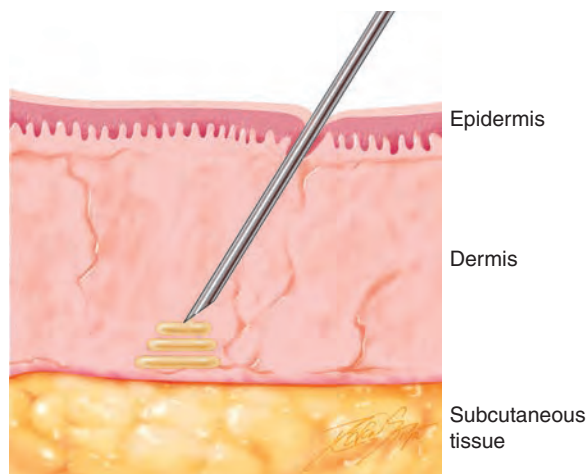
Indications and Applications



ArteFill can be used in several areas. The safest indicated areas are the nasolabial folds and deep marionette lines. It is highly effective for deep soft acne scars and produces excellent long-term results for these types of scars. ArteFill has been used extensively in augmentation of the lips; however, there are reported incidences of irregularities, lumps, and bumps. Patients must be informed of adverse effects before receiving injections in the lips.

ArteFill has been injected into rhytids in the glabellar and periorbital region. The tissue in these regions tends to thin with age, and permanent fillers such as ArteFill may become visible over time. Correction of very superficial rhytids is difficult with ArteFill, and this is not an indication. Patients with a known allergy to collagen should be approached with extreme care with pre-injection testing with collagen for possible sensitivity. ArteFill has been used in patients of all ages and can result in excellent correction of deformity and scar in addition to providing great soft tissue augmentation results. It should be considered as one of the fillers of choice for permanent soft tissue augmentation.

Injection Technique



ArteFill has been injected in all of the soft tissues of the face as well as other parts of the body. It is injected in similar fashion to other soft tissue fillers. The recommended needle is 26-gauge, and it is supplied in a 0.5 cc syringe. ArteFill is placed as the needle inserted into the deep dermal plane is withdrawn. Once the ArteFill has been placed in a region, it must be massaged to make sure that there is uniformity of placement and that there are no lumps or bumps. Immediately after injection, mobile areas (nasolabial folds and lips) should have tape placed over them to limit the amount of movement and facilitate the formation of scar tissue around the beads. Tapes should be in place for the first 4 to 5 days. With lip augmentation, Botox should be injected around the lips in small doses (1 to 2 units in four points above and below the lips) in addition to taping the treated areas to prevent too much motion.

The technique for acne scars involves placing the ArteFill on the deep dermal plane with either simultaneous or subsequent release of the scar if necessary. As in other soft tissues, serial injections every 8 weeks may be required for complete correction of the scar. The material should be stored at 4° C and warmed to room temperature before use.

Level of Placement and Volumes

ArteFill is placed in the deep dermal plane. A nerve block is generally required for its administration. Initially, the average volume of ArteFill used in the lips is 0.5 cc per lip with patient follow-up 6 to 8 weeks after the injection. Varying amounts

can be used in other areas; nasolabial folds may require anywhere from 0.5 to 1.5 cc of ArteFill per side for correction. It is important to note that with initial injection the aim is to undercorrect the area.

Longevity

ArteFill is considered a permanent filling substance. As the patient ages, more volume may be required after about 1½ years.

Ease of Injection

Technically, Artecoll is the most difficult filler to inject. It is more viscous than any other filler and the syringes can contain air (due to the evaporation of collagen), which may cause irregularity in pressure and delivery.

Combined Treatments

Other fillers such as Restylane may be used in the same areas as ArteFill. A nonpermanent filler is often placed first; then a permanent augmentation with ArteFill is done 4 to 6 months later. Botox is very useful to help reduce the movement in areas such as the lips and glabellar region. The Botox treatment should be done 2 weeks before the ArteFill treatment to reduce the movement of the tissues in the first 3 to 5 days after the injection. Restylane Fine Lines/Touch should be used for the superficial lines rather than ArteFill. Care should be taken in patients undergoing treatments with radiofrequency as Artecoll may cause the tissues locally to receive more energy if the probe is placed right over the ArteFill. The PMMA is stable when subjected to very high temperatures.

Postinjection Care

The patient should be scheduled for a postoperative visit 6 to 8 weeks after the initial injection. They should also be informed that they will not see initial results for the first 6 to 8 weeks. In comparison to other fillers, there is only a mild to moderate increase in soft tissue augmentation in the first weeks as three fourths of the volume of the syringe is collagen, which is rapidly absorbed after the initial injection. Collagen is the vehicle for placement of the bead. Volume change occurs when the tissue grows into the bead. Cool packs and medications recommended for Restylane (such as antihistamines) will also help with reduction of postinjection morbidity.

Adverse Effects, Reactions, and Complications

One of the disadvantages of ArteFill is that irregularity will result if too much material is placed in one spot. If this is discovered soon after injection, it should be treated with massage followed by injection with a dilute dose of steroid (0.2 mg/ml

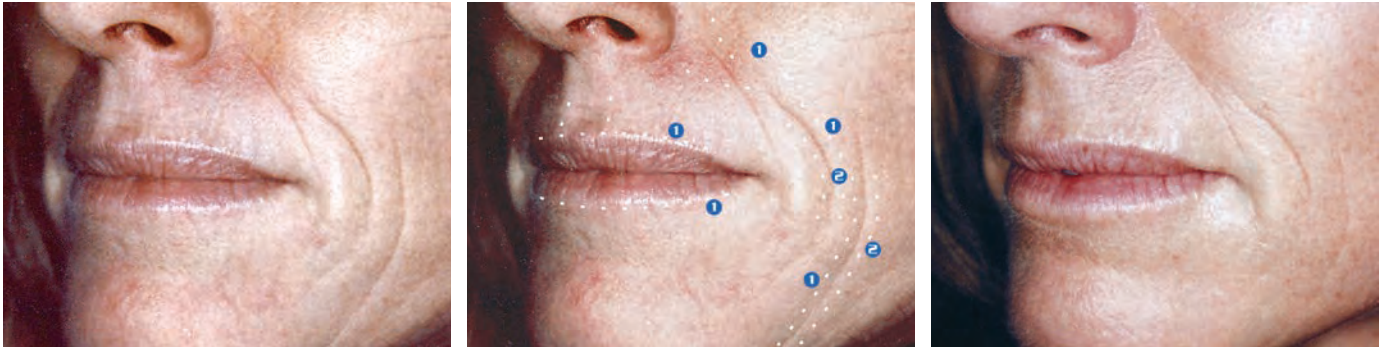
triamcinolone [Kenalog]) to soften the irregularity. Subsequent excision of the irregularity may be required if there is a persistent lump or bump. The incidence of granuloma formation is very low when ArteFill is injected with proper technique. It is highly recommended that a new user undergo supervised training before injecting ArteFill. With careful planning and placement of ArteFill, one can achieve excellent results for long-term to permanent soft tissue contouring.

Results



1, ArteFill is placed at the vermilion border first. 2, Augmentation of the dry lip must be done with care. 3, Augmentation of the wet-dry junction and the lateral lip (this can be turned out by injecting from the vermilion to the wet-dry mucosal junction).

This 33-year-old woman requested lip augmentation. She had a good lip shape to start with and was the ideal candidate for lip augmentation with ArteFill or any other filler. The injection was done under a nerve block with local anesthetic with adrenaline. ArteFill 1 cc was injected into the upper lip; 1 cc was also injected into the lower lip. It was placed in the vermilion border to increase border definition, projection, and size; the dry lip to increase size and projection; and the wet-dry junction to increase size and projection. She is shown 1 year after injection. No lumps, bumps, or irregularities are evident. The patient is very satisfied with the result and shows good long-term results and normal appearance of the lips when animating. The injections were done in two steps with 0.5 cc per lip per session 2 months apart. With ArteFill the injections should be planned 1½ to 2 months apart to allow maximal change with tissue formation around the beads. For the lips some patients may require a total of 3 to 4 cc. Patients with thin lips should be warned of the minimal to moderate change in size and shape. If too much volume is placed, there is an increased chance of lumps, bumps, or irregularities.



Center: 1, Areas where ArteFill has been placed in the deep dermis. 2, Areas where ArteFill has been placed in the deep dermis, and Restylane Fine Lines/Touch has been placed at the dermal-epidermal junction.

A total of 1.5 cc of ArteFill (0.75 cc per side) was placed in this 38-year-old woman, who requested amelioration of nasolabial folds and marionette lines. ArteFill was injected into the deep dermis of her nasolabial folds, lip-vermilion border, and marionette lines. Restylane Fine Lines/Touch was placed at the dermal-epidermal junction, overlying the area in which ArteFill was placed in the marionette grooves (a total of 0.4 cc: 0.2 cc per side).

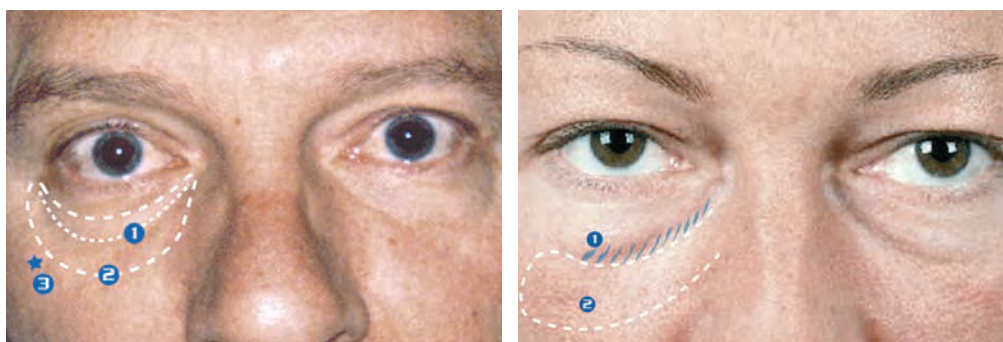


This 47-year-old man demonstrates the effectiveness of ArteFill for correction of cystic acne scarring (*arrows* indicate acne scars). A total of 3 cc of ArteFill was injected into the deep dermis on each side of his face. Two sessions of injections were performed under local anesthetic 2 months apart to achieve the desired result. He also had 0.7 cc of Restylane injected into his upper and lower lip vermilion.

Autologous Fat Grafting

Features and Applications

The relatively recent development of effective methods of structural fat grafting have been revolutionary in contouring the face and body. Autologous fat enhances the subcutaneous volume and intramuscular size but does not act as a dermal filler. Basic indications are facial (cheek, malar hollow, jawline shape, chin projection, supra-orbital hollow, nose shaping), body contouring (buttock augmentation, correction of liposuction deformity, chest contouring, correction of scars), and more recently, the breast. With respect to the breast, fat grafting is very promising for primary augmentation, secondary corrections, and breast reconstruction, yet its use remains controversial. Proper training is required, and a long learning curve can be expected to achieve top-quality results.



In this 48-year-old man (*left*), fat was placed at 1, the deepest level of the infraorbital hollow, just below the orbital rim. The inferior extent of fat placement is indicated at 2. The fat is first placed to the deep layer at the inferiormost aspect, then added stepwise superiorly to the orbital rim; 3 indicates the malar high point. In the 38-year-old woman (*right*), Restylane treatment and fat grafting were combined to good effect to fill the infraorbital hollow.



Preoperative and 1-year postoperative results after microfat grafting to the hand are shown in a 58-year-old woman.



Preoperative and 1-year postoperative results are shown after microfat grafting to the temples, cheeks, and jawline and bilateral upper blepharoplasty in a 50-year-old man.



Common areas in which fat is placed for effective correction are the infraorbital hollow, malar region, the angle of the mandible, anterior/posterior jawline, chin, nasolabial folds, and the supraorbital/temporal region (1 and 2). Indications may vary from facial aging to lipoatrophy to congenital aesthetic deformities. Structural fat grafting is also extremely effective in the periorbital region in combination with lower and upper lid blepharoplasty, as well as in facial rejuvenation in combination with a SMAS technique to fill the periorbital hollow. The supraorbital region, the nasolabial fold, the jawline anterior to the jowl, and the nasal base may be augmented with microfat grafting in combination with face lifting.

In comparison to the injectable soft tissue fillers, autologous fat is an excellent tool for deep soft tissue filling and augmentation. Fat grafting is also effective in scar subcision when the scars are soft and fat filling is carried out underneath. Fat is also used to contour deformities of the nose, after either traumatic or aesthetic surgery. In comparison to the injectable fillers, results are variable when fat is used to contour the lips and perioral region. Fat can be used for deep soft tissue augmentation when it

is injected below the periosteum of the malar bone in the upper one third of the nasolabial fold. Fat may have decreased longevity when placed in the subcutaneous layer to soften the nasolabial fold if the patient has a dynamic smile with compression of the fold.



1, Primary depth of hollow in which Perlane is first placed, on the bone. 2, Area augmented with Perlane to contour the malar region and correct the "polar bear" feature.

The use of Perlane on the deep layer of tissue can achieve similar results to fat grafting in certain areas of the face as can be seen in this woman whose periorbital hollows and malar bone were augmented with this filler.

Injection Technique

The basic technique for microfat grafting consists of the harvesting of fat from a donor site and transplantation to a recipient site where it acquires a new blood supply, which enables it to survive. Technically, small packets of fat are placed in individual spaces to increase the volume of the tissue. These small packets acquire a new blood supply through angiogenesis. The cells that are transplanted may increase or decrease in size depending on weight gain or weight loss. Fat survival is technique dependent, and some cases may require secondary injections that may be done at varying lengths of time after the initial surgery. Fat storage after harvesting, for further or late grafting, is controversial, because fat cells have been shown to lose viability when frozen.

The technique for harvesting may be done with either a Coleman 14-gauge harvesting cannula or a Lambros 3 mm cannula (Grams Medical, Costa Mesa, CA). Aspiration is done with a 10 or 20 cc syringe held at 1 to 2 cc negative pressures to minimize trauma to the fat. The site of harvesting has no consequence with regard to results and longevity. Fat may be harvested from any location where there is excess. The fat is then spun for 1 minute at 1500 rpm to separate the blood, oil, and local anesthetic. The remaining fat is then transferred into syringes for injection using a variety of techniques, depending on the region, density, and thickness of the tissues. A 1 cc syringe is used in the facial region, with less than 0.1 cc of fat being placed with each pass. Varying degrees of correction are carried out when placing the fat. The harvesting cannula may also be used for injection of the fat in truncal areas.

Volumes

The volumes of fat required vary. In general, 3 to 7 cc may be used per side in the periorbital region and 2 to 5 cc for the nasolabial fold, 1 to 3 cc for the anterior jawline, and 6 to 15 cc for the posterior jawline. The surgeon should harvest two to four times the volume required for transfer, depending on the site and harvest technique.

Longevity

If fat survives transfer, it becomes permanent. It gains or loses volume if there is an increase or decrease in total body fat. It is sensitive to direct trauma, including forceps injury, and it is also sensitive to injury with radiofrequency devices (Thermage, Inc., Hayward, CA). Radiofrequency devices should not be used in areas that have been grafted. If a physician is contemplating fat transfer in combination with radiofrequency, the radiofrequency treatment should be completed before the fat transfer; this may be done immediately before the grafting procedure.

Adverse Effects, Reactions, and Complications

Complications of fat transfer are similar to those of any other injection or surgical technique. Care should be taken to deposit small amounts (0.1 cc) per each injection pass in the face to avoid fat emboli to the eye or brain. Technique-related complications include placing the fat too superficially in the thin skin of the upper and lower eyelids. Care should be taken not to inject the fat into the intramuscular or direct subcutaneous layer between the muscle and the skin. Fat placed in these areas will manifest as an irregularity, either static or dynamic. To address this complication, the surgeon may remove fat either through a blepharoplasty incision or a direct incision followed by pinching the fat with forceps. Other rare complications include infection/abscess, chronic inflammation, change in skin texture (peau d'orange), and fat graft survival, either too much or too little.

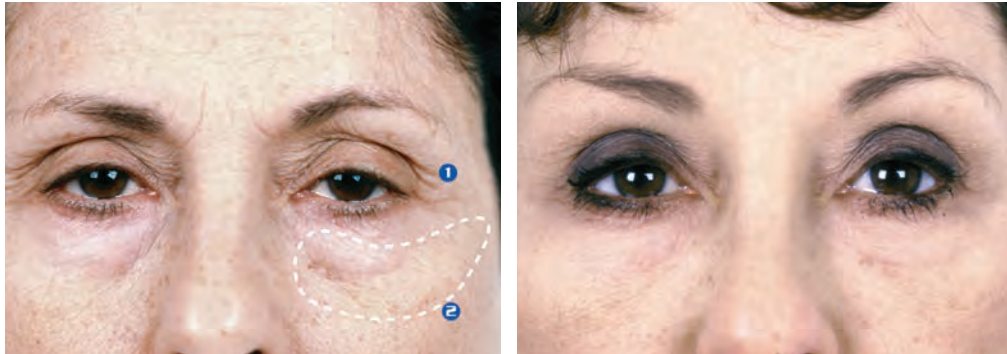
Results



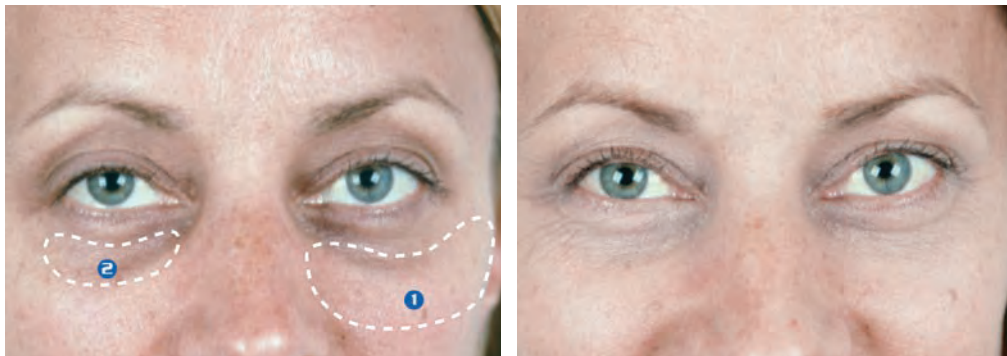
This 48-year-old man is shown 1 year after microfat grafting to the malar region combined with transconjunctival blepharoplasty and canthopexy. A total of 6 cc of fat was placed per side in the subperiosteal region on the periosteum to augment the malar soft tissues and eliminate the periorbital hollow. The eyelid was not incised. Postoperatively the nasojugal groove and periorbital hollow were eliminated, and good lid position is exhibited.



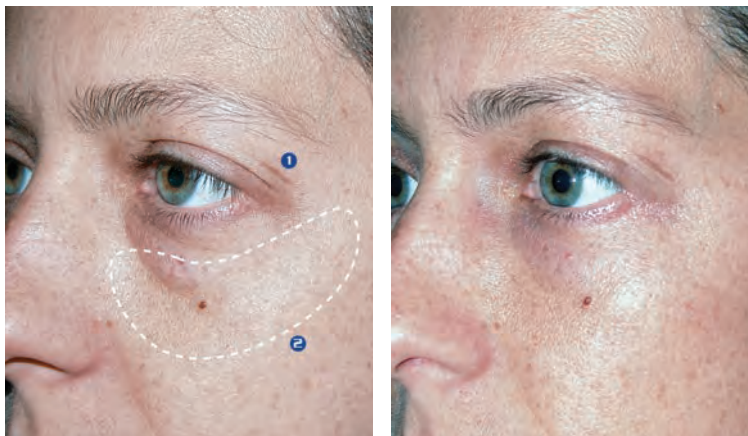
This 38-year-old woman complained of fullness below her lower eyelid. This fullness was due to the orbicularis oculi muscle (1). Microfat grafts (4 cc) were placed on the deep layer below and up to the edge of the muscle bulge (2). She required only one grafting session and no eyelid surgery. She is shown 1½ years after injection.



This 60-year-old woman underwent a face lift, open brow lift, upper blepharoplasty, and lower eyelid transconjunctival blepharoplasty. Left: 1 indicates the superolateral extent for fat grafting. A total of 4 cc of fat was injected to the malar bone and nasojugal groove to increase cheek projection (2). She is seen 1 year after microfat grafting.



This 36-year-old woman underwent microfat grafting to the malar region and nasojugal groove (1) to correct her tear trough and periorbital hollowing. The oil from the harvested fat was injected between the skin and the orbicularis oculi muscle (2) to induce inflammation and scar tissue, which lightens the color of the skin. She did not require a blepharoplasty incision. She is seen 1 year after fat grafting.



This 34-year-old woman underwent transconjunctival blepharoplasty, canthopexy, and malar fat grafting to improve facial contouring (1 indicates an old scar). The fat was used to increase cheek projection, augment the malar high point, and decrease the nasojugal groove and periorbital hollow (2). She is seen 1 year after treatment.

Technical Guidelines for Filler Combinations

To achieve optimal benefit, tissue fillers may be used in combination. In particular, the hyaluronic acids, which come in three different sizes, produce excellent results when used in combination. The larger-molecule fillers, Perlane, Puragen, and Juvéderm Ultra Plus, should be placed in the deep layer followed by the addition of Restylane, Hylaform, Juvéderm Ultra, Eleveess, or Prevelle Silk in a more superficial plane. This layering can be done in both the nasolabial folds and the lips depending on the depth and severity of rhytids. Restylane Fine Lines/Touch is an excellent choice to use on top of either Perlane or Restylane at the most superficial level, the dermal-epidermal junction. Quite often the depth of a fold is associated with a fine line at its very deepest portion. The Fine Lines products are able to soften this line. Additionally, Restylane Fine Lines/Touch is quite useful in combination with Restylane, Hylaform, Juvéderm Ultra, Prevelle, or Eleveess for the glabellar region in which the fold may have a degree of depth and breadth of 1 to 2 mm with a very fine line running down the central deep portion. Again, to avoid tissue necrosis, caution should be used when injecting in the glabellar region.



For the lips, combinations of fillers may include ArteFill combined with Restylane/Hylaform/Juvéderm Ultra/Elevess or Restylane Fine Lines/Touch to achieve long-term correction and enhancement as is seen in this patient (also seen on p. 377). Combining Perlane and Restylane Fine Lines/Touch can achieve very similar results after repeat injections over a longer period of time. In some cases the combination of the two fillers produces results that may last from 8 months to 1.5 years. In areas such as the hollowing anterior to the jawline and jowl, Pelane/Puragen/Juvéderm Ultra Plus can be placed on the bone to give a deep-layer enhancement followed by subcutaneous or intermediate dermal placement of Restylane/Hylaform/Prevelle Silk/Elevess/Juvéderm Ultra to complete the correction of the deformity at the anterior jawline.



The combining of the larger molecules of Perlane/Puragen/Juvéderm Ultra Plus along with Restylane Fine Lines/Touch is quite useful in the treatment of acne scarring whose acne scarring was significantly improved with this approach. ArteFill is also a great choice for filling acne scars for permanent results.

Some individuals prefer to combine Restylane injection in the deep layer of the lip with Zyderm/CosmoDerm for the superficial augmentation. These individuals would inject the Zyderm/CosmoDerm before Restylane/Hylaform/Juvéderm Ultra to take advantage of the lidocaine anesthetic effect.

Results



This 47-year-old woman requested restoration of her lips, chin fold, jowls, and nasolabial folds. Note the herpetic outbreak on her left upper lip. She underwent injections of 0.35 to 0.7 cc of Perlane/Restylane into her nasolabial folds and 0.2 cc of Restylane with 0.2 cc Restylane Fine Lines/Touch into her extended nasolabial folds. She also had 0.2 cc Restylane placed into her marionette lines. Her mental fold was treated with 0.3 cc of Perlane/Restylane and 0.3 cc Restylane Fine Lines/Touch. Then 0.35 to 0.7 cc Perlane was injected on bone or into deep dermis to correct her jowls. She is shown 4 months after injection.

General Considerations and Technical Pearls

Technical Nuances

All fillers result in dramatic improvements if used correctly and precisely. It is important to note that the results achieved with each filler are dependent on a learning curve, and some fillers are more forgiving than others. When learning to inject fillers, it may be easier to use the collagen fillers because their viscosity is low and placement into the tissue is done with relative ease. Additionally, these fillers do not last as long as the hyaluronic acids. There are special adjustable needles provided with the syringes that make injecting for novices even easier. Collagen is formulated with lidocaine so a patient is more comfortable as the injection process proceeds. Perlane/Juvéderm Ultra Plus/Puragen and Restylane/Juvéderm Ultra/Elevess/Prevelle Silk are less forgiving when injected improperly. These must be placed precisely at the level of the deep dermis and mid-dermis, respectively. The amounts placed on each pass should be limited to less than 0.1 cc so that no lumps or bumps are created. If an irregularity is noted, then this may be massaged gently to reduce its prominence. If a large amount of material is placed at one site, then a possible sterile abscess may occur resulting in loss of volume in the region along with inflammation and swelling.

ArteFill can be used as baseline filler for the nasolabial folds and lips. Subsequently injections can be performed with Perlane, Restylane, or Restylane Fine Lines/Touch with excellent results. It must be noted that ArteFill, despite its permanence in the tissue, provides correction of a deformity only for a period of 1½ to 2 years. Age-

related changes and atrophy may give rise to the need for additional soft tissue augmentation.

Of these fillers, ArteFill is the most difficult to inject. It is highly viscous and must be warmed to room temperature to allow ease of injection. If there is loss of the collagen suspension, there may be air present in the syringe, which can make the injection quite irregular. Careful massage of the tissue must be done after placement so that no lumps or bumps remain. The larger 26-gauge needle causes more tissue trauma and bruising compared with the smaller 27- to 31-gauge hyaluronic acid needles. Perlane and Restylane are easier to inject than ArteFill.

Perlane/Juvéderm Ultra Plus is injected with a 27-gauge needle, and Restylane/Juvéderm Ultra/Prevelle Silk/Eleveess is injected with a 30-gauge needle. They can be placed with precision. Fantastic results can be achieved with proper training and a good aesthetic eye. Restylane Fine Lines/Touch is less viscous than Perlane and Restylane. It is placed at a very superficial level and may be placed in a serial injection technique by spot placement or by linear threading at a very superficial level. If an irregularity is noted, then gentle massage of the tissue will correct the deformity. It is supplied with a 31-gauge needle and tissue trauma and bruising are minimal.

Sculptra can be used in conjunction with most fillers other than ArteFill. Generally it is more of a panfacial filler; to add volume to the whole face and improve the texture and quality of the skin. More focused contouring may be done with the hyaluronic acids, Radiesse, or the collagens. Radiesse can be used in a similar fashion to Sculptra (panfacial volume restoration), but it does not have the same longevity. A patient may decide that he or she wants an immediate change instead of waiting 3 to 4 months for the results of Sculptra to be evident. But some patients like the longevity of Sculptra (1½ to 2 years versus Radiesse's 1 year).

Adverse Effects, Reactions, and Complications

All of the fillers have possible adverse effects. Perlane, Restylane, and Restylane Fine Lines/Touch have an incidence of reaction of approximately 1 in 3000. Reactions may occur such as local erythema, swelling, and deformity, which may be undulating and recurrent. This is rarely seen. Other reactions to the hyaluronic acids may include frank allergy, cellulitis, sterile abscess, local noncellulitic erythema, and telangiectasia. If the patient has preexisting telangiectasia, this should be noted before injection. Additionally, the patient should be informed that there is a possible risk of telangiectasia formation and that preexisting telangiectasias may become more severe and require treatment after injection. Soft tissue necrosis and embolic phenomenon have been reported but are rare. The area most implicated is the glabella, rarely on injection with Restylane and more commonly with collagen. An algorithm for treatment of blanching postinjection that includes warm compresses, nitroglycerine, epinephrine, hyaluronidase, and heparin has been proposed to reverse or minimize such ischemic events.

ArteFill can result in local granulomatous reactions (as with any soft tissue filler). The instances reported to date in North America are low (0.02% to 1%). There have been more extensive reports of granulomas in Europe (perhaps because of the earlier generations of the product). These may present as localized bumps or nodules that are tender to the touch. On histologic examination of the tissue, giant cells and multinuclear giant cells are present in the nodules, with an accompanying inflammatory response. If the product is placed too superficially in the dermis, the resultant tissue formation may lead to a white coloring of the skin. This is similar to the bluish discoloration (Tyndall effect) that may occur with any of the hyaluronic acid fillers when placed in the superficial layer of the dermis. If ArteFill is not placed in small amounts with each pass, deformities may result that can be difficult to treat. These nodules may be treated with local excision, massage, or injection of dilute steroid (0.2 mg/ml of triamcinolone [Kenalog]). A stronger Kenalog concentration (up to 40 mg/ml) may be needed to control the inflammation. If granuloma occurs, treatment options include direct steroid injection, excision, systemic treatment with oral steroids, or a combination of these treatments depending on the severity of the granuloma.

Bovine collagen (Zyplast and Zyderm) has been associated with severe local or regional allergic reactions that can become chronic and difficult to treat. Again, if these reactions are unresponsive or minimally responsive to local steroid injection, they may require oral steroid treatment. Allergic reactions can result in long-term scarring. Localized infection may occur after injections. No such hypersensitivity reactions are seen with human-derived CosmoDerm/CosmoPlast.

The injection of all filling substances may result in a herpetic outbreak if the patient has a predisposition. It must be noted that patients with a previous history of herpes simplex outbreak should receive prophylactic treatment with an appropriate antiviral medication.

Concluding Thoughts

The ideal filler has not yet been defined or created. There are a large number of fillers available in the international market; however, there are fewer available for use in the United States and Canada. The ideal filler may not be a single product. At the present time, a combination of available fillers provides correction of soft tissue rhytids and soft tissue augmentation and enhancement, and in some cases a non-surgical lift. A truly permanent filler may not be desirable as the facial soft tissues change with age. For example, certain patients who received silicone many years ago have resultant permanent deformities that cannot be corrected because silicone cannot be removed from the tissue. For this reason we do not inject silicone. The com-

ponents of an ideal filler include excellent safety profile, biocompatibility, longevity, ease of use, reproducibility, ease of storage, affordable cost, ability to combine with other fillers, and stability to give the most ideal result. It is important for physicians to have proper training and to understand the injection techniques that apply to each category of fillers. With precision placement and a good eye for aesthetics, tremendous results can be achieved. The combination of injectable fillers with surgical and nonsurgical techniques including *botulinum* toxin will continue to evolve as cosmetic surgeons continue to develop an understanding of the aging face and what is required to reverse this process. In particular, surgeons have moved to using a combination of tissue adjustment and volume restoration. Companies are eager to bring new fillers to the market. Each new tissue filler will have to be evaluated for its best application, technique of injection, amount used for quantifiable effect, ease of use, ability to combine with other fillers, longevity, and possible adverse effects.

Clinical Caveats

Off-label use of synthetic materials is technically possible but does carry some risk. The plastic surgeon is vulnerable from a liability standpoint, and discretion should be used when using products in an off-label manner. The patient must be informed of off-label use.

When treating deep folds and tear troughs, it is important to undercorrect these deformities. This results in a more natural appearance and leaves room for further correction in the future if that is desirable. Overcorrection of these areas can result in visible abnormalities and stigmata of filler use, particularly when the patient shows animation.

Inexperienced injectors should always opt for rapidly resorbable fillers such as bovine collagen (if available) and hyaluronic acids. This allows for faster resolution of any technical errors that may occur. Alternatively, in the case of hyaluronic acid fillers, hyaluronidase can be used to dissolve the filler.

Often in cases in which a slight correction is required, the patient forgets his or her preoperative appearance. It is imperative to use photography and point out any asymmetries before treatment to establish the patient's expectations and for comparison after injection.

Complications of dermal fillers can be avoided by the use of proper technique (small aliquots, appropriate level and quantity of injection, undercorrection, and massaging with some fillers). This is especially important with the longer-lasting fillers.

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Fat grafting is rapidly becoming one of the most requested procedures for a new generation. It offers a valuable tool to address patient demands for less invasive cosmetic procedures that produce natural, long-lasting results. The author provides surgeons with the expert guidance needed to master this technique for a wide variety of applications, including facial and hand rejuvenation, adjustment of facial proportions, and correction of liposuction deformities.

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In recent years a variety of products have been brought to market that possess many of the properties necessary for improving facial appearance. Almost all of these innovative materials are effective for restoring youthful contours and fortifying aging skin; however, many of them work only in defined sites and planes of the soft tissue layers of the face. Additionally, all of them have short-term and long-term adverse consequences with various levels of severity. In this monograph an assembled panel of experts collect and organize the marketing information and clinical reports, present the regulatory status, and discuss what new products are in the pipeline. They also discuss the characteristics of each filler and debate their efficacy and clinical applications in a spirited roundtable discussion. Numerous pretreatment and posttreatment cases are presented.

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A number of facial filler materials that have not yet been approved by the FDA for use in the United States have been employed by physicians in Europe for several years. Although these products have proved efficacious, some complications events have been associated with their injection or inappropriate application. Moreover, the long-term effects of injecting into the face materials that cannot be removed without surgical intervention is an issue that deserves serious consideration by both physicians and patients.

Suggested Readings

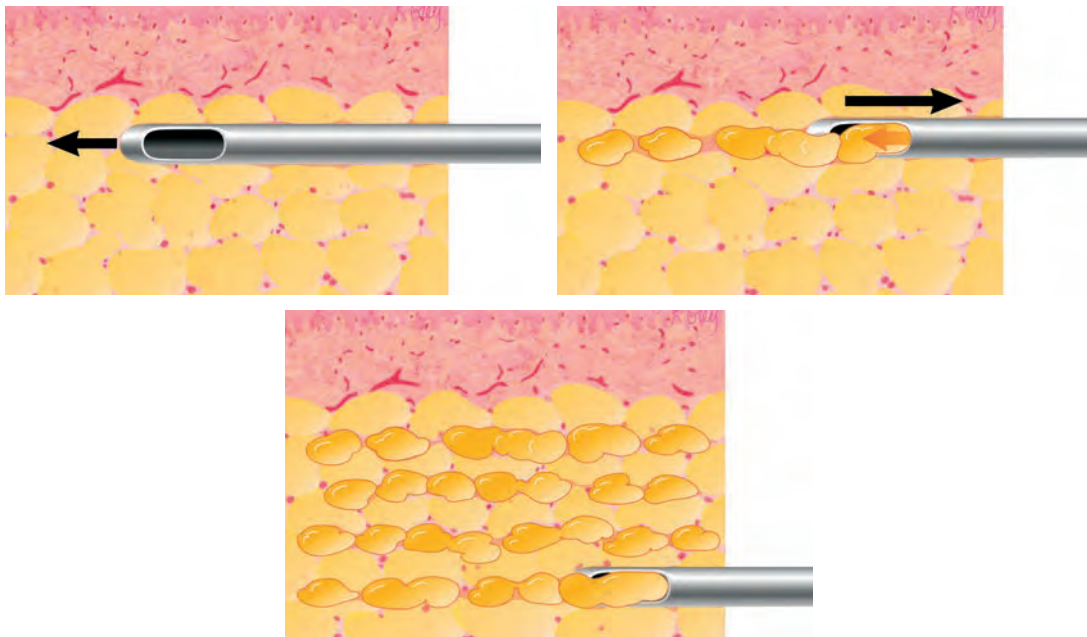
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CHAPTER 13



Structural Fat Grafting: *Basics and Clinical Applications in the Hand, Face, and Nose*

SYDNEY R. COLEMAN

Autologous fat grafting is a technique that has grown in popularity in recent years with the increasing demand for injectable tissue fillers and with new discoveries concerning the regenerative capabilities of transplanted fat. Interest in fat grafting applications has grown exponentially as physicians have recognized fat's enormous potential for solving aesthetic and reconstructive problems. As one of the most biocompatible of soft tissue fillers, autologous fat has broad applications in aesthetic surgery. Placement by separating the parcels one from the other encourages longevity, promotes stability, and effectively integrates the fatty tissue into the host tissues so that they are minimally detectable. Fat grafted in this manner is a safe, long-lasting, and natural-appearing tissue filler. It is also an effective means of changing facial and nasal contours, revising scars, and rejuvenating the hands and face. This chapter focuses on the basic principles of structural fat grafting and the most common applications for rejuvenation of the hands, nose, lips, and nasolabial folds.

Evolution of Technique

Physicians have been experimenting with injections of substances to alter surface contours of the face since the nineteenth century. In 1899 Gersuny first reported the injection of paraffin to replace resected testicles. He later reported on the use of paraffin to correct facial contour deformities. Additional reports on the use of paraffin for correcting facial defects were later made by Miller and Kolle. As paraffin use fell into disfavor because of the many complications associated with it, aesthetic surgeons continued to use injection techniques with other substances such as rubber and purified latex in search of the ideal filler material. In 1908 Eugene Holländer of Berlin first published his experiences with injecting fat into the face. In 1912 Holländer published before-and-after photographs of the use of injectable fat for correction of facial atrophy and breast scarring. In 1926 Charles Conrad Miller in the United States described his experiences injecting fatty tissues through cannulas.

The introduction of liposuction in the 1980s helped to popularize this idea of using autologous fatty tissue for implantation. A byproduct of liposuction, the suctioned semiliquid fat could be reinjected through cannulas and needles. The ready availability of semiliquid fat after liposuction helped to renew surgeons' interest in grafting autologous fat through a cannula, and myriad techniques for grafting have been introduced since that time, with mixed results.

In 1987, after initial success with grafting fat into iatrogenic liposuction deformities, I began to place fat in the face for aesthetic reasons. These early efforts yielded long-term structural changes that have demonstrated permanence. Since that time the technique has been refined, altered, and improved to ensure better integration and stability of the grafted fat and to provide an alternative method, outside of traditional surgical techniques, for altering facial contours and contributing to overall facial rejuvenation. It has also been used successfully for hand rejuvenation and for treating iatrogenic deformities resulting from liposuction. (See Chapter 87 for more information on fat grafting for iatrogenic deformities.)

Pretreatment Assessment

Determining the specific amount of fat and the levels of placement necessary to execute subtle contour changes in the face requires a well-developed strategy. Before a plan can be established, the surgeon must evaluate the patient's appearance and acquire information on the patient's lifestyle, expectations, prior aesthetic procedures, and medical history.

The surgeon should carefully review past aesthetic procedures to make certain nothing has been overlooked. In my experience, injections of silicone and even fat are the procedures that patients most often neglect to mention. Even if patients disclaim any injections on the intake form, it is advisable to ask whether they have had silicone, collagen, or fat injections. Because the presence of scars on the skin can influence the approach for placement of fat grafts, the history should include skin biopsies, punch biopsies, and so forth.

Because structural fat grafting is invariably an elective procedure, the treatment of candidates in poor general health should be approached with caution. Problems with bleeding, bruising, and unusual swelling after prior procedures should be addressed to prepare the patient and surgeon for similar problems. A history of any outbreaks of fever blisters on the lips is solicited to determine whether herpes simplex prophylaxis is indicated. A neurologic history is essential. Fat infiltrated into the muscles of a patient who has recovered from a facial nerve injury or Bell's palsy may act as a stent, inhibiting movement in the affected areas of the face. Any history of psychiatric problems and their current status, along with their possible impact on the surgical patient, should be carefully considered before a patient is accepted.

I schedule several consultations with a patient before surgery. For patients interested in rejuvenation procedures, I ask them to bring photographs of themselves when they were young to help determine the degree of augmentation needed. These photographs provide a better gauge of the patients' aesthetic preferences. Patients need to understand the details of the planned procedure, the expected outcome and postoperative course, their responsibilities during recovery, and possible sequelae and complications.

Informed Consent

In my experience, the most important part of the informed consent process is the time spent with the patient in preparing for the procedure. In addition to a verbal explanation of the procedure and the perioperative course by the surgeon and nurses, the patient is given printed material for referral. It is important to prepare the patient for the postoperative swelling and bruising and the potential for complications. Although this procedure is associated with a high rate of long-term patient satisfaction, patients who are not prepared for the expected or unexpected postoperative sequelae can pose major problems.

Physical Examination

Physical examination of the face supplements the photographic documentation. Because photographs cannot capture the relationship of the underlying structures to the skin, palpation is used to determine landmark relationships, such as the height of the infraorbital rim compared with the eyelid and the relationship of the angle of the mandible to the actual shadow of the jawline.

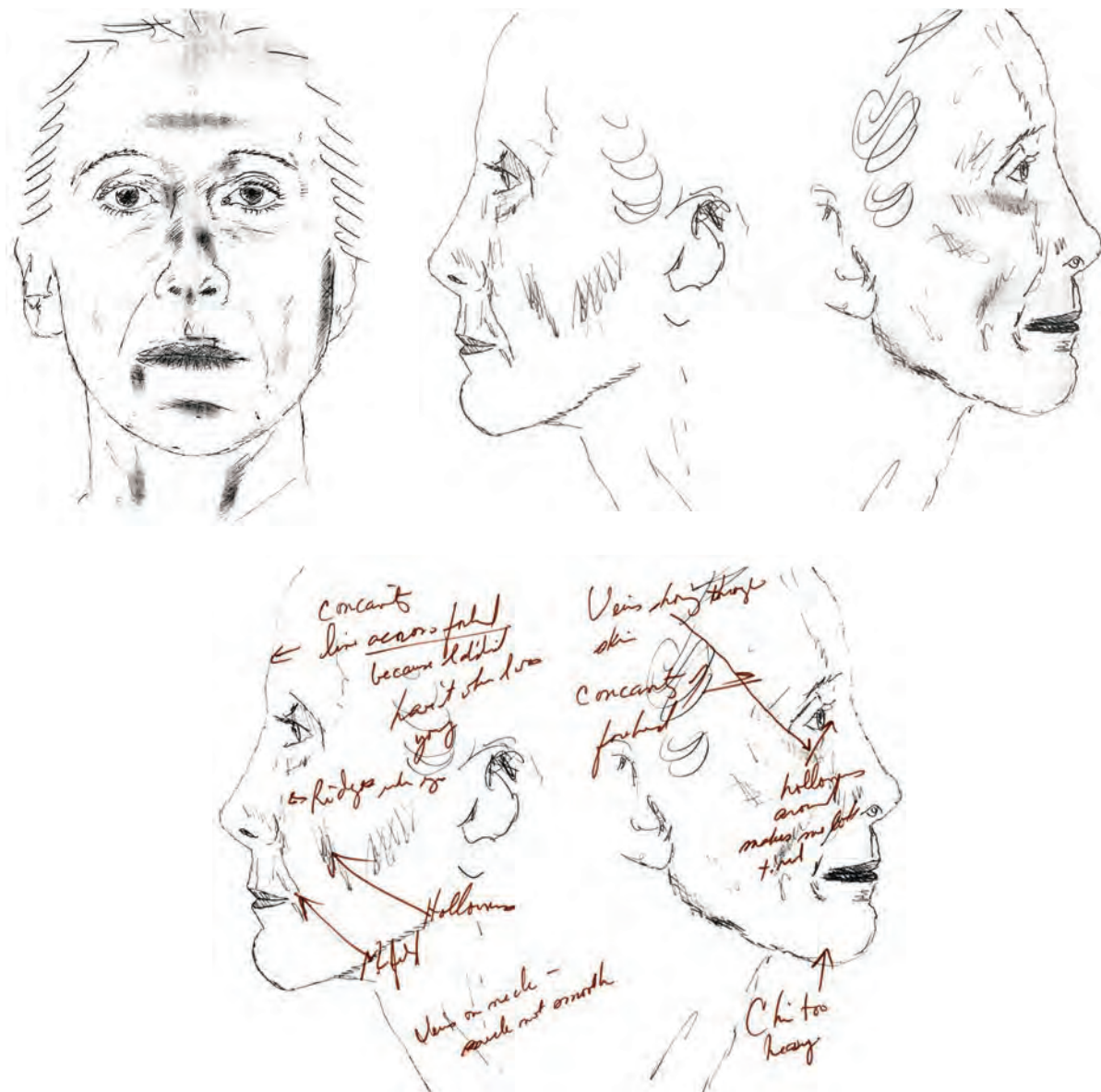
Pretreatment Planning

Photographs

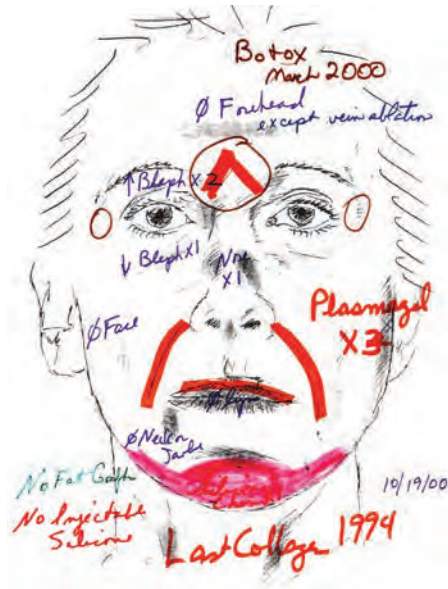
Detailed photographic documentation is essential to successful structural fat grafting. Photographs record the patient's preoperative appearance and serve as a basis for three-dimensional analysis. For example, in the face I take photographs of the patient from a variety of angles and views. In all of these views, the patient's hair should be pulled back from the face and ears, even for male patients, and collars should be pushed down or clothing covering the neck should be removed. At least one set of pretreatment photographs is taken with the patient wearing no makeup so that the color and texture of the skin can be documented.

Tracings and Blueprints

Summary of Perceived Problems

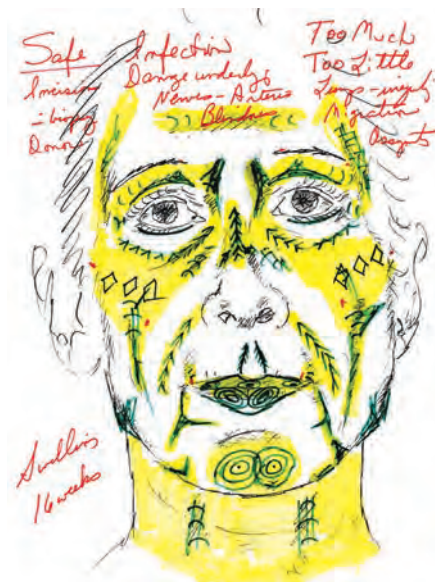


When grafting fat in the face, tracings of the patient's face are used to evaluate perceived problems and document patient complaints. They are used when I plan the procedure and in discussions with the patient. I use them to predict the volumes required, the level of placement, and the structural support required to achieve the desired changes. These tracings also serve as a form of informed consent to document the planned changes during the consultation, detailing areas of fatty tissue placement and removal as well as incision sites. What is most important, they serve as a reference for making the markings immediately before treatment and during the procedure.



On a separate tracing I summarize the operations over the facial features involved. I also ask patients to describe all *botulinum* toxins, hyaluronic acid, calcium hydroxylapatite, collagen, silicone, or other substances injected into their faces and map this information on the tracing, along with the time of these injections.

Markings



On the day of the procedure, colored marks are drawn on the patient's face using the blueprints created at the second consultation as guides. The markings outline areas to be augmented and amounts of tissue to be infiltrated. These markings also serve as reminders of the specific levels of placement against the skin, against bone, or in intermediate levels. I photograph these markings with a digital camera and print them out for a quick record; they are also stored at a higher resolution for a higher quality record. These digital images and printouts of the markings serve as a useful reference during the procedure, especially because the markings may become obliterated during placement of the fatty tissue.

If the patient later says, “Well, I didn’t really understand you were putting fat there. I thought you were going to put fat into my forehead also!” I can point to the documented markings on the photographs in that area to gently remind the patient of the original plan that he or she agreed to.

Harvesting, Refinement, and Transfer

The basic principles of structural fat grafting include the following:

1. Harvesting with a blunt cannula and syringe using low suction
2. Refinement with centrifugation to facilitate removal of nonliving components
3. Purposeful placement into recipient tissues, separating parcels from each other

Fatty tissue is more fragile than most other human tissues and is easily damaged outside the body by mechanical, barometric, and chemical insults. To survive harvesting, transport, and implantation with cannulas and syringes, fat must be harvested in intact parcels small enough to be inserted through a small cannula but large enough so that the tissue architecture is maintained.

Material harvested by syringe liposuction may contain as little as 10% or as much as 90% of fatty tissue on centrifugation. The aspirated material separates into three layers: the top layer is composed primarily of oil, the bottom layer is almost entirely made up of blood and lidocaine, and the middle layer contains potentially viable parcels of tissue. If each sample is composed of a different percentage of viable fat, it is very difficult to accurately estimate the volume for placement. To obtain consistent predictable results, most of the oil, blood, and lidocaine can be gently removed from the harvested tissue by sedimentation or centrifugation.

Preparation for Harvesting

Because I have observed no clear correlation between donor site location and longevity of the implanted tissues, I select harvesting sites that enhance body contour and provide maximal access to the patient in the supine position that is used for almost all facial augmentation procedures. The abdomen and medial thighs are commonly chosen donor sites. When abdominal or medial thigh fat is limited because of prior liposuction or low levels of body fat, the suprapubic region, the anterior thighs, and the area above the knees are the next choices.

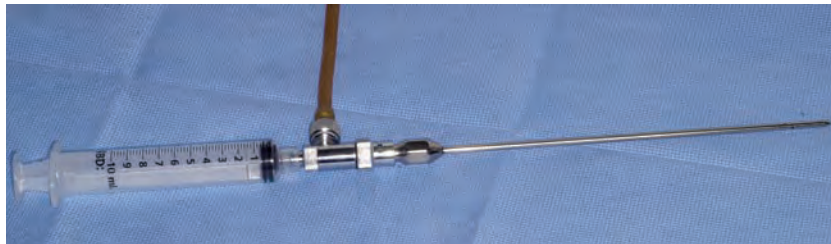
When the patient is placed in the prone position, the posterior medial thighs, lateral thighs, and the love handles are prime options for donor tissue. In patients with low body fat, especially men, the abdomen and love handles may consist mostly of fibrous tissue with little available fat. Using the thighs as donor sites in these men is often a viable alternative.

Donor Site Access

Whenever possible, harvesting sites are accessed through incisions placed in creases, previous scars, stretch marks, or hirsute areas. The pubic region is the most useful incision site because the abdomen, medial thigh, and anterior thigh can be reached with ease. To harvest fat from the upper abdomen and flanks, additional incisions can be made in the umbilicus and upper abdomen. With the patient in the supine position, the knee can be reached through an anterior knee incision. Occasionally an incision in the lateral hip can also be used for access to the thigh or to the lower love handle. Incisions in the midback and lateral sacrum provide access to the love handles and flank.

Sterile Technique

Bacterial contamination of the fatty tissue can result in infection that causes re-sorption of the grafted material. Therefore meticulous sterile technique is always observed with careful attention to preoperative patient preparation.

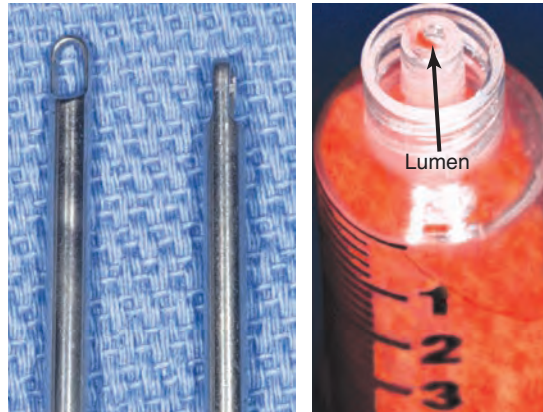


A blunt Laminar infiltrator attached to a 10 cc syringe is used to infiltrate the lidocaine solution into the projected sites of fatty tissue removal. Usually 1 ml of lidocaine is infiltrated for every cubic centimeter of fat harvested.

Epidural or general anesthesia is preferred for removal of larger volumes or when multiple sites are used. To ensure hemostasis, Ringer's lactate in a concentration of 1:500,000 epinephrine is also infiltrated in a ratio of 1 ml of solution for each cubic centimeter of fat harvested using a blunt Laminar infiltrator. Tumescent techniques are not used during the harvesting phase.

Basic Harvesting Instruments

Instruments for structural fat grafting should be efficient and minimally traumatic to the grafted tissue during both the harvesting and placement phases. A two-hole cannula with a blunt tip and dull distal openings placed extremely close to the end is used for harvesting.

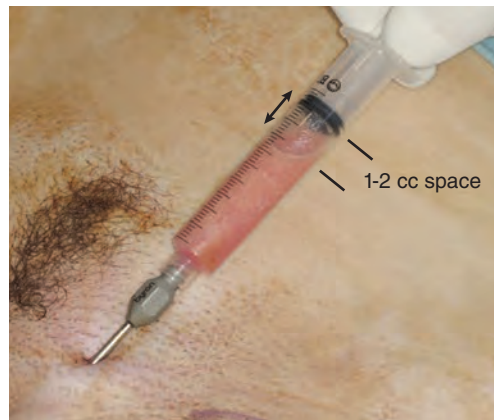


The distal openings of the harvesting cannula are the appropriate size and shape for harvesting the largest intact fatty tissue parcels that can readily pass through the lumen of the Luer-Lok syringe and will therefore also be able to pass through the much smaller (17-gauge) lumen of the infiltration cannulas without clogging.



The length of the harvesting cannula is usually 15 cm. Although a 23 cm cannula has a greater reach, it can potentially place greater torque on the Luer-Lok aperture and break the syringe tip during extraction. It is advisable to use the shorter cannulas initially, advancing to longer ones once the surgeon is more familiar with the instruments. After a surgeon becomes adept at using straight harvesting cannulas, then he or she should advance to the use of curved cannulas to follow the curvature of the flanks, thorax, or thighs. The curved cannula can be especially helpful when harvesting from the abdominal midline through an umbilical incision to keep the tip of the cannula from slipping into a deeper plane.

The incisions made for infiltration of anesthetic solutions are also used for harvesting fatty tissue. These incisions are just large enough (usually 2 to 3 mm) to permit insertion of the tip of the harvesting cannula. The inserted cannula is attached to a 10 cc Luer-Lok syringe by the Luer-Lok connection. Only 10 cc syringes are used for harvesting; these are small enough to be manipulated manually without locking devices.



During removal of fatty tissue, care is taken to minimize mechanical trauma to the fragile parcels of fat. The plunger of the syringe is gently manipulated to provide 1 or 2 cc of negative pressure space in the barrel of the syringe while the cannula is pushed through the harvest site. Initially excess fluid may be noted in the harvested material. When substantial fluid is present, the syringe is placed on a table for several minutes to allow the fatty tissue to separate from the liquid component. Then the aqueous portion can be expressed by pressing on the syringe. The syringe with the refined fat is then reconnected to the cannula, and harvesting continues until a greater quantity of fat has been obtained. All incision sites are closed with nylon interrupted sutures after harvesting is completed.

Refinement

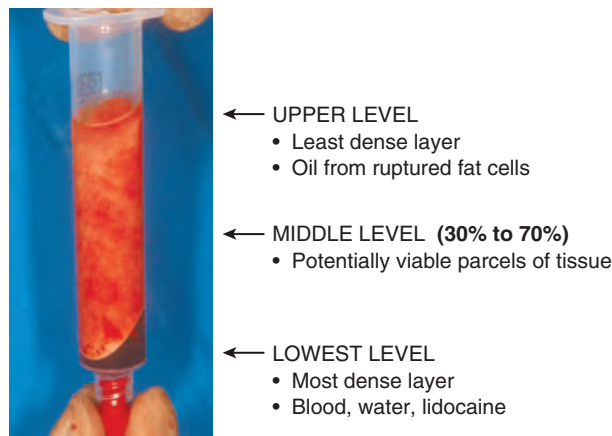


After the fat has been harvested, the cannula is removed from the syringe and replaced with a dual-function Luer-Lok plug for capping; this is available in most hospitals.

Centrifugation



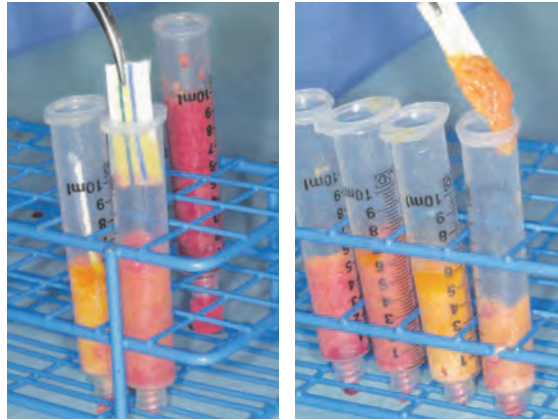
After the Luer-Lok syringe is sealed, the plunger is removed from the proximal end of the syringe. The syringe minus the plunger is then placed into a centrifuge to separate the viable from the nonviable components. The recommended centrifugation is 1300 G, which translates into 3000 rpm on the most commonly used small laboratory centrifuges. I have found the optimal centrifugation time to be 3 minutes. Each 10 cc syringe is placed in an individual sleeve of the central rotor of the centrifuge. These sleeves can be changed or emptied in case of spillage of the aqueous portion of the syringe. Care should be taken to choose 10 cc syringes that fit into the sleeves easily.



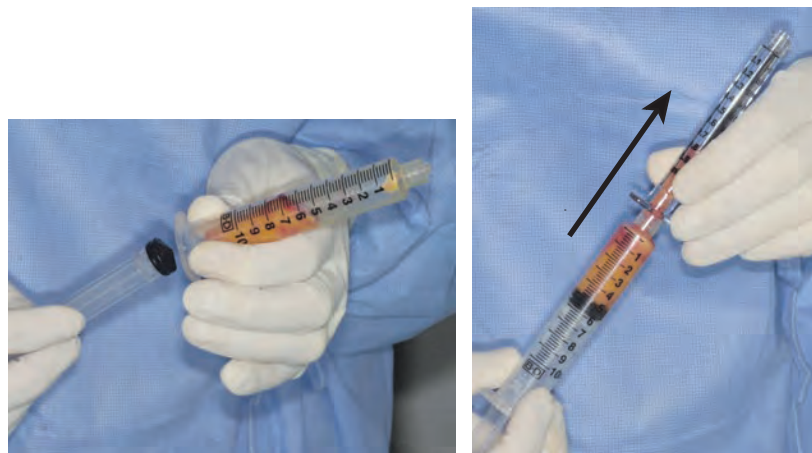
Centrifugation separates the denser components from the less dense components to create multiple layers. The upper level, or the less dense level, is composed primarily of oil; the middle portion is composed primarily of potentially viable parcels of tissue and the lowest level is the densest layer and is composed primarily of blood, water, and lidocaine. The middle portion has more oil present in the upper portion and denser tissue present in the lower portion. It has been my observation that the denser fatty tissue in the lower portion has a greater reparative effect on the tissues into which it is injected, and appears to have a more predictable survival. Studies are currently being conducted to verify these observations.

Separation of Components

To avoid losing the vacuum that holds the contents in place, the oil layer is decanted first, before the plug is removed from the Luer-Lok syringe. (The oil can be used for lubricating both the harvesting and insertion site incisions.) After the oil is poured out of the syringe, the plug is removed from the syringe and the aqueous portion flows out through the Luer-Lok aperture.



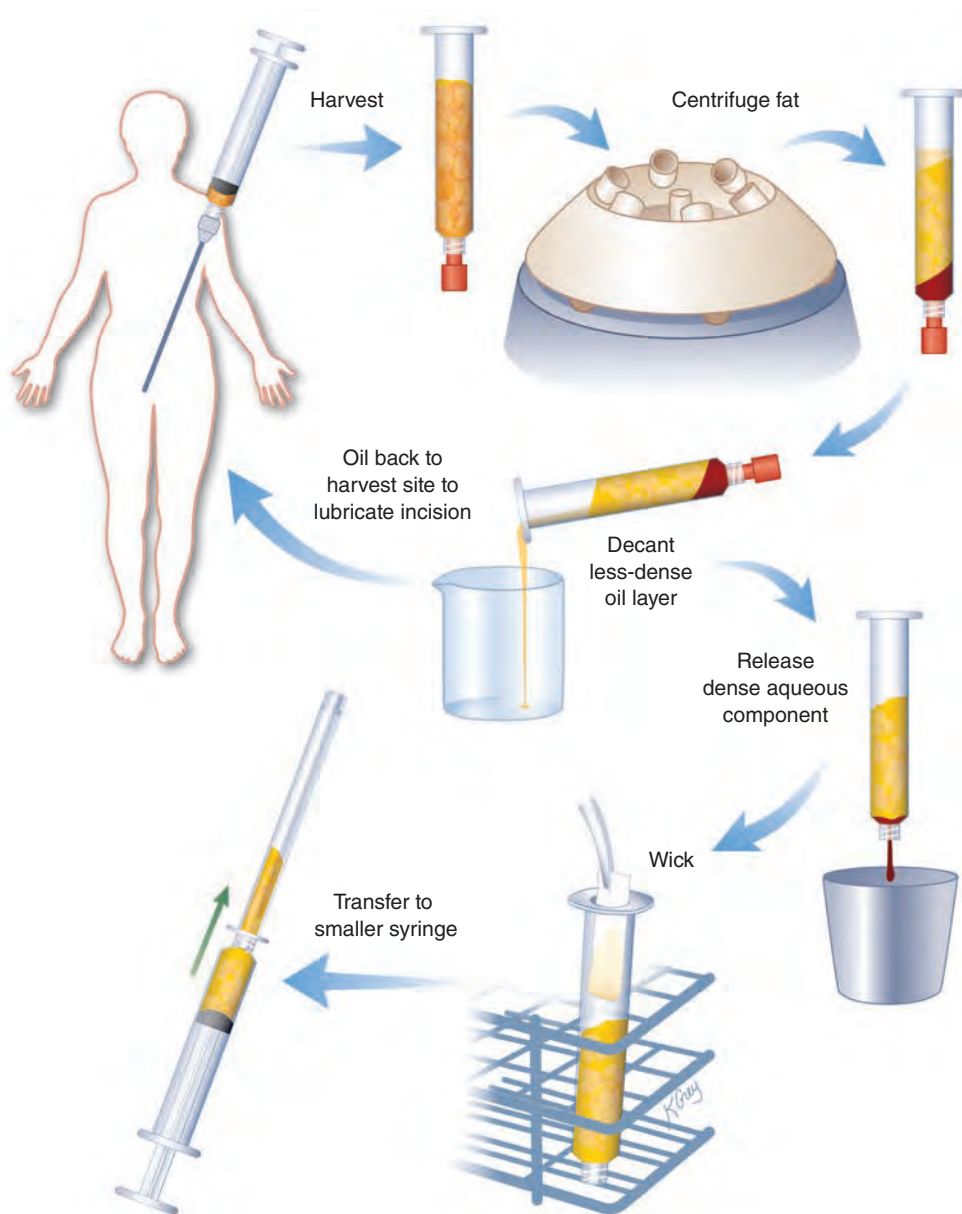
Wicking the superior portion of harvested fat using neuropads or Telfa strips removes more of the remaining oily component of harvested fat. After 4 minutes, the wick is replaced with another piece of wicking material. Wicking is performed at least twice. Fat may stick to the material as the wick is removed, but scraping the fat off the gauze can irreparably damage the fat. If the surgeon suspects that some of the fat has been damaged by excessive exposure to air or mechanical trauma, the fat should be discarded.



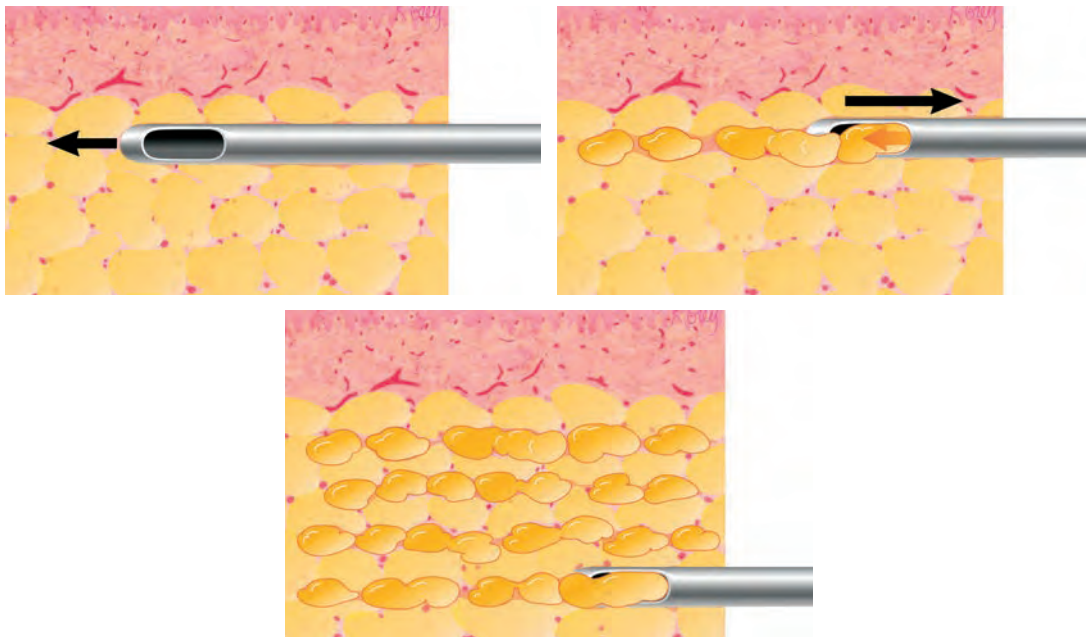
The plunger is then replaced after the fatty tissue is allowed to slide down to the edge of the syringe. A finger should be pressed over the Luer-Lok aperture to control the fat slippage with air pressure. The plunger is then placed into the syringe and ad-

vanced to obliterate the dead space. The fat can be stored in the 10 cc syringe in this fashion for brief periods of time before being transferred to smaller syringes for infiltration. Advancing the plunger of the 10 cc syringe with the Luer-Lok aperture placed at the base of the smaller syringe transfers the contents. Both syringes should be kept in a relatively vertical orientation to avoid accidental insertion of air bubbles into the column of fat during transfer. I use only 1 cc Luer-Lok syringes for placement of the tissue into the face and hands and 3 cc syringes for the body.

OVERVIEW: FAT REFINEMENT AND TRANSFER



Placement Techniques

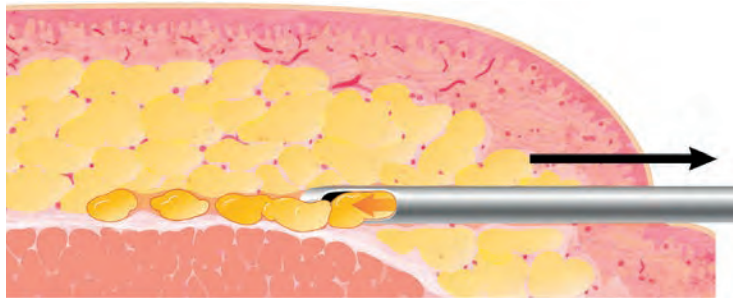


Placement of the refined fat into the recipient site is the most challenging part of fat grafting. Fat parcels should be placed to ensure uniform survival, stability, and integration into the surrounding recipient tissue. The key to fatty tissue placement is maximization of the surface area of contact between the harvested fat and the recipient tissues. By placing these small parcels of fat so they are separated from each other by the host tissue, the larger surface area of contact can be maintained. Because bacterial contamination may destroy transplanted fat, scrupulous attention is paid to sterile technique.

Regional blocks using 1% lidocaine with 1:100,000 epinephrine through 25-gauge needles are used when appropriate and convenient. For all planned incision sites on the face or body, I place a solution of 0.5% lidocaine with 1:200,000 epinephrine with a 27-gauge needle. Incisions 1 to 2 mm long are made in the face, neck, body, and hands; these are also used for placement of the fatty tissue. Small amounts of the 0.5% lidocaine with 1:200,000 epinephrine are diffusely infiltrated using the structural fatty tissue cannulas into the areas of planned placement.



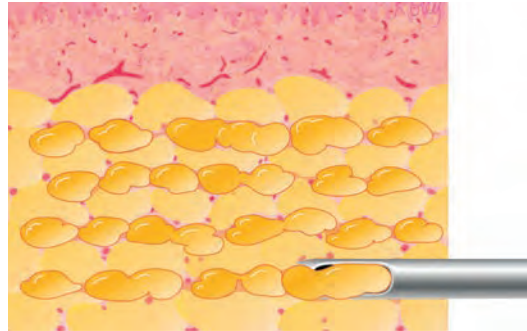
The infiltration cannula is inserted through each tiny incision that was used for infiltration of the local anesthesia and advanced through the tissues to the appropriate plane. The skin is stabilized with the opposite hand. No fatty tissue should be ejected during the advancement of the cannula into the recipient tissues.



Once the cannula is in the desired location, *the plunger of the 1 mm syringe is pressed slightly while the cannula is being withdrawn*. A small aliquot of fatty tissue is then left in the pathway of the retreating blunt cannula, permitting more stable and regulated placement and minimizing the potential for irregularities or clumps of tissue.



Placement of minuscule amounts of fatty tissue with each pass is critical to successful structural fat grafting. To maximize the surface area of contact, the largest amount of tissue that should be placed in the face with each withdrawal is $\frac{1}{10}$ cc. Intact parcels of fatty tissue should be somewhat separated by the tissues of the recipient site to maximize the surface area of contact between donor and recipient tissues.



Estimating the volume to be placed in each area can be challenging, and there is little room for error. Minimal compensation should be made for resorption in this situation. The injected material is not pure fat; even after refinement, there will be quantities of blood, lidocaine, or oil present in the refined fatty tissue. Therefore it is best to use small amounts of infiltrate initially, increasing the amount gradually as experience is gained. The use of 1 cc syringes initially is particularly important to prevent overzealous augmentation.

Use of Blunt Cannulas

Although I switched from sharp to blunt cannulas in 1992 to avoid injuries to underlying structures, I have also found blunt instruments to be superior for placing fatty tissue autografts in other regards as well. Unlike the sharp tip of a needle, the blunt tip does not cut a swath through the tissue. As the blunt tip is advanced, the natural tissue planes separate in a more physiologic fashion. As the blunt cannula is withdrawn, the deposited fatty tissue parcels fall into the natural tissue planes as the host tissues collapse around them. In addition, using blunt cannulas for more stable placement of fatty tissues allows the surgeon to place much larger volumes of fatty tissue. Finally, placement with a blunt cannula reduces the possibility of intravascular injection of the fat.

Stability of Transplanted Fat

Separating the parcels of fat does more than increase the chance of survival. Placing the fatty parcels with a blunt cannula that causes minimal disruption of the natural tissue planes facilitates better fat adherence to the recipient sites. Minimal destruction of the tissues and maximal surface area of contact combine to create a more stable relationship between the new fat parcels and the surrounding tissues.

After the edema resolves, the texture of the grafted tissues essentially resembles that of the host tissues rather than retaining the structural qualities of fatty tissue. By placing fat in small parcels and separating every parcel with the donor site tissues, the fat becomes integrated with and feels like the tissues into which it is placed.

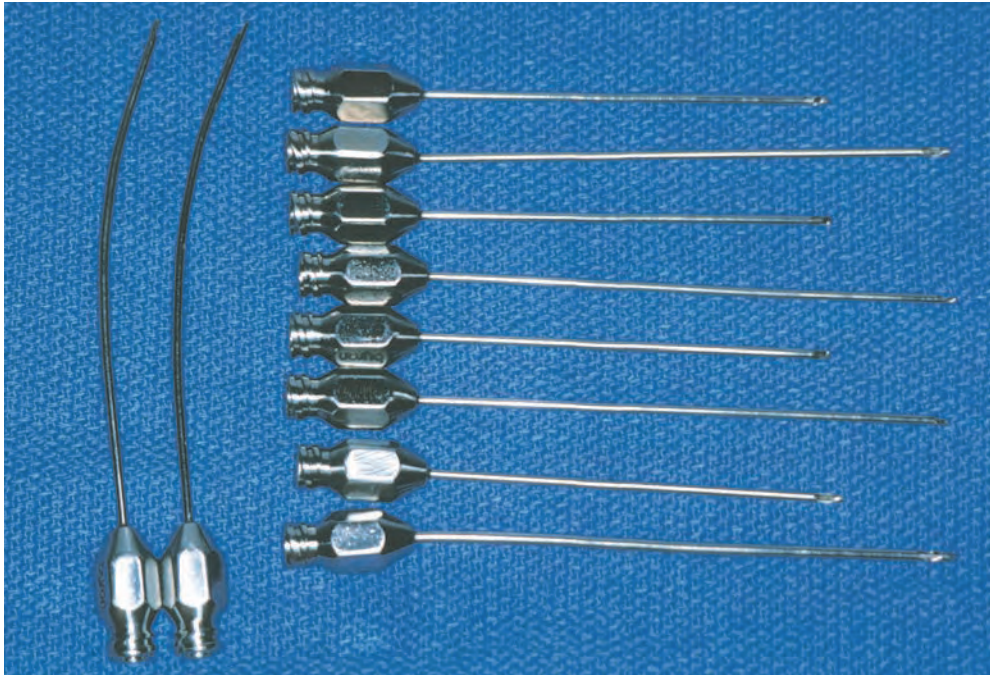
This three-dimensional technique of placing refined fat into the recipient sites creates the shape, volume, and structural changes defined in the operative plan. Accuracy of the initial placement is imperative, because the infiltrated fatty tissue is difficult to remold afterward. The fatty tissue should be deposited in the desired location, shape, and volume with each pass of the infiltrating cannula. If a cyst or clump forms accidentally, digital manipulation can sometimes flatten such minor irregularities. However, *the tissue should never be placed with the idea that digital pressure can change the shape after placement.*

Structural Manipulation



The host tissues can be manipulated to change their shape better if the fatty tissue is placed bluntly in minuscule amounts with each pass. If the tissue adheres to the recipient tissue after each pass, then multiple passes can change the intrinsic shape of a site while adding volume. Injections in the nasolabial folds, lips, and lower eyelids to relieve scleral show are examples of structural manipulation.

Instrumentation for Placement



The instruments used for placement of fatty tissue are dramatically different from those used for harvesting; they are shorter and have a smaller gauge, with only one hole at the distal end. The fat infiltration cannulas vary in length and shape, but the most useful lengths are from 5 to 9 cm for use in facial procedures and from 9 to 15 cm for body-contouring procedures. Cannula tips also come in various sizes and shapes for individualized treatment.

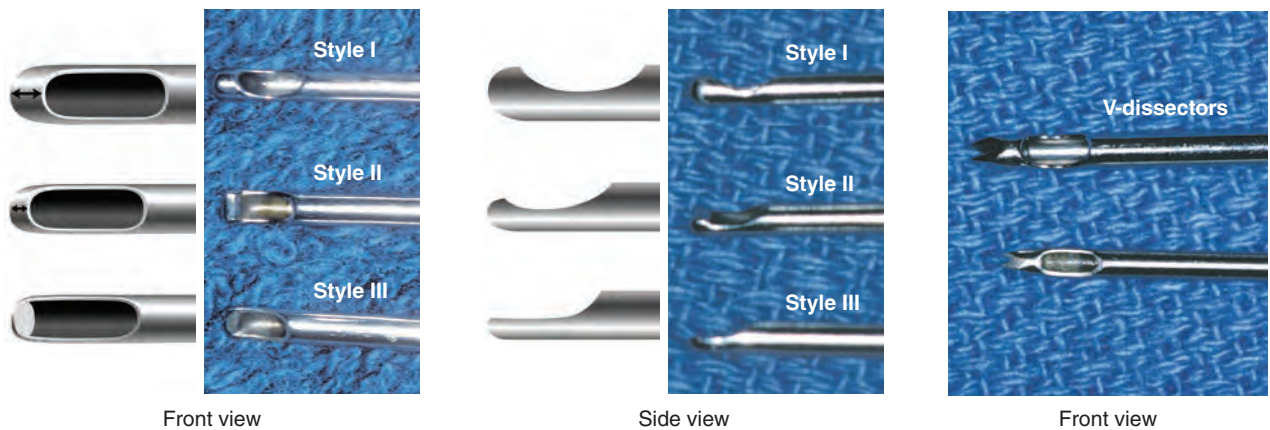
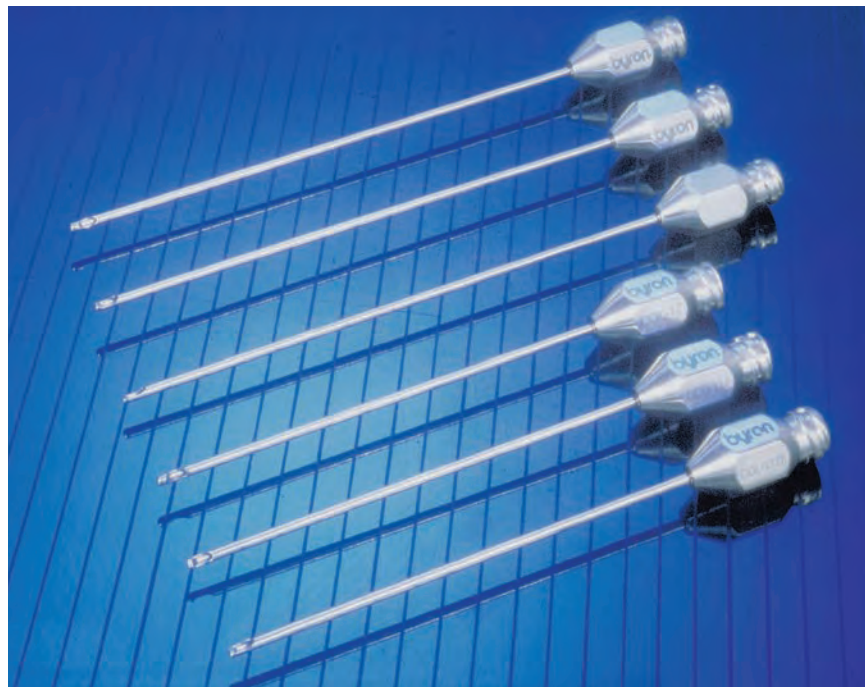
To facilitate structural fat grafting, I have developed three different styles of blunt-tipped cannulas as well as a V-dissector, each with its own function. I developed these beginning in 1993 (Byron Medical, Tucson, AZ, a division of Mentor):

The Coleman style I cannula is completely capped on the tip, with a lip extending 180 degrees over the distal aperture. It is my workhorse, and its primary purpose is to minimize traumatic injury to underlying structures.

The Coleman style II cannula is similar to the style I but is not totally capped. It has a lip extending over the distal aperture approximately 130 to 150 degrees. This cannula is useful in most situations.

The Coleman style III cannula is flat on the end, permitting dissection of tissues in specific situations; for example, when pushing through scars or fibrous tissue. It is also helpful when placing tissue in immediately subdermal or submucosal tissue.

The Coleman V-dissector is used for release of adhesions.



To facilitate use in different areas of the face and body, the cannulas come not only in a variety of lengths but also in numerous sizes from 20 to 14 gauge. The smallest gauges are used in the periorbital region and the larger gauges can be used in the body.

As a result of recent concerns about the sterilization of small-bore cannulas, a line of high-quality disposable cannulas is now available in the same shapes and sizes.

SPECIFIC CLINICAL APPLICATIONS

Hand

The hands are one of the first areas to exhibit visible signs of aging. The simple, reliable technique of autologous structural fat grafting can be used to achieve long-lasting rejuvenation of the dorsum of the hand, restoring a slight fullness to atrophic subcutaneous tissue, softening the color, defining the exposed extensor tendons and veins, and supporting the aging skin.

The key to structural fat grafting of the dorsum of the hand is purposeful placement of a smooth layer of tissue against the undersurface of the dermis, with extra placement into deficient intermetacarpal and web spaces. The goal is to restore a youthful fullness to the back of the hand.

Aesthetic Considerations

The dorsum of an attractive, healthy-appearing hand has a slight subcutaneous fullness that obscures veins and tendons but does not hide them. The tendons are more defined when the metacarpophalangeal (MCP) joints of the wrist are extended than when they are flexed or in repose. The superficial veins are usually discernible, and the more slender and athletic a person is, the larger and more distinct these veins appear. The blue color of the veins can be seen through the skin, but the white tendon color is not usually discernible. There is a generalized fullness of the skin and subcutaneous tissues that adds volume to the nonbony hand and frames the joints with a youthful fullness.



In the dorsum of an aging hand, generalized subcutaneous fullness gradually disappears as the subcutaneous tissues atrophy. With loss of fullness, the veins appear more prominent, their blue color deepens, and the extensor tendons appear whiter and more visible through the thin skin of the dorsal hand. The tendons are promi-

ment even at rest or with flexion of the MCP joints. With the loss of supporting fullness under the dermis and a gradual diminution of elasticity, the skin's texture becomes more crêpey and wrinkled.



The intermetacarpal spaces deepen, especially between the thumb and the index finger, and there is some loss of intrinsic muscle volume. With loss of fullness in the hand, the fingers and joints may appear enlarged and arthritic.

Anatomic Considerations

Only the bluntest of cannulas, style I, is used at all times in the hand to avoid damaging underlying structures. With careful placement in the subdermal layer between the veins and skin, few anatomic structures are exposed to trauma. Even the trauma to the veins is so minimal with this technique that I have rarely seen significant bruising after structural fat grafting to the dorsum of the hand. The primary potential for anatomic problems results from manipulation of fat after placement. Strong digital pressure on a clump of fat can push the newly grafted tissue deep to the tendons or even deeper into the intrinsic muscles of the hand.

Indications and Patient Selection

Persons with noticeable loss of subcutaneous fullness of the dorsal hand and apparent thinning of the skin are the best candidates for hand rejuvenation with fat grafts. These patients usually also have prominent underlying veins and tendons along with an increase in the crêpiness of the skin. Patients with intermetacarpal wasting or arthritis are also candidates for this procedure because adjustment of the volume proportions of the hand will create a much healthier appearance by decreasing the relative size and boniness of the joints.

Technique



This 57-year-old woman is typical of patients seeking fat grafting for hand rejuvenation. She thought that her hands looked much older than her face, with gradual loss of the fullness that created a “bony” appearance. She especially disliked how her joints appeared enlarged and arthritic, even though she had no functional problems. The well-defined tendons glistening through her thin skin also bothered her, and she believed that her hands were much too “veiny.”

Markings



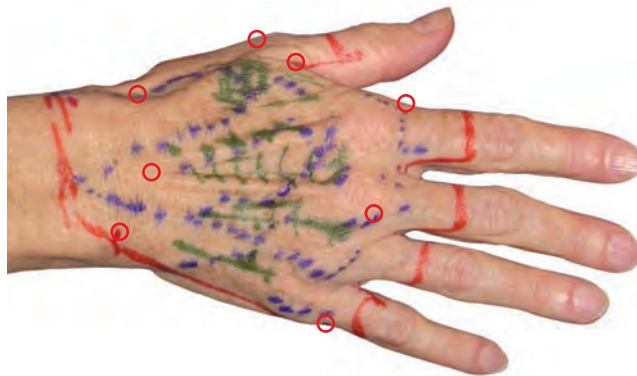
The patient's hands are marked with borders of placement delineated by the orange line running along the fingers and down the ulnar and radial hand, crossing the proximal forearm. Places where more tissue will be placed are marked in green, and larger veins are marked in blue.

Anesthesia

General anesthesia or heavy sedation and a double-level wrist block are most often used for anesthesia of the hands, as was done for this patient. The 1% lidocaine with 1:100,000 ml of epinephrine is placed superficially with 25-gauge needles at two levels: one just proximal to the planned area of infiltration and another approximately 2 cm proximal to the first block.

Incisions

Incisions are made with a No. 11 blade in the direction of the wrinkle lines, at six or seven sites spaced around the periphery of the hand. The incisions are a little longer than 1 mm.



The best locations for incision placement are the following (*see red circles*):

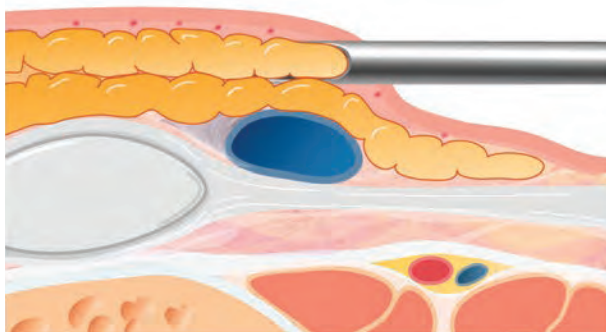
- Ulnar and radial wrist, at the level of the MCP joints at the ulnar little finger
- Central dorsal wrist
- Web space between the ring finger and middle finger
- Radial index finger
- Radial thumb

Infiltration Cannulas



To avoid damage to underlying structures, particularly the veins, a blunt 17-gauge cannula is used for fat placement in the hand. This blunt infiltration cannula is completely capped on the tip, with a lip that extends 180 degrees over a solitary distal aperture. I prefer cannulas that are 7 or 9 cm in length.

Level of Infiltration



The level of placement is almost entirely in the immediate subdermal plane superficial to the veins, where it can provide support to the skin.

Placement Volumes

I generally recommend placing at least 20 cc of fat in each hand. More fat will be required for patients who want significant feathering onto the forearm or correction of intermetacarpal wasting. Extreme overcorrection should be avoided; I place only as much tissue as is needed to achieve a specific result based on my previous experience.

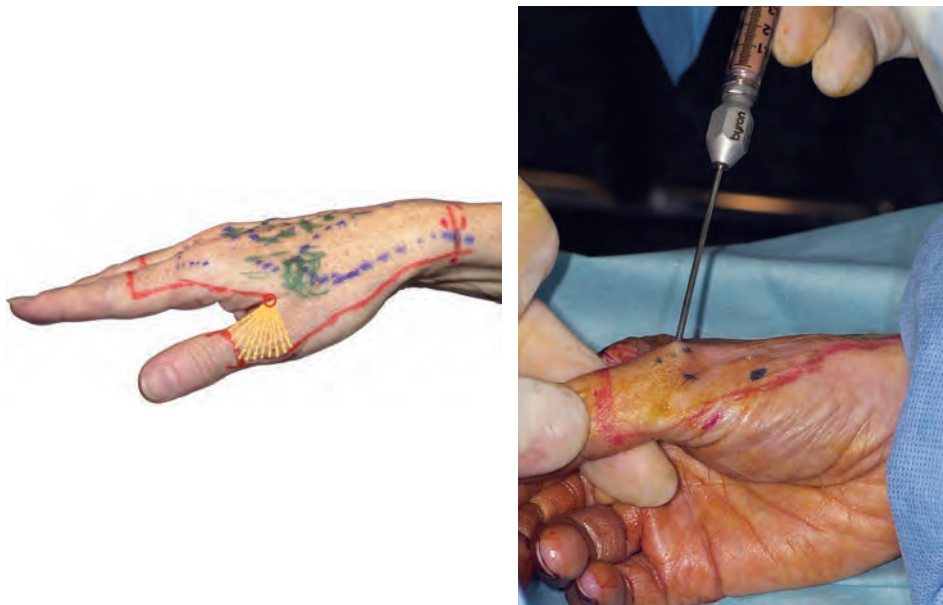
The basic placement technique is the same as for any location on the face. With each pass of the cannula, less than $\frac{1}{10}$ cc and sometimes as little as $\frac{1}{50}$ cc is placed; $\frac{1}{10}$ cc is considered the maximum increment of tissue to place in the hands or face. The small 1 cc syringe provides much greater control over increments placed with each pass. Accuracy in the initial placement is crucial, because once placed, it is difficult to reliably change the shape of the fat significantly after placement, especially after edema is present. As the tissue is incrementally infiltrated with multiple passes of the cannula, a plane of fat is created by placing minuscule amounts of tissue in close proximity to each other, but separated by a tiny space. If the surgeon accidentally allows a lump or irregularity to form, immediate digital manipulation will usually flatten it to ensure that the newly placed fat looks and feels smooth to the touch.

Sequence of Placement

I start with the phalanges and proceed proximally over the web spaces, dorsum of the hand, and dorsum of the wrist and forearm, if indicated. Placement is almost all immediately subdermal, with occasional slightly deeper placement in deep intermetacarpal deficiencies.



The proximal phalanges and web spaces are usually approached first. Placement usually begins with the radial MCP thumb incision into the proximal phalanx of the thumb. This placement is sometimes difficult because of the adherent nature of the skin over the thumb MCP joint, so the incision should not be placed on the volar surface of the thumb, but more in a more dorsal direction.



Next, the proximal phalanx of the thumb is infiltrated from the ulnar incision at the level of the thumb MCP joint.



Then the first web space is approached from both the ulnar thumb incision and the radial index finger incision. I place tissue into the proximal phalanx of the index finger across the first web space from the ulnar thumb incision. The first web space requires at least 1 cc of fat in most cases.



Next, the proximal phalanx of the index finger is approached with several passes made in a radiating pattern through each incision site. Only a minuscule amount of fat is placed with each pass in this area. By infiltrating fat from multiple directions, a “weaving” pattern of placement is created, thereby supporting the skin, in some cases all the way up to the proximal interphalangeal (PIP) joints.



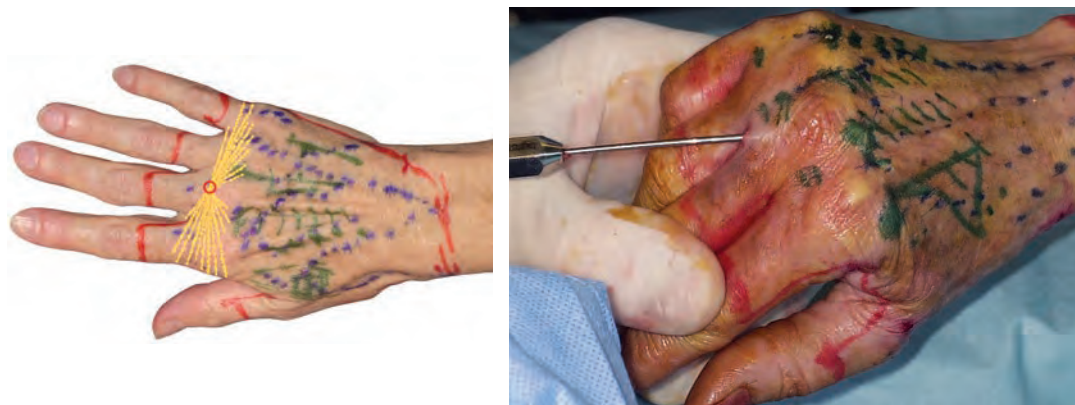
Once fat has been grafted into the thumb and index finger, placement continues in minuscule increments over the index, middle, and ring fingers from an incision around the middle MCP joint. Care is taken to avoid placing fat over the joints, because the desired appearance is a reduction in the size of the joints. To cover the superficial digital veins and place fullness evenly around the MCP joint, fat should usually be feathered so it extends slightly past the proximal half of the proximal phalanx.



The little finger and ring finger are then infiltrated from the ulnar incision at the level of the MCP joint.



From the same ulnar incision, further placement can be made across the MCP joints all the way to the index finger. This allows more perpendicular placement, extending down along the distal web spaces, which frequently have thin skin and are wrinkled. Sometimes the unsupported skin may even fold over.



After fat is placed over the phalanges and into the distal web spaces, the spaces between the MCP joints are treated. Only a thin layer of tissue is placed over the MCP or PIP joints to avoid the appearance of enlarged joints.



Even after the insertion of as much as 7 cc of fat into the phalanges and web spaces of the fingers and thumb, the hand does not look overfilled, because the fat has been evenly distributed in a relatively thin layer.

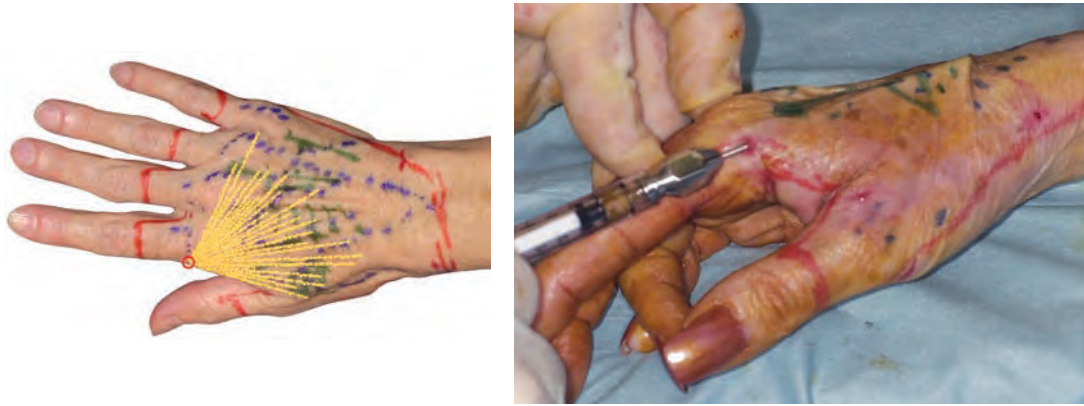


Once placement of fat into the phalanges is completed, I return to the radial hand for more proximal placement. Using the radial thumb incision through which placement into the phalanges was begun, I radiate a pattern through the first web space over the thumb metacarpal almost to the palmar aspect of the radial hand. A number of passes made in a radiating fashion will be needed to place 3 to 4 cc of fat through any one incision.

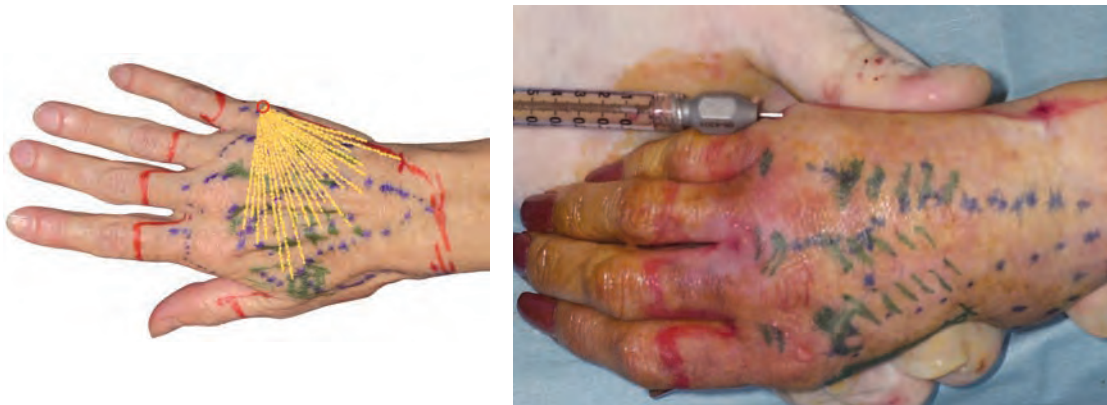


The radiating pattern of placement can be clearly seen in this series of photographs depicting placement from the radial wrist incision. The placement begins at the radial hand at the juncture of the volar surface with the dorsal surface and progresses through the web space, over the dorsum of the hand and wrist, to the volar surface of the forearm. Four or more cubic centimeters of tissue may need to be placed over this area, with each aliquot of placement less than $\frac{1}{30}$ cc.

Next, the surgeon again approaches the more proximal placement into the first web space, radiating a pattern down across the dorsum of the hand.



A cannula is then inserted through the incision in the radial index finger at the level of the MCP joint. From here fat is placed through the first web space into the subcutaneous plane of the proximal phalanx of the thumb, radiating over the metacarpals of the thumb, index finger, and middle finger; fat is eventually placed proximal to the MCP joints of the fingers. The incision between the middle and the ring MCP joints is used to radiate a pattern of placement from the proximal index and middle fingers over the back of the hand to the proximal ring and little fingers.



Through the incision into the skin of the ulnar hand at the level of the MCP joint of the little finger, a pattern is radiated gradually almost to the ulnar aspect of the palm.



Then, from the ulnar wrist incision, a pattern of placement is radiated out from the ulnar wrist across the dorsum of the hand and wrist to the distal forearm. Usually fat is placed to cover the wrist and may even extend onto the distal forearm if the veins are bothersome in that area.

A curved Coleman style I or II cannula helps to navigate the contours of the hand and allows more controlled placement into the slightly deeper planes, such as when more tissue is needed in intermetacarpal depressions.



Every incision is sutured with 6-0 interrupted simple nylon. In this patient, a total of 28 cc of fat was placed into the right dorsal hand from the PIP joints to the proximal forearm. At the end of the procedure the hand is a little puffy, but not remarkably overcorrected. The extent of the area of grafting is adjusted until the physical appearance is pleasing, keeping in mind the patient's expectations.

Postoperative Care



Microfoam tape is placed on the skin of the infiltrated areas immediately after the procedure and left in place for 3 or 4 days as a protective barrier. A tight layer of Microfoam tape on the skin of the infiltrated areas will create a slight compression over the grafted areas, which may reduce edema. This tape also makes it difficult for the patient to touch the dorsal hand and inadvertently displace the newly placed fatty tissue through the loose areolar planes of the dorsal hand. Patients are instructed to avoid touching the backs of their hands for at least 1 week, particularly during sleep, and also to avoid sleeping with their heads against their hands. They are also told to keep their hands elevated above the level of the heart as much as possible and to use cold compresses as tolerated.

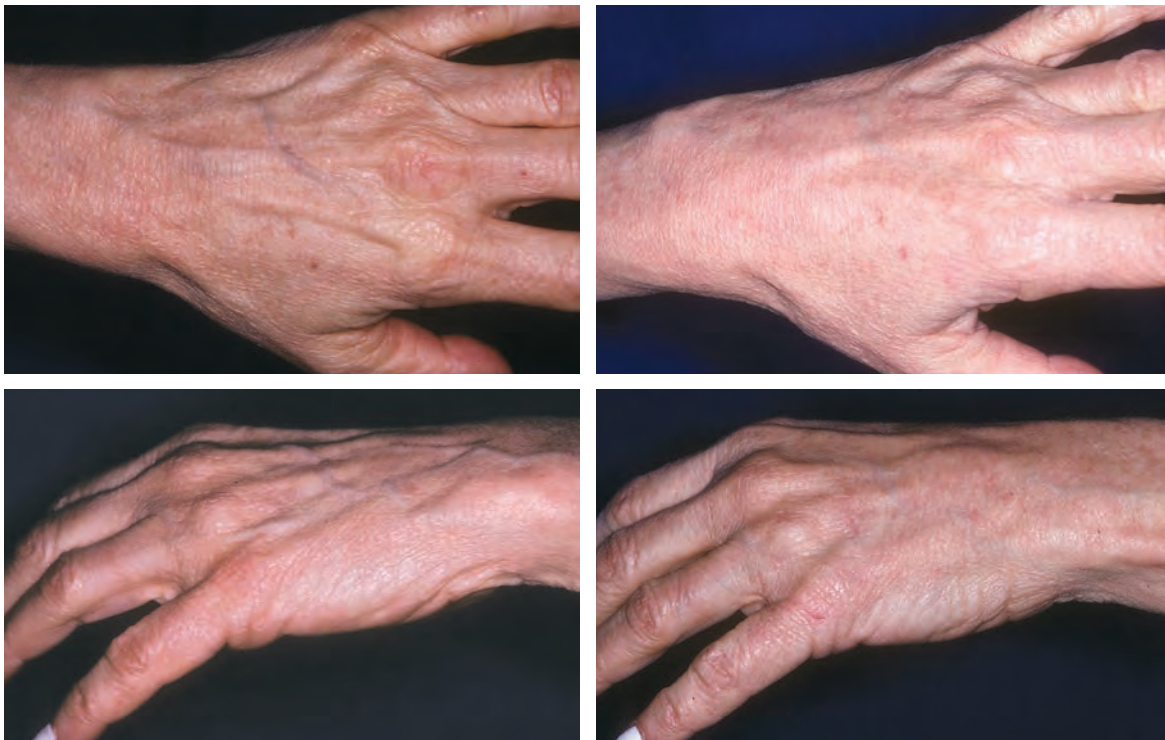
Problems and Complications

Edema is the most common postoperative sequela. Numerous passes with a cannula create substantial swelling in the dorsum of the hand, but bruising is surprisingly minimal after infiltration of fat with a style I blunt Coleman cannula. Within 2 to 3 weeks after the procedure, much of the swelling will have subsided, and although the hands may be a little puffy, they usually look natural and presentable.

Before 1992, I used sharp 16-gauge needles to inject lumps of fat into the dorsum of the hand and then massaged the fat into a smooth layer. Those patients experienced unpredictable results and noticeable lumps. Irregularities and migration have not been a problem since 1992, when I changed the placement technique.

The only other complication in the hand that I have experienced is unilateral scarring of the dorsal hand during a simultaneous chemical peel. I have not seen any bacterial or viral infections in patients with fat grafts to the upper extremities. I have also not seen a significant hematoma or even significant bruising in the dorsum of the hand when blunt cannulas are used, and patients have not complained of sensation changes. However, I have seen several patients in consultation after placement of fat into the dorsum of the hand by other physicians. Some of these patients had grafted fat located deep to the tendons, and fat even appeared to be present in the intrinsic muscles of the hand.

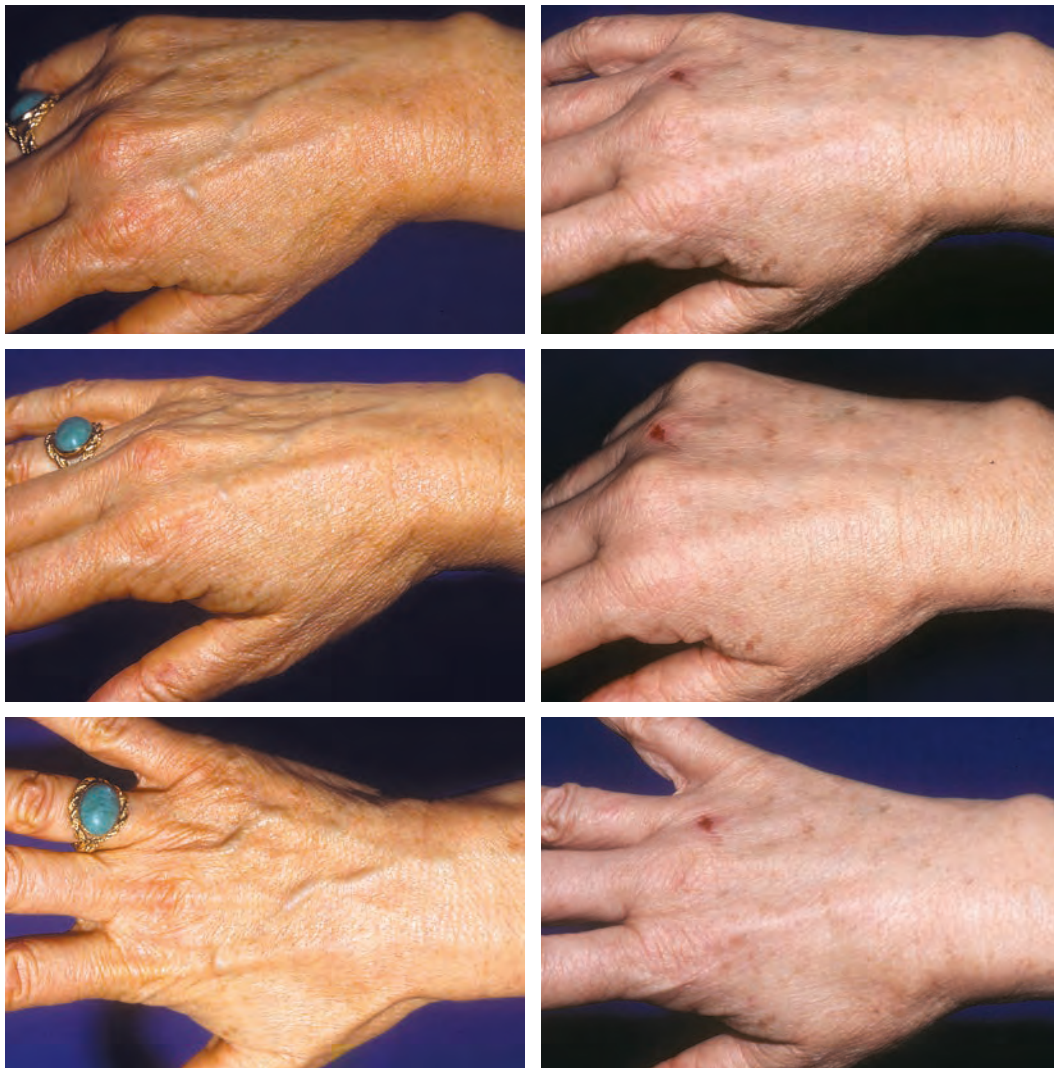
Results



Preoperative

2 years postoperatively

This 55-year-old woman presented with translucent skin through which one could clearly see the blue dorsal hand veins and glistening tendons. Fat removed from her love handles was processed down into usable tissue. At the same setting as a facial and neck procedure, 21 cc of fat was placed into the left hand and 25 cc was placed into the right hand. She returned 2 years later, extremely pleased with the way her hands looked.



Preoperative

39 months postoperatively

This 62-year-old woman presented with crêpinous of the skin of her hands and increasingly noticeable veins and tendons. She specifically wanted to place a small amount of fat onto the middle phalanx to decrease the boniness of her PIP and MCP joints. Twenty-nine cubic centimeters of refined fat was placed into her left hand and 28 cc into her right hand, from the distal forearm over the proximal phalanges and onto the middle phalanges, almost to the distal interphalangeal joint. The patient returned at 39 months, enthusiastic about her results.



Preoperative

1 year postoperatively

This 44-year-old man presented with the perception of thin forearms, which he thought made him look older and unhealthy. Eighteen months earlier, another plastic surgeon had placed AlloDerm into both forearms. The patient believed that the AlloDerm was completely resorbed within 6 months, although he had a hint of scarring in the midforearm. I layered 47.5 cc of refined fat into his right forearm and 50 cc in the left forearm proximal to the wrist over slightly more than half of his volar forearm. He returned at 1 year, delighted at the thickening of the circumference of his distal forearm and the smoothing of his volar forearm skin.

Nose

Fat grafting to the nose is an effective method for complementing rhinoplasty procedures. Fat grafted to the nose is surprisingly well integrated; the grafted fat assumes the structural qualities of the part of the nose into which it is placed. By filling and adding structural support, grafted fat can fill holes, alter the nose's contour, or add support to address a number of problems.

Aesthetic and Topographic Considerations

The aging nose loses fullness in the glabella and nasion more than in any other location. As this area atrophies, the remaining parts of the nose become relatively larger. Therefore the tip appears larger, and it may also seem to droop.

A frequent sequela of rhinoplasty surgery is an open roof in which the cartilaginous and bony parts of the nose have been repositioned so that they are no longer continuous. This leaves an open roof that is palpable and often even visible through the thin skin of the nasal dorsum. Deformation of the cartilage or bone occurs in other situations after rhinoplasties. The skin of the nose in some patients is so thin that irregularities can be amazingly visible, so that many malpositioned subcutaneous structures are painfully evident after nasal surgery.

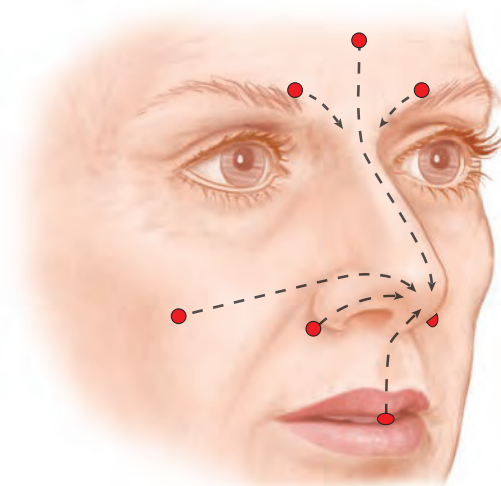
Indications

The most obvious and simplest use of fat grafting to the nose is to fill in irregularities and divots. Placing a thin layer subcutaneously provides support for the skin and can disguise visible irregularities of the cartilage and bone. Concentrating the fat grafts into defined areas can improve the line of light reflection on the dorsum or subtly change the proportion of one part of the nose in relation to another part. The structural application of fat grafts can improve alar notching or close an open roof. Finally, structural fat placed in the nasal valve may act like a spreader graft to relieve nasal airway obstruction. But fat grafting to the nose does much more than fill defects: it provides soft tissue coverage of the bony and cartilaginous framework under the skin.

Anesthesia

Anesthesia is obtained in most cases with local infiltration of 0.5% lidocaine with 1:100,000 epinephrine and sedation. Epinephrine is useful for causing vasoconstriction, thereby decreasing the possibility of intravascular emboli.

Incisions



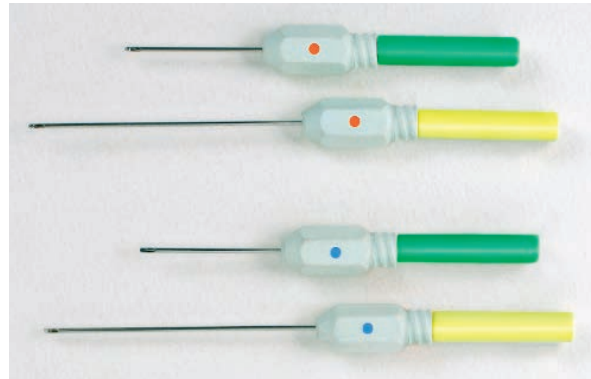
Incisions are usually made in the central forehead, medial eyebrows, cheek, or alar base and through the central lip.

Infiltration Cannulas



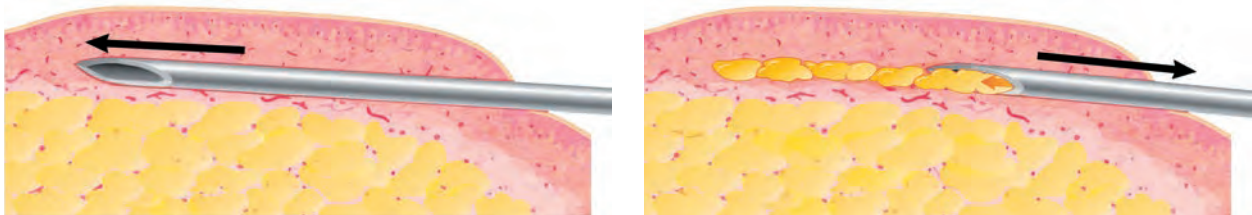
Infiltration into the nose is performed mainly with Coleman style III cannulas. The tip of the style III cannula helps push through the frequently encountered fibrous tissues of the nose, especially a nose that has scarring from a previous operation. Although I use straight cannulas most often, curved cannulas help navigate the curvature of the nasion and glabella as well as facilitating different approaches to the alae.

Mini Cannulas



Recently I have started using mini-cannulas. Although I still prefer the larger bore cannulas for many areas, I have changed to 19-gauge (external measurement) cannulas with a style III tip for most applications in the periorbital and nasal regions. These instruments are named *mini Coleman cannulas*.

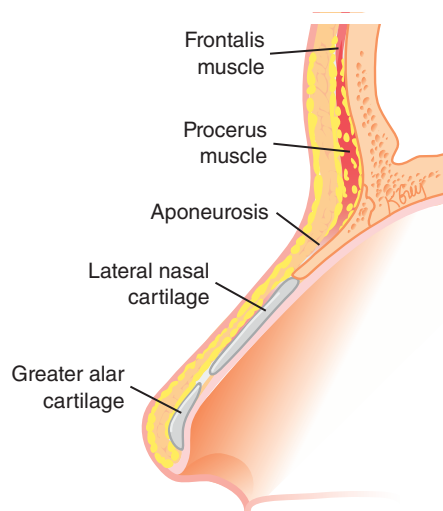
Intradermal Infiltration



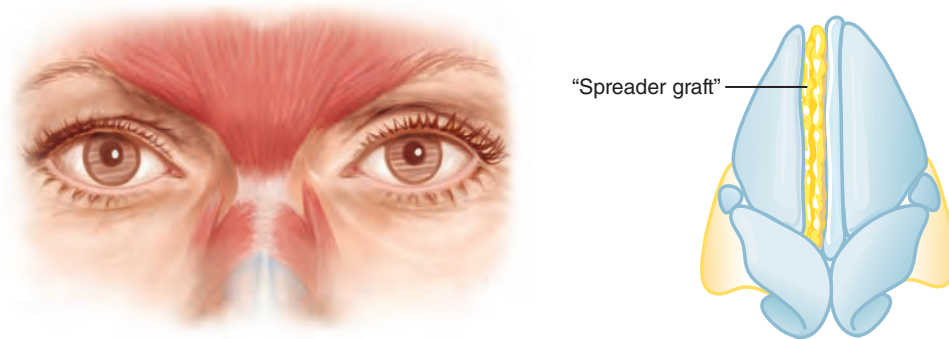
Deep dermal injection

Finally, I sometimes find intradermal infiltration of fat with a sharp needle helpful. This needs to be approached with great caution to avoid intravascular emboli.

Level of Infiltration



Fat is layered from the periosteum/perichondrium to the intradermal level.



In particular, a significant layer can be placed into the muscles of the upper nose, nasion, and glabella. Occasionally, fat can even be placed posterior to the cartilage to help expand the nasal valve, as a “spreader graft.”

Volume Ranges

The volume placed varies widely, depending on the defect being treated, but can be as little as 0.4 cc in the alar rim to as much as 9 cc in a saddle nose deformity.

Markings



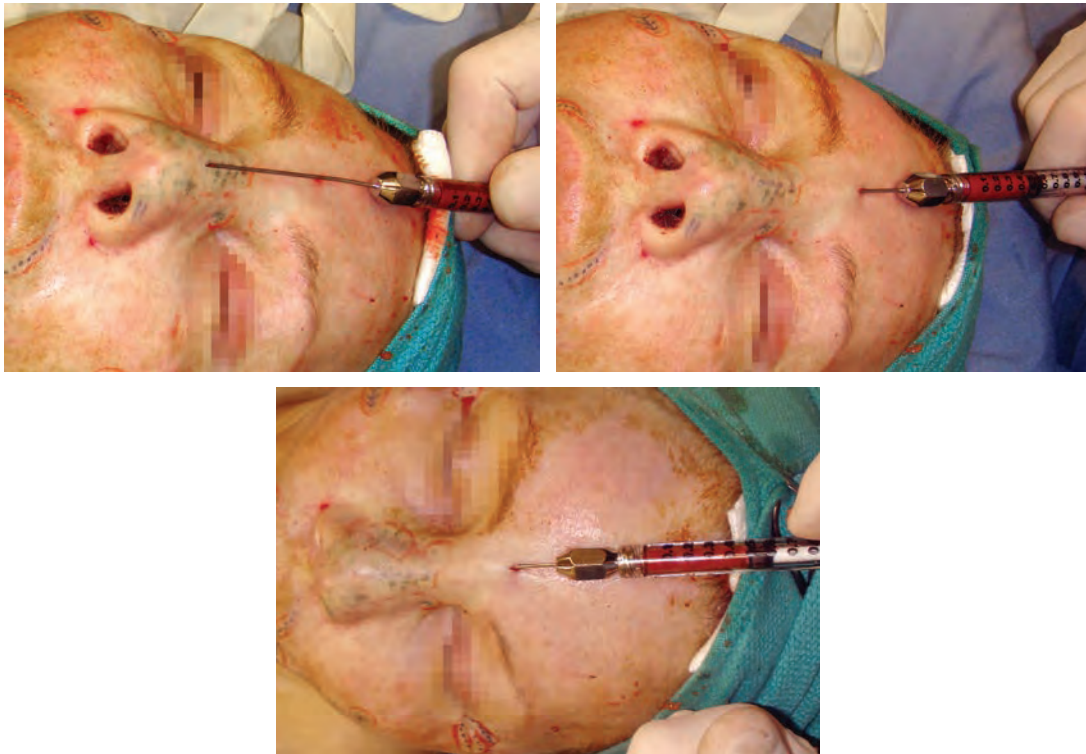
These drawings are for a patient whose primary goal was to increase the projection of her nasal tip, but she understood that this was difficult to accomplish with fat grafting. She also wanted the nasal dorsum straightened more, with placement of more tissue down the center of the dorsum to obtain a more central light reflection. She also specifically wanted to have still less alar notching and more columellar show.



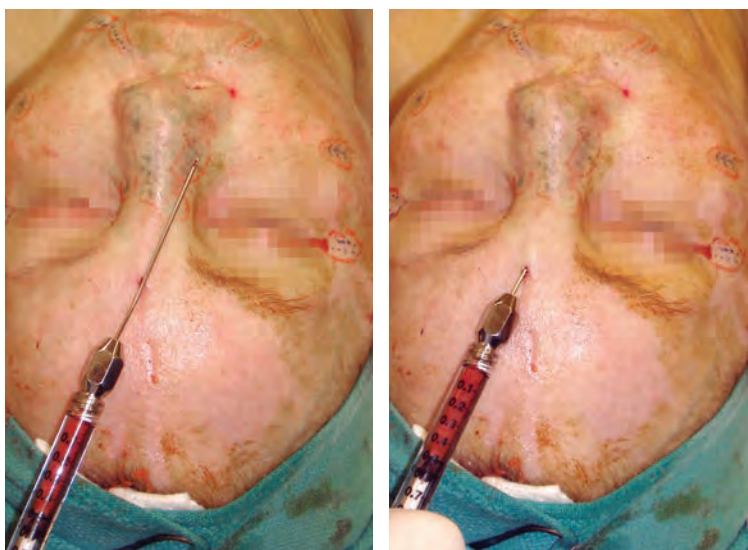
On the day of the procedure, the goals reflected in the blueprints are transferred to her nose using colored markers. Green marks indicate a planned structural change in the area. Blue marks indicate planned intra-dermal placement of fat as well as subcutaneous placement; orange marks are used to delineate the limits of placement (usually no fat is placed in the areas marked with orange).

Technique

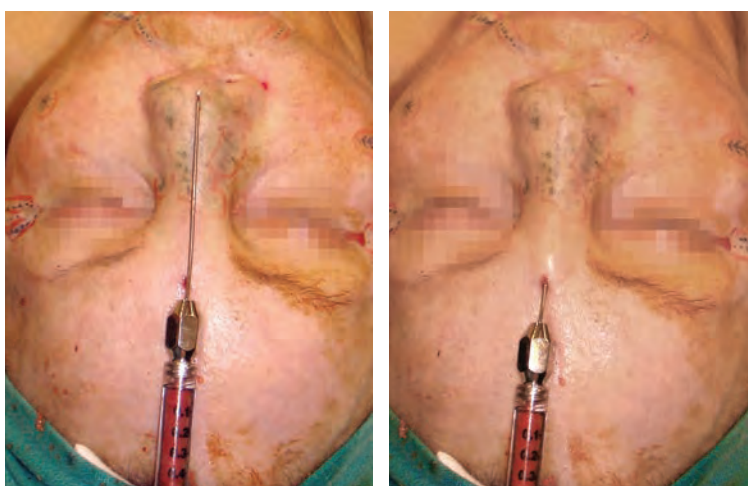
The key to placement of fat into the nose is meticulous placement in every layer available: intradermal, subcutaneous, and intramuscular; into fibrous tissues; and above and even below the perichondrium and periosteum.



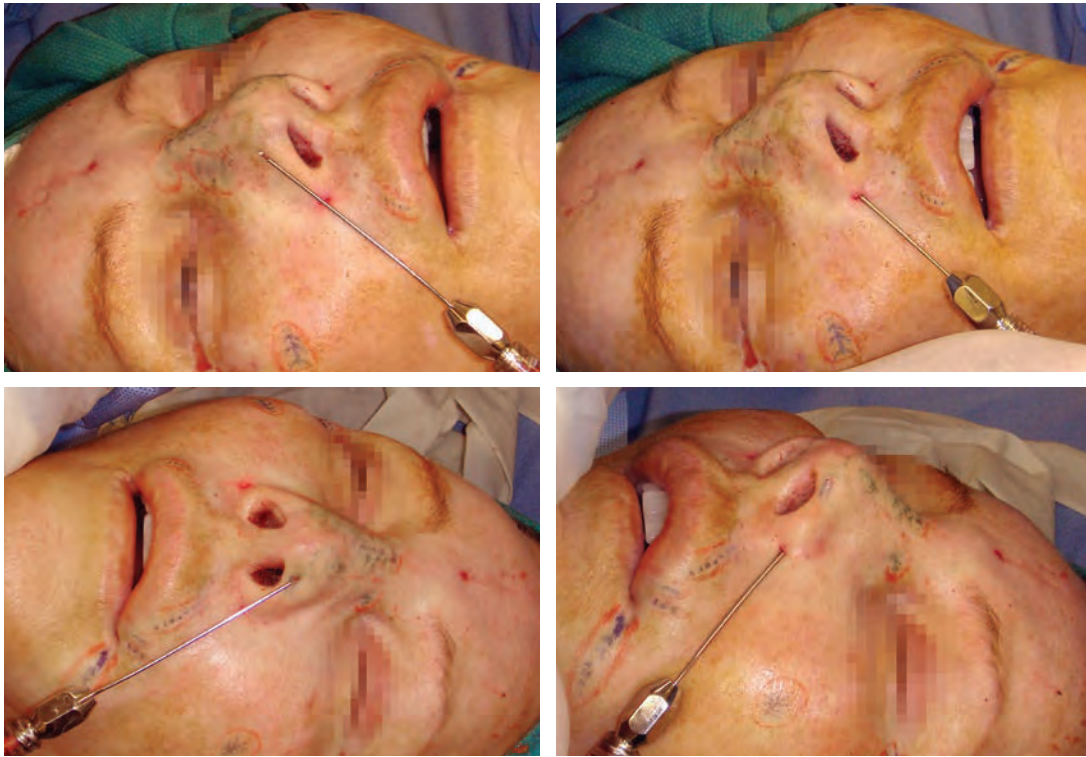
The dorsum is approached first with a curved Coleman cannula through the forehead incision. The fat in this case was layered beginning against the periosteum/perichondrium and gradually brought through the layers to the immediate subdermal layer.



Fatty tissue is then layered in a similar fashion into the right lateral nose deficiency through the same forehead incision.



The tip is approached through the same incision to provide the first direction for layering into the tip to try to increase tip projection.



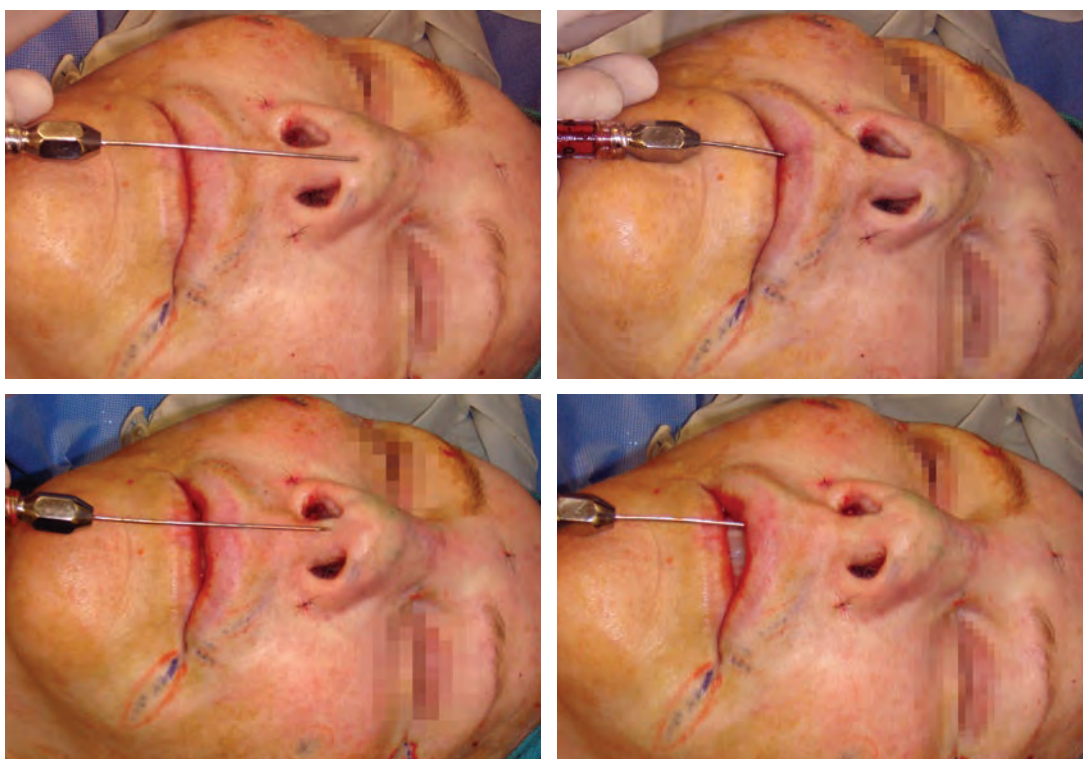
From the alar base, tissue is layered for structural support into the area of alar notching. This structural approach should start at the alar rim through the middle alae. From this approach, further augmentation of the nasal tip can be attained to increase tip projection.



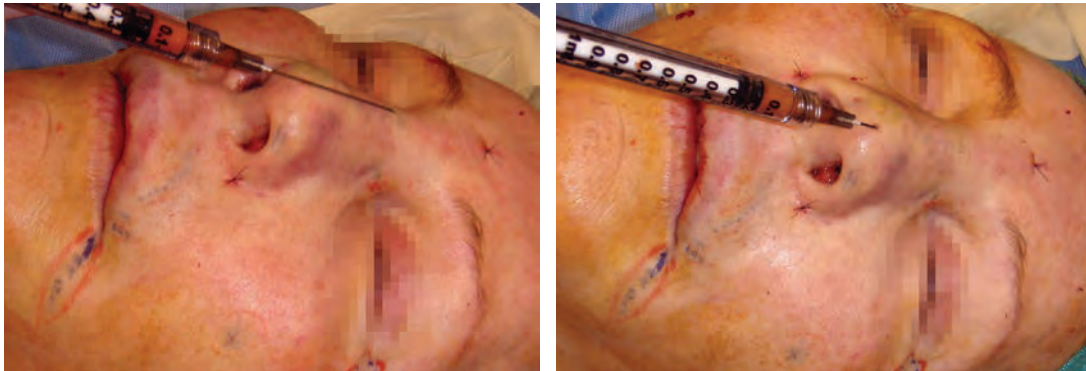
The right lateral nasal deficiency that was approached from the forehead now can be approached from the alar base. Adding a second direction of placement is always advised if possible.



Before proceeding with another direction of placement into the nose, the incisions already made should be closed to prevent leakage of the fat out the incision sites.



An incision is made in the vermilion of the lip to access the tip from another direction as well as placement into the columella to increase columellar show.

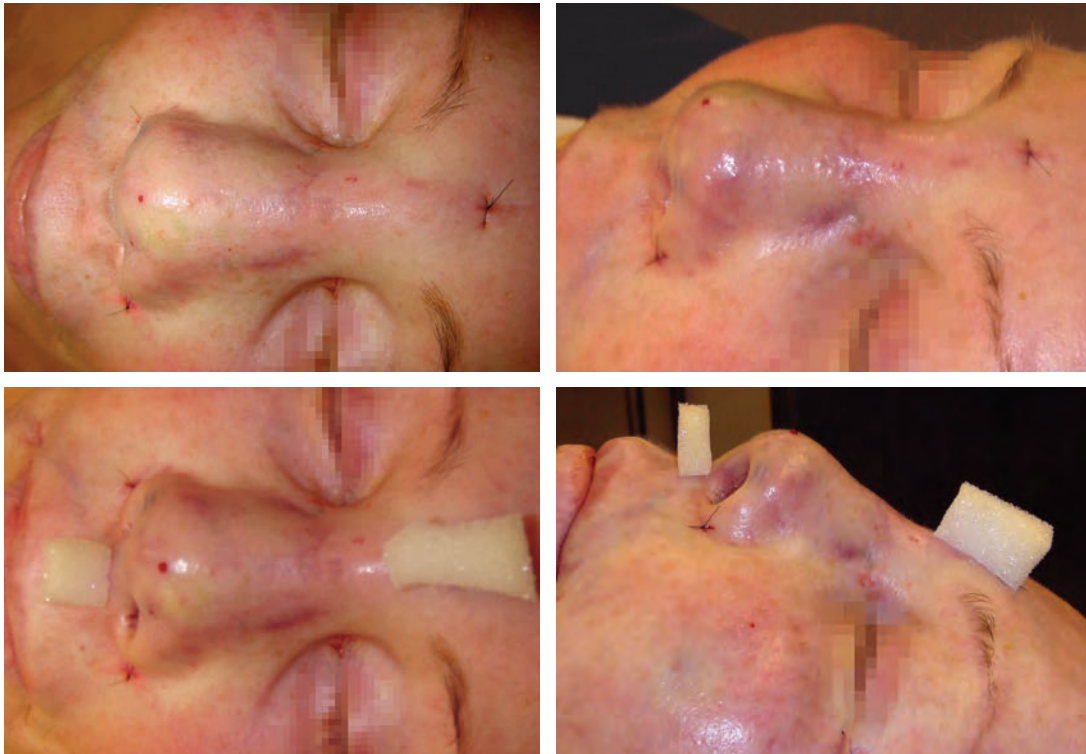


Intradermal injections into the central dorsum can sharpen the straight line of reflected light and add extra dorsal and maybe even tip projection.



Further support in the alar rim can be created by supplementing the subcutaneous placement with intradermal injection from a different direction. The surgeon should avoid injection into the deeper structures with a sharp needle to avoid intravascular cannulation of arteries.

Dressings



The appearance of the patient immediately after the procedure is shown. Reston foam is applied to the glabella and base of the columella and secured with Tegaderm to prevent migration of fat out of the directions of entry.

Postoperative Care

Dressings vary, depending on the specific procedure performed. The dressings are used to reduce migration of the fat out of the areas of placement through the placement tunnels. This can involve placing pressure between the incision sites and the area of infiltration, or providing protection to the nose (with a splint) to prevent manipulation of the newly transplanted fat. The patient should be told to avoid aggressively touching the nose to prevent fat migration.

Problems and Complications

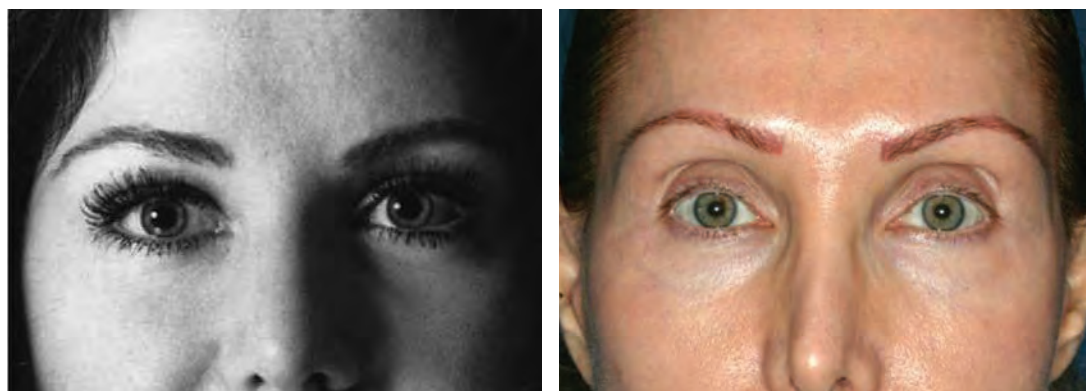
Probably the most common problem after placement of fat is inadequate correction. Even if there is a significant improvement, patients usually want to have more. Patients must be prepared for the potential need for a second or even third treatment.

Intravascular injection is the most feared potential complication from injecting anything into the nose with a sharp needle. Care should be taken to inject epinephrine, remain at a superficial level, and place the fat in tiny aliquots when using sharp needles in the nose. Blistering that occurs 3 or 4 days after injection of any particulate substance into the nose is most likely an intravascular event, not an infection.

Results



This 56-year-old woman had had four rhinoplasties by plastic surgeons on both coasts of the United States, and silicone injections to her nose. She also had undergone two face lifts, a coronal brow lift, and, at least four times, fat grafting by another surgeon to her lower eyelids and cheeks. Surprisingly, she had undergone no blepharoplasties or any procedures to her upper eyelids, except for the brow lift.



A photograph of the patient when she was younger reveals a much softer nose and fuller periorbital region. Closing the open roof was a priority to visually connect the bony and cartilaginous portions of the nose. I planned reconstruction of the alar rim with an attempt at medialization of the nasal tip, as well as filling of the lateral osteotomy sites.



Markings delineate the planned procedure: 3.5 cc was placed into the dorsum first using a Coleman style III cannula, followed by 1 cc with a 22-gauge needle to increase the light reflection; 3.3 cc was placed into the right alar region and 2 cc into the left; 1 cc was placed into the lateral nose on each side, feathering into the lower eyelids. The adhesions were so strong that a V-dissection was necessary to release them.



Preoperative



6 days postoperatively



5 weeks postoperatively



1 year postoperatively

Comparison of these photographs reveals that the remarkable swelling and bruising present at 6 days postoperatively had resolved completely by the fifth week. The difference between the 5-week and 1-year follow-up is minimal; primarily there has been further softening of the osteotomy site corrections. The improvement of the peri-orbital region in general is evident, with remarkable improvement in the quality of the skin and lightening of the skin color.



Follow-up at 1 year after the fat grafting procedure demonstrates a remarkably normal-appearing nose. The bony portion of the nose flows more naturally into the cartilaginous area, with a more distinct central light reflection and far fewer irregularities.

The augmentation of the central dorsum connects the cartilaginous nose with the bony nose along the dorsum to allow a line of light to flow continuously from the nose to the nasion. In addition, structural augmentation of the alar rim pushes the nasal tip back to a more central, normal-appearing location. Curiously, the increase in the size of the rest of the nose makes the nasal tip appear much smaller, even though no tissue was removed.



This patient had undergone at least 12 previous nasal procedures, including placement and removal of Gore-Tex, numerous ear cartilage grafts, and not only autologous but also homologous rib cartilage grafts. With all of her procedures, she had sustained a large septal perforation.



The plan developed during earlier consultations was marked on her immediately preoperatively. The plan was primarily to create soft tissue coverage to disguise the many irregularities left from her previous procedures, especially the cartilage grafts.



The green markings indicate changes in shape, and the orange markings show the limits of placement. In the glabella the focus was on rejuvenation, calling for placement of subtle amounts over the entire area, from orange markings to orange markings, plus some placement directly into the skin of the frown lines (blue). Incision sites are marked in red in the forehead, medial eyebrow, anterior malar cheeks, and vermillion in the middle of the upper lip.

During the procedure, 0.5 cc was placed in each alar region with a Coleman style III cannula, and 0.5 cc was placed into the dermis of the columella with a 22-gauge needle. Into the dorsum 3.5 cc was placed with a Coleman style III cannula and 1 cc into the midline with a 22-gauge needle to increase the light reflection; 0.5 cc was placed diffusely with a Coleman style III cannula and 1.0 cc placed into the glabellar frown lines and the central vertical wrinkle into the skin with a 22-gauge needle. At the end of the procedure, a V-dissector was used to free up some of the scarring present between the skin and the underlying bone or cartilage.



One year after this procedure, softening of the angular edges from the nasal cartilage and bone can be seen, along with an apparent thickening of the skin, especially over the dorsum. The glabella is slightly fuller, with a diminution of the frown wrinkles. However, the wrinkles lateral to the areas of placement are more obvious. The lateral view shows that the amount of placement was minimal.

Lips

Structural fat grafting to the lips can produce long-lasting enhancement of the upper and lower lip with purely autologous material. Structural form is one of the primary considerations with lip augmentation. Consistently good results are obtained by placing tissue with careful attention to the effect that injected volume will have on ultimate lip shape.

Aesthetic and Anatomic Considerations



An attractive upper lip has a distinctly protuberant and continuous turgid white roll, which is separate from the skin of the lip. The white roll usually tapers off from peaks on either side of the Cupid's bow and becomes less obvious laterally. Cephalad to the white roll, the skin drops back from the protuberance of the white roll to begin the slight concave curve of the upper lip. The upper lip has two distinct philtral columns curving in a similar concave fashion from their origin where the white roll hits the peaks of the Cupid's bow to the columella. That curve is dramatically more concave inferiorly than superiorly. Under the Cupid's bow, the vermilion of the lip has a well-centered, distinct tubercle. That tubercle is the most caudal element of an attractive upper lip. Medial to each commissure is a fullness of the upper lip that is significantly less protuberant than the central tubercle in the vermilion. Between the central tubercle and the lateral fullness is a concavity or slight depression.

The lower lip has a slightly protuberant rim like the white roll of the upper lip, but less distinctive in color and turgidity. An attractive lower lip has elements that complement the upper lip, following the shape, but with the opposite components from the upper lip. A distinct central depression, essentially a cleft, is bordered on either side by tubercles significantly larger than the central protuberance of the upper lip. The alignment of the lower lip tubercles is oblique so that they push the central lip out into a distinct pout. The most important difference between the upper and lower lip in a normal, young mouth is that the amount of vermilion visible in the lower lip is much greater.

Placement of fat into different parts of the lip leads to different results. Particular attention should be paid to the level and anatomic areas into which the fat is placed. The goal of lip augmentation is to flip out the vermilion of the lips enough to create attractive, pouty lips with the least volume possible. This is accomplished by superficial layering of structural fat, primarily immediately under the mucosa and vermilion to increase the exposed surface area of the lip.

Because the goal is eversion of the vermilion of the lip, care should be taken not to place any support into an area that might oppose eversion. For instance, placement of fatty tissue deep to the cutaneous element of the lips will increase the structural support of the skin. This may soften some of the vertical wrinkles cephalic to the white roll or caudal to the rim of the lower lip. However, increasing the structural support of the skin will invert the vermilion of the lips, making them appear smaller.

Indications and Patient Selection

The primary indications for lip augmentation are aging and the patient's desire for adjustment of facial proportion. Often these two indications are present in the same patient. As a person ages, the lips lose subvermilion and subcutaneous fullness. This results in an inversion of the lower lip and deflation of the upper lip. As a person ages, the upper and lower lips usually become more similar in size on frontal view. The best candidates for lip augmentation are persons who had full lips when they were young. Restoring fullness to their lips will return them to their youthful state.

The most challenging patient is the one who never had full, attractive lips. In these patients, to create a full, attractive lip, the fatty tissue must be placed so that the vectors of placement overwhelm the patient's natural anatomic tendencies.

One of the most difficult patients is the one who has had placement of a nonintegrated, permanent soft tissue filler such as Gore-Tex, solid silicone, dermal fat grafts, fascia grafts, or other similar fillers. If these nonintegrated substances can be removed from the lip, I usually recommend doing so. In patients in whom I have left the substances in place, there remains an unnatural feel to the lip. Patients who have had injections into their lips of permanent fillers such as silicone, Artecoll, DermAlive, and polyacrylamide gel represent a different challenge. Because it is impossible to remove these substances, the surgeon who chooses to operate on these patients must devise a careful plan that will avoid making the lips look worse.

Anesthesia

Sedation is usually used in combination with local infiltration. In addition, 1% lidocaine with 1:100,000 epinephrine can be used for infraorbital and mental nerve blocks to further facilitate anesthesia; 0.5% lidocaine with 1:200,000 epinephrine

is infiltrated into the dermis at the incision sites before the incisions are made. Next, 0.5% lidocaine with 1:200,000 epinephrine is infiltrated into the superficial muscle and submucosal planes using a style III cannula, with placement of approximately 3 or 4 ml into each lip.

Incisions



The incisions for placement into both the upper and lower lip are most commonly made near the commissures of the lip entirely on the cutaneous lip. I will place the incision in a wrinkle line radiating from the lip. Occasionally I use the midmalar incision or mandibular incisions for placement of some of the tissue, especially to approach the cutaneous lips.

Infiltration Cannulas

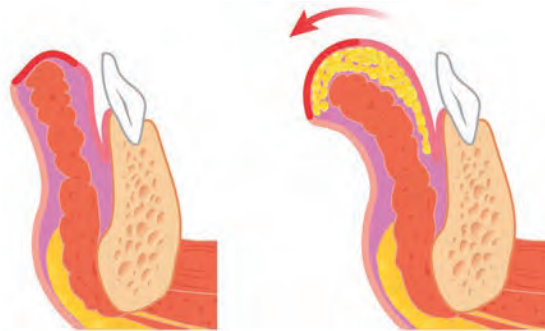


The sharpest of the blunt cannulas, a style III infiltration cannula, is used almost exclusively for placement into the entire lip. This cannula allows me to place the refined fat with the greatest accuracy into the plane immediately deep to the mucosa or vermilion.

For an aging lip with wrinkling, I will often place 0.5 to 1 cc of fat using a 22-gauge needle injecting into the deep dermis and immediate subdermal space.

Level of Infiltration

Successful enhancement of the lip is not just a matter of placing a specific volume of fat into the lip. The level of fat placement is of paramount importance to consistently realize any planned changes.



Correct superficial fat placement

Almost all of the grafted fat should be infiltrated into the most superficial level, immediately deep to the vermilion and mucosa.

Volume Ranges

The suggested volumes of placement are as follows:

More than 0.75 cc but rarely more than 1.25 cc for restructuring the white roll

More than 0.75 cc and less than 1.25 cc in the lower lip rim

A minimum of 1.5 cc but rarely more than 4 cc into the body of the upper lip

Slightly more than twice the amount placed in the upper lip is placed in the lower lip body for the average patient

Technique



This 38-year-old woman presented for treatment of acne scarring. During her initial consultation, she noted that an attempt to augment her lips had been made in the distant past with intradermal collagen injections and requested a modest lip aug-

mentation to soften her lips and make them look less severe. She desired more vermilion show to her upper lip but wanted to avoid having too much of a flip in the upper lip because she did not want her lips to have an overly augmented, puffy look.

Markings



The green pen markings outline the plan for lip augmentation. The green line below the white roll shows the plan for placement into the vermilion below the white roll, not into the white roll. The placement caudal to the white roll will extend out almost to the commissure but will end approximately 4 mm before the oral commissures. The markings show that placement into the body of the lip will be emphasized centrally and laterally to create a distinct concavity of the area not marked in green.

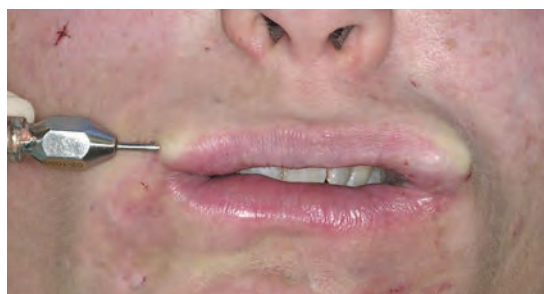
The beginnings of the philtral columns are marked as a reminder that placement of the fat should be extended slightly into the base of the philtral columns to slightly increase their turgor. The lateral oblique “balls” of the lower lip are also marked. The lower lip placement is in the vermilion next to the cutaneous lip, with no placement at all deep to the cutaneous element of the lower lip. Slight depressions in the lateral cutaneous lip were identified in this patient and marked on the skin. This is the only place that structure will be placed under the lower lip cutaneous portion.

White Roll

I usually begin simple aesthetic augmentation of the lip by placing tissue into the area of the white roll. This area is the most difficult and requires the most precise placement. Although I commonly use the style III cannula for placement into the white roll, I occasionally will use a sharp needle to place a small amount into the deep dermis.



Access for the white roll placement is from the incisions near the lip commissures on either side.



After advancing the tip almost to the opposite commissure through the upper lip, the cannula is withdrawn slowly across the cephaladmost vermilion as gradual pressure is placed onto the plunger of the 1 cc syringe. The objective is to lay down a small (but sometimes as much as $\frac{1}{5}$ cc) increment of refined fat. In many lips, such as those shown above, the metallic tip can be seen shining through the vermilion caudal to the white roll as the cannula is withdrawn across the lip.



I usually approach the placement into the white roll from both lateral incisions. To add structure to the philtral columns, I divert the cannula up from the vermilion into the columns. This placement is also extremely superficial, and the tissue is placed immediately under the skin, avoiding insertion of fat directly into the orbicularis oris muscle when possible. I placed 0.8 cc of tissue into this patient's upper lip white roll.

Lower Lip



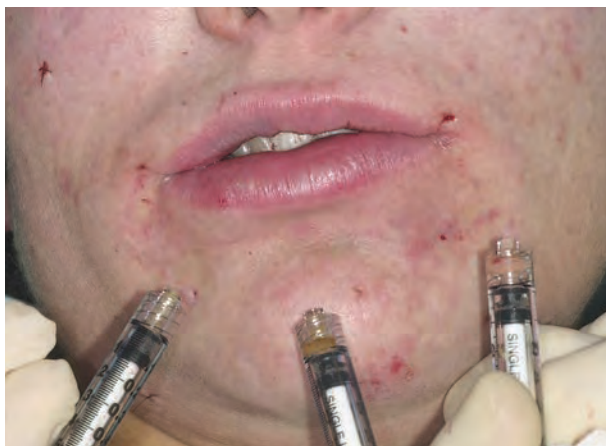
Although the lower lip does not have an actual white roll, the placement in the lower lip begins with an approach almost identical to that of the upper lip white roll. The graft is placed in the vermilion just cephalic to the cutaneous border using a style III cannula. Again the fat in the lip should be placed in the immediate subdermal layer. Although I advance the tip of the cannula all the way to the opposite commissure, I place most of the tissue along the lower lip rim into the central two thirds of the lip. An attractive lip is not excessively full all the way to the commissure. Care is taken to place this tissue extremely superficially and in the vermilion only.



The next consideration in infiltrating the lower lip is maintenance of a youthful shape. My first approach to the lower lip after establishing a turgid rim is to create oblong “balls” or protuberances on each side, just lateral to the center of the lip. In this patient an ipsilateral incision is used to place the left ball into the lower lip. As in most areas of the lip, the depth of placement is immediately under the mucosa and vermillion with a style III cannula. The key to this placement is central eversion of the lower lip while leaving a distinct deficiency, almost a cleft centrally. As always, the fat must be placed in miniscule amounts.



After an initial volume from one side is placed, a similar amount is placed into the opposite side through its ipsilateral incision.



At this point, 1 cc has been placed into each ball and another 1 cc into the lower lip rim.



As I continue to place tissue into the balls of the lower lip, I switch to the contralateral incision for placement of another volume on either side. This approach allows me to feather back into the mucosal lip with a structural layer.



The focus of vermilion augmentation of the lower lip is the formation of lateral oblong balls with a central deficiency or cleft. The focus of placement into the mucosa is to encourage a central pout or eversion of the lower lip. After establishing the shape of the lateral oblong balls in the vermilion, some central lip placement is feathered between the lateral balls. The objective of this maneuver is to force out a central prominent pout from the lower lip while creating the lateral oblong balls. A thin layer of tissue is placed all the way to the frenulum of the lower lip to encourage eversion of the lower lip.



After placement of 2 cc into each lower lip ball and 1 cc into the lower lip rim, the lower lip has a distinct central pout with lateral protuberances and a central deficiency.

Upper Lip



In the upper lip, placement starts in the central fourth of the lip with a style III cannula. The level is against the vermilion and mucosa centrally. The placement in the upper lip is in the same depth as the lower lip, but the areas into which the fat is placed are opposite of those used in the lower lip. The placement here continues where I left off with the white roll. In the central fourth of the upper lip, I infiltrate under the vermilion by repeated linear injections into a level immediately under the vermilion to create a layer of tissue extending from the white roll back into the mucosal lip almost to the frenulum. Everting the lip with the opposite hand allows more predictable immediate subcutaneous placement. Note the blanching of the mucosa of the right upper lip. Finally, the contralateral tubercle is approached in a similar fashion.



Preoperative



4 days postoperatively



7 days postoperatively



44 days postoperatively

The following volumes were used in the lips of this patient. Into the cutaneous portion of the upper lateral lip, 0.3 cc was placed on each side. Into the white roll of the upper lip, 0.8 cc was placed with a 22-gauge needle, and 2 cc was placed into the lip itself. Into the lower lip, 0.75 cc was placed with a 22-gauge needle, and 6.5 cc more was placed using a style III cannula. The patient is shown at 4 days, 7 days, and 44 days after treatment.



The patient returned at 4 months, extremely pleased with her result and appreciating that she had a better pout and fuller upper lips. To evaluate the lips on any patient, the mouth must be relaxed and the lips not touching each other. I find that having the patient purse the lips allows a different evaluation of the volume of the lips.

Posttreatment Care

No dressings are used on the lips. Patients are told that the wet mucosa will undergo keratinization and become dry mucosa or vermillion. During this process, the lips may peel like a snake shedding its skin. Moisturizers or ointments are helpful during this process. The patient is asked not to massage the lips in the first weeks; however, the patient is encouraged to move the orbicularis oris in an attempt to promote lymphatic drainage. There are no further restrictions on lip motion after the procedure.

Recovery from fat grafting in the lips is usually the most difficult, in terms of the degree and duration of swelling, until it resolves sufficiently for the patient to return to daily activities. Cold or iced dressings (frozen peas or crushed ice in Baggies) are therefore of the utmost importance on the lips and should be actively encouraged.

Problems and Complications

In my experience rupture of the skin of the lower lip has occurred several times. This is a situation in which tension placed on the lower lip creates enough internal pressure to cause spontaneous lacerations that split open the lip in several locations. Such lacerations are closed with simple interrupted sutures. Because this lip splitting has occurred only in the lower lip, when it does occur it has become the volume-limiting factor in that case. For that reason, I usually start placement into the body of the lower lip before the body of the upper lip. Other possible but unusual complications include scarring, pyogenic granulomas, infection, and lip necrosis.

The mouth is one of the most likely sources of contamination. Therefore I am especially concerned about transporting bacteria, fungus, virus, or mycobacteria from the mouth to other sites and delay placement of tissue into the lip until the last step of any facial procedure. Any time I make an incision near the lip, I give prophylactic antibiotics (usually intraoperative cephalosporin). Eight years ago I started having patients gargle with Peridex preoperatively. Since that time, I have seen only one minor perioral infection.

Results



This 50-year-old patient presented with lips that were already aesthetically appealing but no longer as everted as when she was young. The lower lip was no longer the dominant larger lip, and the upper lip was not as full as when she was young.



As always, more attention was directed to planning the shape than in considering the volume. The markings made on the patient's lip reflect the plan. The approach to the lower lip emphasizes the dramatic eversion of the central lip while minimizing placement into the central lip. This is accomplished by primary placement into the previously described oblong balls of the lower lip. The alignment of these oblong structures is such that their axes converge above the most protuberant point of the pouty lower lip. On this patient, the upper lip markings were drawn to emphasize eversion of the central tubercle of the upper lip. However, some eversion of the lateral upper lip is desirable. It is this eversion of the lateral upper lip vermilion show that establishes the apparent width of a lip.



A total of 6 cc was placed into the lower lip. Into the upper lip, first 1.1 cc was placed caudal to the white roll, then 2.5 cc was placed into the upper lip, emphasizing the central and lateral tubercles, but with some fat placed in the concavity between them. Finally, 1.4 cc was placed to emphasize the philtral columns.



4 days postoperatively



17 days postoperatively



1 year postoperatively

Swelling at 4 days and 17 days after surgery is alarming to the patient. I always warn them that they will not look recognizably human but more like a monster for at least a week. Recovery from fat grafting in the lips is the most difficult, because it can be up to 4 weeks before the patient feels somewhat comfortable. Although visible swelling in this patient had completely resolved by 3 months, she claimed to feel changes in the texture as well as the size of her lips for up to 8 months.



Preoperative

1 year postoperatively

8 years postoperatively

The patient returned after 8 years with little if any change from her first year follow-up. She had had no procedures performed on her lips and had no fillers placed. She maintained obvious eversion of the lips in good form. If anything, her lips are slightly more everted than I would want. In the last few years I have tended to place less fatty tissue, trying to emphasize eversion over volume. If I were to augment the lips on this patient now, I would place less than half of the 1.4 cc placed into the philtral column and I would place less than 1 cc into the area of the white roll.



The ring flash oblique views allow a different analysis of the augmentation. One can see that despite the sizable volume added to the upper lip, there appears to be more incisor show as the lip is everted. In addition, the length of the upper lip is shortened both by the eversion and by the relative increase in the vermillion of the upper lip, which makes the cutaneous portion less of the overall lip.

Nasolabial Folds and Marionette Grooves

Fat grafting is also an effective method for treating nasolabial folds and marionette grooves. The key to fatty placement in these folds is infiltration of areas rather than individual lines. The focus is on placement over a general area to add support to the facial structures and improve the quality of skin.

Indications and Patient Selection

The primary indication for correction of the nasolabial folds and marionette grooves is aging. Older patients object to the expressions that age seems to have painted in the folds and lines on their faces; these appear more prominent and objectionable with each passing year. Younger patients who have deep nasolabial folds have a similar reaction when they perceive that their deeper-than-usual folds make them ap-

pear older than they are. The most important consideration with nasolabial folds is to be certain that the patient understands that the folds in the marionette area will not disappear. Improvement in the texture of the marionette grooves is frequently the best improvement possible with subcutaneous placement of fatty tissue. Collagen or hyaluronic acid may be indicated for additional blunting of the fold.

Anesthesia

One percent lidocaine with 1:100,000 epinephrine can be used for infraorbital and mental nerve blocks to facilitate anesthesia; 0.5% lidocaine with 1:200,000 epinephrine is infiltrated into the dermis at the incision sites before the incisions are made. Next, 0.5% lidocaine with 1:200,000 epinephrine is infiltrated into the nasolabial and marionette regions using a style II cannula.

Incisions

Lower midmalar incisions provide access for the perpendicular placement of tissue, and an incision in the lateral chin or mandibular border provides access for the longitudinal placement of tissue. Frequently an incision near the commissure is used for a different angle of placement.

Infiltration Cannulas



In the nasolabial fold there is little possibility of damage to any underlying structures, so Coleman style II is the most common cannula used in this area; a Coleman style III cannula may be used in areas of very fibrous adhesions, especially against the skin.

Level of Infiltration

The primary level of placement is immediately subcutaneous to deliver structural integrity to the cutaneous element of the fold. However, for deeper folds and premaxillary deficiencies, placement in the deeper planes may be indicated, especially in the nasolabial folds.

Volume Ranges

Volume ranges vary:

For correcting a minimal line in the nasolabial fold, as little as 1 cc is sometimes needed.

For deep nasolabial folds that have a significant premaxillary deficiency, infiltration with as much as 10 or 11 cc is required.

Marionette grooves can be corrected with as little as 0.5 cc, and rarely more than 3 cc is needed.

Care should be taken to avoid overfilling of the nasolabial or marionette regions. In the quest to eliminate folds, unnatural fullness can be created.

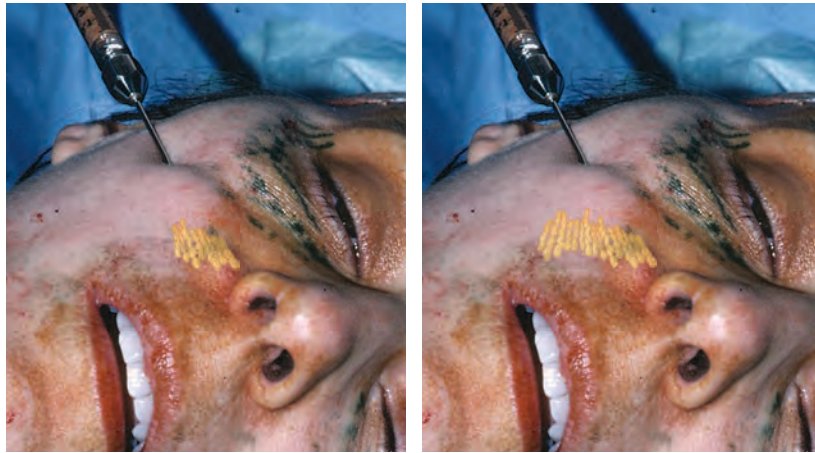
Technique



The markings are made with arrows pointing to the depth of the nasolabial fold crease, indicating the need for filling either on both sides of the crease or in the premaxillary region. In the premaxilla and marionette region, I usually fill from the medial area to the crease.



The syringe plunger is pressed minimally with each retreat of the cannula to express a small line of fatty tissue into the area of the nasolabial fold. Approximately $\frac{1}{10}$ to $\frac{1}{30}$ cc is expressed with each retreat of the cannula in this area.



Cephalad, the fat is placed medial to the folds. Only minimal fat is placed lateral to the fold, because the area lateral to this part of the nasolabial fold is usually already fuller than the patient desires.



A good deal of attention is paid to treating creases medial and lateral to the existing nasolabial folds and crease. Correction of the fold without infiltration of surrounding tissues will serve to accentuate preexisting minor creases. Next, the nasolabial fold is infiltrated from below to complement the structural placement of the transverse elements of fatty tissue. Although the cheek approach is the most important direction for placement of fatty tissue, placement of fat in a longitudinal direction allows a more precise volume correction immediately against the crease of the fold itself and adds structural integrity.

From the same cheek incision site that was used to place the fat perpendicular to the nasolabial folds, I begin the approach to the marionette region. Again placement is guided with the opposite hand with attention to avoiding perforation of the oral mucosa. Often infiltration of the marionette groove is continuous with the lateral mental region.



The marionette area is approached from many directions: it can be infiltrated from the chin, oral commissure, or the lateral mental region as well as the cheek. The aim of this multidirectional approach is to improve the texture of the region and to provide structural integrity to slightly elevate the corners of the mouth. The surgeon must avoid overfilling the marionette region with subcutaneous placement. Often a small amount of intradermal injection of fillers or fat can improve the result from subcutaneous placement.

Posttreatment Care

One layer of 1-inch Microfoam tape is used as a dressing for the nasolabial and marionette grooves. Recovery from placement into the nasolabial fold and marionette grooves is usually better tolerated than placement into other areas such as the lips or periorbital region. Bruising is often minimal, and the swelling usually looks acceptable within a few days. I do not recommend massage of the nasolabial and marionette areas.

Complications

The most common complication after ablation of the nasolabial fold is the formation of folds medial or distal to the old folds. That is why surrounding structures should be feathered or infiltrated when indicated.

Results



This early patient is shown before and 9 years 3 months after injection of fat using a 16-gauge sharp needle. I injected only 4 cc into each nasolabial fold from one direction (inferiorly).



Changes in this patient are typical of those commonly seen after nasolabial fold correction. Although there is a significant improvement, it is not the stereotypical change often anticipated by most surgeons who perform intradermal injections. The most consistent change observed after placement of a volume of fat into the subcutaneous planes of the nasolabial folds is that the fold moves forward on the face to be further away from the underlying bone and dentition. The mass effect of the diffuse placement of fatty tissue blunts the crease of the fold, but a slight fold remains. This type of fold is usually present in youthful photographs of patients. There is also a texture change in the area of the fat infiltration with a decrease in fine wrinkles and pore size. Even with careful feathering, some increase in the wrinkling of the skin can be seen where the feathering ends, especially in the medial marionette region. If patients desire a greater change to specific folds or wrinkles, adding additional fullness can sometimes help.

Clinical Caveats

Fat is living tissue that must be in close proximity to a nutritional and respiratory source to survive.

Maximizing the surface area of contact of each parcel of fatty tissue with the surrounding host tissues is essential for successful integration and anchoring of the newly placed tissue and to structurally manipulate the host tissues.

Incisions are placed in wrinkle lines, in folds, or in hair-bearing areas such as the eyebrow, sideburns, or pubic hair when possible. This facilitates placement of the fatty tissue in at least two directions when indicated.

To strengthen bony or underlying support, the fat can be layered in the deeper levels against the bone or cartilage. To support the skin, improve texture and color, and achieve a more aesthetic external appearance, the fat is layered immediately under the skin. For filling, plumping, or restoring fullness, tissues are placed in the intermediate layers between skin and the appropriate underlying tissue.

Hands

Placement of lumps of fat that the surgeon then tries to smooth out is the most likely technical error encountered in treatment of the hands. With the normal edema that is present, the surface of the hand may appear smooth, but as the edema resolves over the next 12 weeks, the irregularities become visible through the thin skin of the dorsum of the hand.

On palpation, fat parcels placed next to skin will feel like thicker skin, not like fat under skin.

Placing fat in a structured fashion with many minuscule tunnels of parcels of fat over the dorsal hand creates underlying support as well as a radial expansion of the skin.

Nose

Hydrodissection of the alae is often helpful before placement in that region to prevent perforation of the mucosa. This is especially important in scarred noses.

Even in the nose, it is important to try to place tissue from two different directions.

Blistering in the nose after injection of any filler or fat using a sharp needle is likely to be caused by intravascular injection.

The corrections with structural fat grafting are so natural (and often subtle) that the patient has trouble seeing them. Therefore it is essential to document the patient's preoperative appearance and postoperative condition so he or she can appreciate the change.

Lips

When performing several procedures, the lips are saved for the very last step to avoid contaminating the other areas of the face or body.

To accomplish lip augmentation with increased vermilion show, fat should not be placed deep to the cutaneous portion of the lip, because it can expand it and actually decrease the amount of vermilion show.

Because the white roll of the upper lip does not extend all the way to the commissures, placement of fat to strengthen or recreate a white roll should not be extended all the way to either lateral commissure.

Small lumps are amazingly well tolerated in the lip. Large ones are not.

Nasolabial Folds and Marionette Grooves

Correction of a fold without infiltration of surrounding tissues will accentuate pre-existing minor creases.

The marionette region should not be overfilled, because the grooves can easily be enlarged in some individuals.

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CHAPTER 14



Dermabrasion

JAMES L. BAKER, JR.

Aging of the skin is affected by both intrinsic and extrinsic factors. Intrinsic aging consists of endogenous influences such as genetic sequence, chronologic aging, skin laxity, and fine wrinkles of the skin *not* exposed to the sun. Genetic factors in combination with ultraviolet (UV) radiation exposure can affect the degree of UV radiation damage. Race, ethnicity, eye and hair color, and freckles all contribute to early onset of skin aging. Extrinsic aging and photodamaged skin are the result of chronic exposure to UV radiation, one of the major reasons why skin ages. Other factors leading to extrinsic aging include the type of clothing a person wears, where a person lives, and his or her occupation, lifestyle, age, and geography.

Photodamage is cumulative, from the first day of exposure until death. Fifty percent of a person's exposure to UV radiation occurs before 18 years of age. From the first moment a baby is taken outdoors, all subsequent outdoor activities will increase his or her likely radiation exposure. The working environment also influences exposure potential. Exposure decreases for people who work in an indoor environment. Occupations that require outdoor exposure will increase the photoaging process, particularly in unprotected skin. The key to diminishing this damage is education and the use of sunblocks.

Environmental factors such as heat, wind, humidity, pollutants, cloud cover, season, time of day, and reflected sunlight from the sand or snow also play a major role in radiation exposure. UV radiation increases with decreasing latitude and is compounded 4% for every thousand feet above sea level. Therefore skiing on Vail Mountain at 10,000 feet would increase the UV radiation exposure 40% over a visit to Walt Disney World in Orlando, Florida, which is at sea level.

Evolution of Technique

Removal of the upper layer of the skin for improvement in surface texture probably began in Egypt in 1500 BC, when a type of sandpaper was used by Egyptian surgeons to smooth out scars. In 1905 Kromayer, a German dermatologist, used a motorized dermabrader. This instrument used rotating burrs, which could remove the skin at various depths. Kromayer noted that ablation of the reticular dermis would result in healing with no scar. In 1947 Iverson, an American plastic surgeon, applied sandpaper abrasion for acne scars and traumatic tattoos. This technique was similar to the one used by Egyptian surgeons. Kurtin in New York, in collaboration with Robbins, modified power dental equipment for use in dermabrasion. Robbins also developed the diamond fraise, which is widely used today for dermabrasion. In 1985 Silverman et al advocated the use of prophylactic oral acyclovir for patients at risk for developing *Herpes simplex labialis*. Oral antiherpetic prophylactic medication is now a standard in skin resurfacing. In 1995 Tsai et al proposed using aluminum oxide crystals in a microdermabrasion instrument for superficial rhytids.

The current dermabrasion technique, which has evolved from its inception 3500 years ago, employs a small, handheld electric-powered instrument that rotates a wire brush or diamond fraise at speeds of 15,000 to 30,000 rpm. Either sedation with local anesthetics, topical spray refrigerants, or general anesthesia is necessary; the procedure is commonly performed as an outpatient procedure. The abrasion can be precisely controlled and results in an open wound that heals with reepithelialization after a relatively short period. Preventing infection and achieving rapid healing requires attention to detail for basic wound care. A variety of “artificial skin” materials can be used to diminish the discomfort of the operative site after the procedure and to promote wound healing. Products such as N-Terface (Winfield Laboratories, Inc., Richardson, TX), a polyethylene mesh developed as a cover for burn wounds, have been very useful.

In the past decade, incorporating some of the concepts of traditional dermabrasion, the new technique of microdermabrasion has been advocated. Microdermabrasion can improve certain types of scars from aged and sun-damaged skin while avoiding many of the problems seen with traditional dermabrasion. The technique uses a fine beam of aluminum oxide microcrystals to precisely and superficially peel the skin surface. Its advantages are that it is gentle and requires no significant change in the patient’s normal routine or activities. However, multiple treatment sessions are needed for optimal improvement.

Despite the initial popularity of skin-resurfacing CO₂ lasers over the past decade, dermabrasion remains a safe, efficacious, and inexpensive method of skin resurfacing with very predictable outcomes. A complete dermabrasion setup will cost less than \$1000, whereas most resurfacing lasers cost in excess of \$50,000.

Pretreatment Assessment

When dermabrasion is used as an adjunct to facial rejuvenation, the patient’s motivation is well documented and justified. Perioral rhytids are effectively treated with dermabrasion, and the results are predictable and satisfactory. For deep rhytids, only phenol chemical peeling can produce a superior result. However, the hypopigmentation that usually follows phenol peels is undesirable, especially in patients with Fitzpatrick skin types III or IV.

Because of the surgeon’s ability to control the depth with dermabrasion, hypopigmentation is usually avoided. Deep rhytids respond better to dermabrasion than to CO₂ laser resurfacing, with less potential for prolonged recuperation and/or hyperpigmentation, hypopigmentation, or scarring.

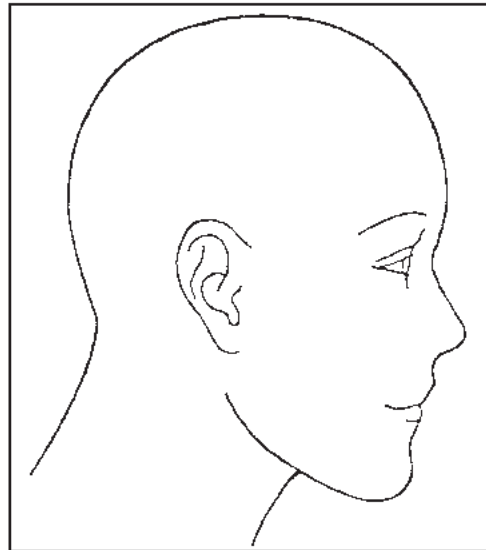
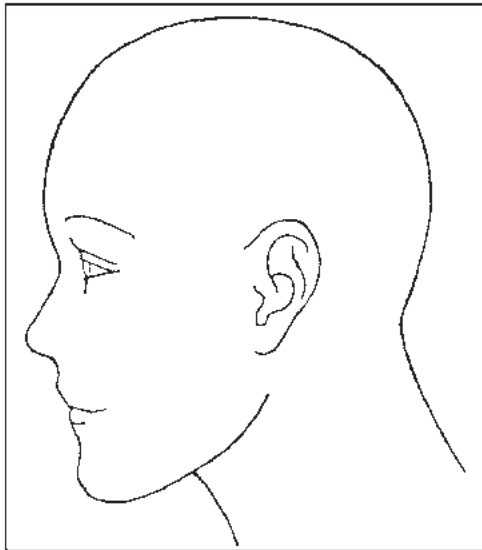
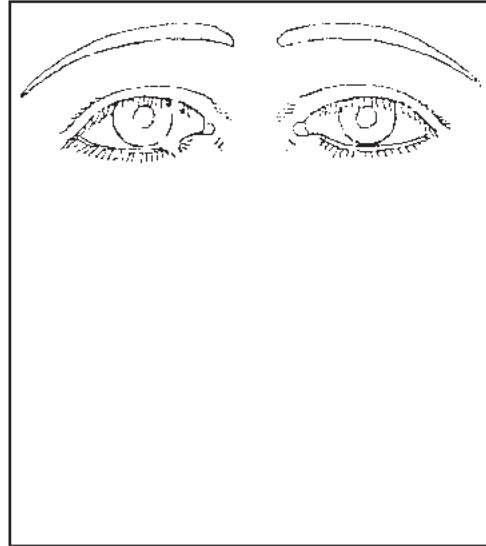
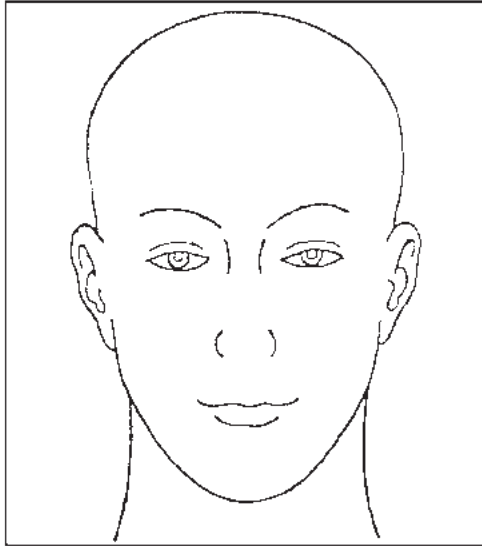
When using dermabrasion for improvement of postacne scarring, the surgeon must evaluate the patient carefully from a psychological standpoint to avoid unrealistic expectations of what the procedure can accomplish. It is very difficult to make the patient understand that scarring is permanent, and dermabrasion can only improve the amount of light and shadow that falls on the craters of the skin. Dermabrasion will produce a more undulating surface as opposed to a rocky, craggy type of dermis. Scars, although they are improved, will not be removed, and the patient should never expect to have the skin restored to the soft smooth texture of infancy. It should be stressed that two or three procedures are necessary for maximal improvement, and it will be an improvement, but not a cure.

Patients to avoid are those who exaggerate a tiny or barely visible defect, such as a small scar, and those who are unable to describe what they expect from the procedure (that is, their desired change). If the surgeon has trouble establishing good rapport with the patient, it is best to decline to treat that person. Surgeons should also be wary of patients who have had two or three procedures performed by different plastic surgeons and criticize all of their results. These patients come to you because they have heard that you are “the best.” If you operate on this type of patient, his or her eventual disillusionment and dissatisfaction following your procedure are predictable.

The extent of the procedure and the areas to be treated should be marked on a face diagram to ensure that the patient understands exactly what areas will be addressed with the procedure and where improvement should be expected. Darker areas can easily be noted with the use of colored marking pens or highlighters. Photographic documentation is mandatory, despite the difficulty in demonstrating skin pits and scars with photography. If lines are extremely deep, it is likely that neither laser resurfacing nor dermabrasion will completely eradicate them, and the possibility of a later treatment with a tissue filler should be discussed. This type of advance preparation should help to adequately inform the patient about what to expect and help to prevent patient disappointment. For this reason and to facilitate compliance, it is extremely important for the patient to understand postoperative care. It normally takes a week before healing is completed, and the patient’s role in wound care is of the utmost importance. The treated area needs to be kept clean and moist with a recommended skin ointment. Sun exposure must be avoided, and the use of sunblocks is mandatory until normal color returns.

ANATOMIC FORM

Name _____ Date _____
LAST FIRST MIDDLE



Patients taking isotretinoin (Accutane) or those who have recently completed a course of Accutane therapy should not undergo any skin-resurfacing procedures for at least 6 months after completion of their therapy. Accutane will act as an inhibitor of pilosebaceous gland function, which is necessary for reepithelialization. I prefer to wait at least 1 year, and ideally, 2 years after Accutane therapy to ensure that pilosebaceous gland function has returned to normal. Because of the paucity of these glands below the mandibular rim, dermabrasion of neck rhytids should also be avoided.

This 52-year-old woman underwent a face lift and attempted removal of neck rhytids by dermabrasion. The result was hypertrophic scarring of all areas treated on both sides of the neck.

This example illustrates why dermabrasion on the neck should not be attempted because of the paucity of pilosebaceous glands, which are needed for reepithelialization.



A complete physical examination is essential, and any health problems should be carefully evaluated. The patient's history of cigarette smoking and alcohol intake should be weighed as to their possible deleterious effects on wound healing. Allergies and medications should also be carefully evaluated.

Fitzpatrick Skin Care Classification

The Fitzpatrick classification system of sun-reactive skin type is a good measure of ideal candidates for skin-resurfacing procedures. Although those with skin types I to III are considered the ideal patients for a predictable outcome for dermabrasion and other resurfacing procedures, those with type IV skin can anticipate a good result with the use of bleaching creams applied both preoperatively and postoperatively to diminish melanocytic activity. However, it should be discussed with these patients that they are more prone to hyperpigmentation problems postoperatively and, of course, all patients undergoing skin resurfacing should be advised to avoid sun exposure or tanning booths until normal color returns. Sunblocks with an SPF of 35 or higher are recommended, and patients should be advised not to sit near a swimming pool or go to the beach because of the reflected UV radiation coming off the water. The sun's rays can also attack the skin even when an individual is wearing a wide-brimmed hat. Boating is also contraindicated during this period for the same reason.

Fitzpatrick's Classification of Sun-Reactive Skin Types

Skin Type	Color	Reaction to First Summer Exposure
I	White	Always burns, never tans
II	White	Usually burns, tans with difficulty
III	White	Sometimes mild burn, tanning moderate
IV	Moderate brown	Rarely burns, tans with ease
V	Dark brown*	Very rarely burns, tans very easily
VI	Black	No burn, tans very easily

*For example, East Indian, Asian, Hispanic, or light African descent.

Skin care counseling with the continued use of alpha-hydroxy acid products and sun-blocks should be a part of the routine discussion and recommended regimen for the patient to ensure the longevity of the procedure. Perioperative use of systemic antibiotics as well as an antiviral medication (acyclovir) is strongly recommended, even without a direct history of a “cold sore” that the patient can recall. Many patients have had inoculation of the herpes simplex labialis virus in childhood and may not remember having had an attack. When it comes to prophylactic use of acyclovir drugs, the familiar expression, “An ounce of prevention is worth a pound of cure,” is sound advice.



This 42-year-old woman underwent perioral dermabrasion for rhytids before prophylactic acyclovir therapy. She gave no history of “cold sores” at any time during her life. A single lesion of herpes simplex occurred in the central portion of her upper lip 5 days after dermabrasion. Her outbreak was treated with acyclovir without sequelae. It is recommended that all patients, despite a negative history, be placed on prophylactic acyclovir therapy for any resurfacing procedure.

For patients with skin types V and VI who are contemplating dermabrasion, it is important to first perform a test spot at the hairline. Although this preliminary test can give an indication of the expected result, there is no 100% guarantee that the remainder of the facial skin will respond identically, and the patient should be forewarned of this.

Healing of the Dermabrasion Wound

Although dermabrasion can be performed to any dermal level by control of the surgeon's hand, most procedures are targeted to a specific level of the dermis. Deeper rhytids require a greater depth of wounding, and it is not the ablation of the abnormal epidermis that creates the result but rather the stimulation of dermal fibroblasts, which lay down collagen that creates the improvement. Healing is expected in 7 to 10 days.

Healing of dermabraded areas is similar to that of split-thickness skin graft donor sites. Initially there is an outpouring of serum, which forms a coagulum that covers the abraded surface, trapping necrotic and other cell debris. Immediate activity begins in the adnexal cells adjacent to those exposed by the dermabrasion. These exposed cells undergo necrosis, and those below take on several of the attributes of squamous epithelium. Marginal epithelial cells migrate from the edges of the abraded areas, and within 3 days new epidermal cells are seen growing across the surface and extending out from these adnexal components. By the fifth postoperative day, epidermal regeneration is usually complete. It is thin, lacks rete pegs, but exhibits developing hair follicles and sebaceous glands. These elements not only contribute to the epithelial resurfacing but are also evidence that functional activity is resuming.

The period required for complete epidermal regeneration is usually between 5 and 7 days. In the newly regenerated dermis, young fibroblasts are seen lying with their long axis in a horizontal plane and new capillary development is noted. Collagen is being laid down by the second week. This new collagen shows a horizontal striation that can last for 3 to 4 years following dermabrasion. It is this new collagen that fills out the skin, resulting in the youthful rounded appearance frequently witnessed after dermabrasion procedures. Moisturizers are recommended to keep the new skin hydrated, and sunblock is mandatory to diminish the possibility of hyperpigmentation.

In the first month there is little evidence of pigment formation in the basal layers of the epidermis. After 1 month, however, some return of fine pigment granules can be noted. With the newly healed postoperative skin, exposure to sunlight intensifies the potential for hyperpigmentation even in patients with Fitzpatrick skin types I to III. It can last from 3 months to several years and occasionally can be permanent.

Treatment for the prevention of hyperpigmentation consists of an SPF 30 or higher sun protection as well as vitamin C tablets (2 g ascorbic acid daily) to inhibit melanin formation, either topical steroids, or in developing cases of hyperpigmentation, 25 mg of cortisone daily to inhibit the pituitary melanocyte-stimulating hormone. Hydroquinone is also indicated to inhibit melanin production by the melanocyte.

Milia are small white-headed cysts arising from the epithelial cells of the hair follicles, sebaceous gland ducts, and sweat ducts that have been sealed over at the time of surgery and have become isolated under the newly epithelialized surface. They usually appear within the first month following the procedure. These can be treated with an exfoliating buffing pad or mild abrasive facial scrubs to unroof the blocked ducts.



This 20-year-old woman underwent full-face dermabrasion for acne scarring. Milia were noted 8 days after the procedure and were attributed to the epithelial regeneration covering the small oil gland ducts. This was successfully treated with gentle abrasion using a buff puff to unroof the small cysts. Prophylaxis is difficult, but treatment is simple.

Equipment



This is a typical small, self-contained dermabrader. There are several units to choose from commercially. They are ideal for office use, because they require limited space for storage or operation and can be easily cleaned with the handpiece being sterilized. Either wire brush or diamond fraise drums are used. I prefer the diamond fraise, be-

cause I am familiar with its operation; I have used it with satisfactory results over the past 35 years and find that it makes it easier to judge the depth of treatment. The diamond fraise is available in different surfaces, from fine to extra coarse. For aesthetic surgery most surgeons prefer medium to coarse, plus a touchup of the finer rhytids with a fine diamond fraise.

Although the small hand engine–type dermabraders have a knob to control the speed of the drum rotation and an on/off switch, this limits the surgeon's control during the procedure. I prefer a foot pedal rheostat, which allows me a wide range of speeds under my total control during surgery. For operating room use, an electric dental motor with a handpiece will provide an unlimited number of years of use with minimal cost or downtime for repair. These motors are extremely reliable and inexpensive.

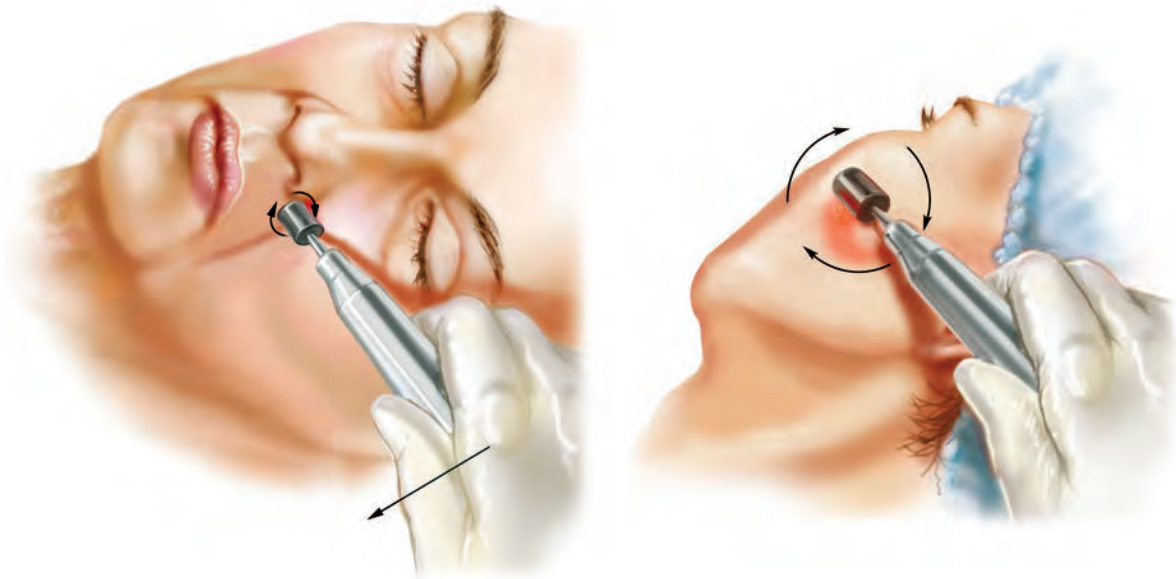


For the past 20 years I have used a Foredom Electric Series S-Engine Motor Style CC with handpiece No. 7D (The Foredom Electric Co., Bethel, CT). The cost is several hundred dollars, and the dental handpiece is very easy to hold and control. A diamond fraise 17 by 10 mm or 17 by 14 mm is used with coarse, regular, or fine surfaces.

Technique

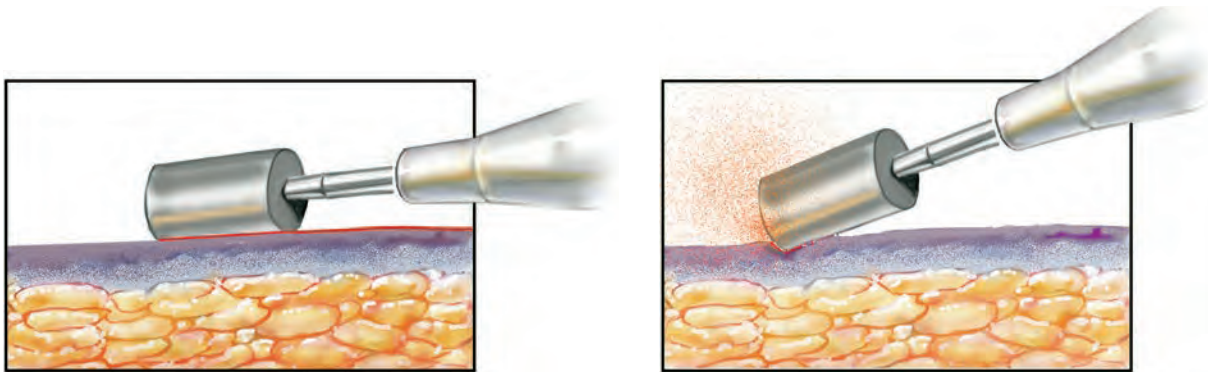
Preoperative treatment consists a broad-spectrum antibiotic administered intravenously just before the procedure, or given orally beginning the day before the procedure, and continuing for 1 week postoperatively. An acyclovir preparation such as Valtrex (500 mg twice a day) or Zovirax (400 mg three times a day) is administered the day before surgery, *as well as the morning of surgery*, and is continued for 7 to 10 days postoperatively. The skin is cleansed with an antibacterial soap in the operating room. Either general anesthesia or local anesthesia with nerve block and se-

dation is used. This is a matter of personal choice, and the decision is made by the surgeon and the patient. Anesthesia equipment should be covered to prevent blood spray from contaminating the equipment, and precautions should be taken by the anesthesiologist and the nursing personnel. Magnifying loupes are used not only to magnify the surface of the skin and the rhytids but also to help protect the surgeon from blood spray. The surgeon's eyes should be covered with some protective eye shields, in any event. If acne scars are being addressed, it is helpful to mark the pit of the scar with a surgical marker and outline the area of maximal scarring. This will be helpful in determining the depth to which dermabrasion will be done. It can also be performed with deep rhytids, placing a line at the base of the depth with a fine-point marker.



Because the drum is rotating in a clockwise direction, the drum should always be moved toward the leading edge of soft tissue. With the drum rotating counterclockwise, the hand moves the dermabrading instrument over the cutaneous junction edge to avoid avulsion of the lip. This is very important, especially when trying to treat crow's-feet.

The rotating motion of the drum is used to obtain a smooth surface. Great care must be taken in holding the sponge in the opposite hand a safe distance from the rotating drum. Once the gauze is impregnated with blood, it is very easy to have an edge of the gauze get caught in the fraise or wire brush and torque into the patient's face. This could cause severe eye or soft tissue damage from the whiplike effect of the end of the gauze. The abrader is moved slowly back and forth or in a circular motion across the surface, abrading through epidermis down to the desired level of the dermis.



The bleeding pattern is a good indicator of depth. The skin should be wiped frequently so this bleeding pattern can be observed. Care must be taken to not angulate the fraise or wire brush because the leading edge can cut into the skin surface and cause undesired pitting, grooving, and/or scarring. It is critical to maintain the drum parallel to the skin surface.



When working around the lips, the speed should be reduced and the drum pulled softly over the vermillion-cutaneous junction to avoid avulsion of the lip edge. When nasolabial folds are being dermabraded, the drum should rotate away from the edge of the nose and toward the soft tissue angle at the bottom of the rhytid. The same caution is necessary when dermabrading crow's-feet near the eyelids. *The rotation of the drum should always be toward the leading edge of any soft tissue.*

After the desired depth in the dermis has been achieved, the dermabraded areas should be thoroughly cleansed with saline solution using a soft bristle brush or rough gauze. This will remove the excess skin debris. To diminish bleeding, a sponge soaked in saline solution with epinephrine in a 1:1,000,000 dilution is helpful.

The operative site can then be treated open, with the application of antibacterial or Aquaphor ointment or with a layer of Adaptec or Telfa. For the past 15 years I have preferred to use N-Terface, which is a polyethylene mesh developed originally for the treatment of burn patients. Strips of this nylonlike material are cut to fit over the treated areas, and a layer of Aquaphor ointment is applied. This diminishes the postoperative discomfort considerably, and the material will separate on its own as reepithelialization occurs, which is usually 5 to 7 days. Patients may shower with the material in place and are encouraged to trim loose edges as healing progresses. It will eventually soak off with gentle soap and water application. For many years, thymol iodide powder was used to dry the operative site; however, as this dried to a stiff crust, it was not only uncomfortable but looked unsightly.

Postoperative Care

Bulky dressings over the operative areas are usually discouraged, because they are normally left in place for at least a week and are extremely uncomfortable in warm weather. Perspiration and blood that dry under the dressing create an obnoxious odor and provide an excellent culture medium. The dressings usually have to be soaked off, which also creates discomfort for the patient. The open technique or a thin layer of Telfa or N-Terface is much preferred by the patient, the family, and the surgeon. The patient is reminded of the importance of taking the antibiotic and antiviral therapy until the recommended course has been completed. Normally by the end of 7 or 8 days the patient can apply makeup and be comfortable going out in public. It is stressed to the patient that sunblock must be worn as the first application on the skin each morning before makeup is applied or before leaving the house. If the patient has a lot of red in the skin, this redness will persist for a longer period than in Fitzpatrick type III and IV patients. A green base makeup applied to the red skin will neutralize the color, and then a light layer of natural makeup can be applied. The patient must be careful about being exposed to sun, especially when driving in a car, since glass is made of quartz, not lead, and does not provide any protection from UV radiation.

After a week or two, topical steroid creams can be used if there is marked redness or it appears that fibrosis is occurring that could produce scarring. Temovate cream 0.05% (clobetasol propionate), applied twice a day for 2 weeks and discontinued for a week, can be cycled until normal color returns. The patient must be warned that this is a potent steroid and should not be used continuously or not on the eyelids and only sparingly for the times indicated by the surgeon.

Problems and Complications

Hyperpigmentation and Hypopigmentation

With proper patient selection, and if the expected level of surgical skill has been executed, the results should be rewarding and predictable. Problems and complications, however, can occur with any procedure. Many of these have already been reviewed. Hyperpigmentation of the skin in patients with Fitzpatrick skin types V and VI certainly can be considered one of the least desirable results. Hypopigmentation can occur when very deep dermabrasion has been performed causing a decrease in the number of melanocytes.

Milia

As mentioned previously, approximately one third of the patients who undergo dermabrasion will develop milia, which appear as small white cysts over the surface of the treated area. They normally appear within 2 to 4 weeks after the procedure and will clear spontaneously in most patients. A buff puff or other mildly abrasive product can be applied to unroof these small cysts (see p. 483).

Residual Rhytids

Very deep lines are difficult to eradicate completely, and the patient should be advised preoperatively that filler materials might be indicated and recommended after they have completely healed. Attempting to remove every deep rhytid can produce scarring and surgical judgment is critical in knowing when to stop. This is especially true with postacne scarring, and it should be stressed to every patient undergoing treatment for postacne scarring that they may need a minimum of two to three procedures to achieve maximal improvement. All scars will never be eradicated and some patients will never be completely satisfied.

Scarring

If linear scarring occurs, this is usually caused by inadvertent angling of the drum so that it causes skin gouging from the leading edge (see p. 486). If noted at surgery, several small sutures can be placed and healing will normally occur without noticeable defects. Hypertrophic scarring is more difficult to address and can be caused by an abrasion that is too deep or when infection has occurred postoperatively. Steroid injections may be helpful, especially early in the scar formation.

Infection

Infection is extremely rare because most patients receive perioperative antibiotics and antiviral medications (see p. 481). Patients with occlusive dressings can hide a smoldering infection, and for that reason I do not use them. Hyperpigmentation and hypopigmentation have been addressed, and the patient should be warned preoperatively that these conditions can occur and can be permanent.

Result



This 62-year-old woman presented with severe sun damage resulting from an active outdoor lifestyle. She requested improvement of the deep rhytids in the perioral area. She did not request any other corrections. A photograph 6 months after dermabrasion shows smooth skin with normal color. The patient was counseled regarding future sun exposure.

Concluding Thoughts

For a technique first described about 1500 BC, dermabrasion is still valid as an excellent ancillary treatment for facial rejuvenation. Most important changes have occurred within the past five decades. Dermabrasion is a safe and effective technique that produces predictable results when performed properly. Careful patient selection and a detailed informed consent, which includes the limitations of the procedure, are essential for achieving optimal results and ensuring patient satisfaction.

Clinical Caveats

The drum should always be moved toward the leading edge of the soft tissue.

The drum should not be angled and should be kept parallel to the skin to avoid skin gouging.

Antiviral and antibiotic coverage is required.

Patients should be instructed to avoid sun exposure following dermabrasion until normal skin color returns.

Patients with acne scars and deep wrinkles should be advised that a repeat dermabrasion procedure may be needed.

Annotated Bibliography

Iverson PC. Surgical removal of traumatic tattoos of the face. *Plast Reconstr Surg* 2:427, 1947.

This is an excellent evaluation of the problem of herpes simplex infection following deepithelialization procedures. The beginning of the use of acyclovir drugs for treatment and prevention of this problem is also discussed.

Kromayer E. *Cosmetic Treatment of Skin Complaints*. New York: Oxford University Press, 1930 (English translation of the second German edition, 1929).

The author discusses development of the microdermabrasion technique, which is widely used today by many aestheticians and plastic surgeons on an outpatient basis for removing unwanted epithelium in a simple "lunchtime procedure."

Kurtin A. Corrective surgical planing of the skin. *Arch Dermatol Syph* 68:389-397, 1953.

To go back in time and review wound healing as described by one of the giants in plastic surgery is worthwhile, and this article is well worth reading and rereading.

Lawrence N, Mandy S, Yarborough J, et al. History of dermabrasion. *Dermatol Surg* 26:95-100, 2000.

The authors present a thorough historical review of dermabrasion from 1500 BC to the present. Included are all the advances in this technique, and for those who enjoy the history of procedures, it is one of the best resources and well worth reading.

Suggested Readings

- Campbell R. Surgical and chemical planing of the skin. In Converse JM, ed. *Reconstructive Plastic Surgery: Principles and Procedures in Correction, Reconstruction, and Transplantation*, vol 1. Philadelphia: WB Saunders, 1964.
- Silverman AK, Laing KF, Schuberg DR. Activation of herpes simplex following dermabrasion. Report of a patient successfully treated with intravenous acyclovir and brief review of the literature. *J Am Acad Dermatol* 13:103-108, 1985.
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CHAPTER 15



Chemical Peels

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The process of facial aging can be broadly divided into three categories: structural or gravitational changes, volume depletion, and textural or qualitative changes of the skin. Surgeons are experienced in and comfortable dealing with structural changes by means of a multitude of surgical procedures that receive the majority of attention in meetings and professional publications. This is understandable, because as surgeons we know how to perform surgery and it is within our capacity and experience to read about a new technique and successfully perform it. Correction of volume loss is a relatively new field, but many surgeons are increasingly becoming proficient in the use of alloplastic implants, autologous fat transfers, and injectable dermal fillers; these nonsurgical treatments are now an integral part of many plastic surgical practices.

The treatment of well-established rhytids, creases, and textural changes of the skin is altogether another matter. Surgeons are sometimes intimidated by this aspect of our specialty and tend to surrender their patients to aestheticians or use nonablative superficial techniques that are minimally invasive but may also be minimally effective. An all too common tactic is to simply ignore the problem. In doing so, surgeons are missing the opportunity to provide patients with a more complete rejuvenation and improve fundamental aspects of aging, such as the quality of the skin. Perioral rhytids can be more troubling to a patient than jowls or loose skin, and the very best face-lift results can be marred by deep creases around the mouth or forehead. The reality is that there must be a wounding into the dermis to improve deep wrinkles and etching of the skin, and at present this requires a more prolonged recovery period than that experienced after injectables are used. The goal is to find the best, most cost-effective approach that yields a result significant enough to warrant the recovery period and inconvenience to the patient.

Chemical peels represent an effective method for skin resurfacing to treat rhytids and other skin problems. Today physicians have a number of effective chemical peel options from which to choose; these offer the dermal wounding that is needed, with less morbidity and fewer adverse effects than with the agents that were available previously. Physicians can now plan the depth of peel depending on the patient's skin type, age, or clinical need. By choosing the appropriate resurfacing agent, solution concentration, and peel application, the surgeon can have precise control, thereby achieving treatment goals and avoiding possible problems with hypopigmentation.

Evolution of Treatment

Chemical peels were introduced to the United States in the early part of the twentieth century not by doctors, but by lay operators. The origin of the formulas used by these flamboyant individuals is unknown, but what is clear is that they involved the ingredients phenol and croton oil and that the clinical results were quite good. The early history of chemical peels has been elegantly chronicled by Gregory Hetter, and tracing this history is important to understanding and appreciating where we are today.

These early “lay peelers” used cumbersome “secret” formulas that involved dissolving phenol crystals and drops of the caustic croton oil. Over the years, as these individuals gained notoriety, the response of the medical community was to fight them rather than to learn from them. Eventually plastic surgeons took note, and finally Thomas Baker published a formula in 1961 that was easily reproduced by anyone. The ingredients were simple, and it was presumed that phenol was the peeling agent. In 1962 Dr. Baker altered the volumes of the formula for convenience, while keeping the 3 drops of croton oil unchanged. This effectively elevated the croton oil concentration to 2.1%, and thus he inadvertently altered the history of chemical peeling. This formula was very successful in improving severe wrinkles but also had the significant drawback of causing predictable and severe hypopigmentation. The peel gave dramatic results, but patients developed an unnatural porcelain or alabaster look that required them to permanently wear makeup. For older patients with pronounced wrinkling and light skin color this was a reasonable trade-off, but the peel was not done on younger patients or on darker skin. The peel was considered difficult to perform, and phenol developed the reputation of having an “all-or-none” phenomenon that was out of the surgeon’s control. The presumption was that phenol denatured the skin and created a barrier that prevented deeper penetration; a weaker concentration was thought to be dangerous, because it would peel deeper. It took a great deal of faith and courage to paint the solution on and hope for the best as the face densely frosted. Phenol also had the reputation of being cardiotoxic, requiring a deliberately slow application with strict cardiac monitoring. These beliefs became dogma, no matter how unsubstantiated, and were passed on from generation to generation of plastic surgeons. To this day, these presumptions are still mentioned in professional publications, and “phenol peels” have a negative connotation in lay books on cosmetic surgery. Although the results were quite remarkable, the factors discussed and the long and difficult recovery prevented this peel from gaining widespread acceptance.

The next development in chemical skin resurfacing was the popularization of trichloroacetic acid (TCA) peels by dermatologist Zein Obagi. TCA peels had been around for some time, but Obagi and Johnson’s work in the 1990s brought them to the attention of plastic surgeons. They popularized the concept of skin pretreatment,

as well as documenting and controlling the depth of TCA penetration. Obagi's role was controversial at the outset because of unseemly commercialization with "secret formulas" and very expensive training programs, but his book, *Obagi Skin Health Restoration and Rejuvenation*, remains an important contribution, especially for plastic surgeons less familiar with peels and skin anatomy and physiology.

TCA peels were an important addition in that Obagi showed histologically that different concentrations varied the depth of the peel and that the application technique was a major determinant of the depth reached. Lighter to medium peels were possible with a concentration of up to 25%, and medium to deeper peels occurred with 35% and 50% concentration for more pronounced rhytids. TCA therefore largely overtook phenol as the peeling agent of choice, because of the ability to control the depth of penetration and tailor the peel to the patient's skin type. Although higher concentrations engendered more serious complications, namely scarring, TCA peels at light- and medium-depth concentrations are viable and popular options when chemical peels are considered for facial resurfacing.

Another significant advance in peel resurfacing was introduced by Gregory Hetter in Las Vegas, Nevada. Interestingly, Nevada was a state in which aestheticians could perform weak phenol peels, and Hetter treated multiple patients who had had such peels. These patients had not achieved significant improvement, but more important, had not had any ill effects from the weaker phenol concentrations, directly contradicting what had been believed and taught about phenol peels for decades.

With this in mind, Hetter diluted the Baker formula in half and successfully performed peels on patients without the hypopigmentation that had attended the older peels. Clearly something different was at play, and Hetter devised a series of experiments to explain this phenomenon. Hetter performed peels on a series of patients with different combinations of ingredients of the Baker formula; he noted that phenol alone had scant effect and that adding croton oil to phenol at different concentrations led to deeper peels that were proportional to the concentration of the croton oil. An analysis of the classic Baker formula revealed that the concentration of croton oil was quite high at 2.1%, which was responsible for the results as well as the familiar drawbacks. Having convincingly shown that croton oil was the critical peeling agent, Hetter was free to alter the concentration of the ingredients as desired. He lowered the concentration of phenol and varied the concentration of croton oil, and in so doing, Hetter ushered in a new era in chemical peeling. The new formulas had the advantage of being clinically effective, similar to the classic Baker peel, without the troublesome complication of hypopigmentation. Having the freedom to alter the croton oil concentration as needed is a major advance that allows the peel to be performed superficially or deep, depending on the circumstance. This versatility makes the peel applicable to patients of all ages and skin types.

Having the ability to alter the croton oil concentrations has further ramifications. It is now possible to use croton oil concentrations weak enough so that the application technique becomes one of the important factors in determining the depth reached. The entire process is slowed down so that the surgeon can observe the skin changes and have the opportunity to stop at whatever depth is deemed appropriate. The all-or-none phenomenon seen with the Baker peel was simply that the croton oil concentration was so high that it immediately resulted in dense frosting. This consistently resulted in a peel deep enough to cause hypopigmentation.

Current peeling agents provide physicians with increased flexibility when treating wrinkles, creases, and skin pigmentation problems. It is now possible to use chemical peels to achieve the desired clinical results without reaching a depth that causes hypopigmentation. Another critical difference is that the surgeon can choose different concentrations on different areas of the face, depending on relative skin thickness. Many practitioners of the traditional peel were reluctant to apply a peel to the eyelids because of the fear of scarring, but now with the choice of a weak concentration of peeling solution, the delicate eyelid skin can be effectively improved with safety and predictability.

Pharmacology of Chemical Peeling Agents

Jessner's Solution

Jessner's solution is a standardized mixture of lactic acid, salicylic acid, and resorcinol (14% each) compounded in 95% ethanol. Alone, it causes a superficial epidermal peel. It may be an option for superficial peeling as an adjunctive treatment for acne. It can also be used as a pretreatment before a TCA peel, to enhance penetration of the TCA solution. It should be noted that salicylate toxicity (known as *salicylism*) can cause tinnitus, nausea, and headaches.

Trichloroacetic Acid

TCA (also known as trichloroethanoic acid; CCl_3COOH) is an analog of acetic acid in which the three hydrogen atoms of the methyl group have been replaced by chlorine atoms. TCA acts to dissolve keratin and coagulate surface proteins. This produces a frost as the salts precipitate. It is neutralized by contact with tissue fluids or topically applied saline solution for surface TCA. Lower concentrations (10% to 30% solutions) will produce a superficial epidermal peel. Higher concentrations (35% to 50%) penetrate into the superficial dermis, creating a medium-depth peel. Concentrations above 50% produce a deep peel, which is usually avoided, because this can result in scarring.

Phenol

Phenol, also known as *carbolic acid* or *hydroxybenzene* (C₆H₅OH), is an aromatic hydrocarbon derived from coal tar. The stock pharmacologic solution of phenol is known as *liquefied phenol USP*. This contains 88% phenol, which is the highest concentration that will stay in solution at room temperature; 100% phenol is a crystalline material at room temperature. Similar to TCA, phenol causes protein coagulation and produces a skin frost almost immediately. Liquefied phenol USP penetrates into the upper reticular dermis, causing a medium-depth peel. The Baker’s mixture is the most commonly used and reproducible formula; it is approximately a 50% (w/v) solution. Notably, less-concentrated solutions such as Baker’s mixture penetrate more deeply than higher concentrations, presumably because the more dilute mixture causes less keratocoagulation and more keratolysis, therefore permitting deeper penetration of the phenol.

Baker’s Phenol Mixture	
Liquefied phenol USP 88%	3 cc
Distilled or tap water	2 cc
Croton oil	3 drops
Septisol soap	8 drops

These ingredients do not combine easily. The liquid soap (Septisol) acts to saponify the solution. The solution must be stirred vigorously before application to ensure even mixture of the components.

Croton Oil

Croton oil is an extract of the seed of the plant *Croton tiglium*. Croton oil is the source of the organic compound phorbol. Internally, it is a purgative that causes severe diarrhea. Its action on the skin is related to free hydroxyl groups. It produces a caustic, exfoliating effect on the skin, even in low doses. As mentioned earlier, Hetter showed that croton oil was the essential peeling ingredient in the Baker’s mixture. Altering the concentration of croton oil directly alters the depth of the peel. Commonly used concentrations range from 0.1% to 0.8% croton oil solutions.

Indications and Contraindications

As with all aspects of plastic surgery, patient selection for chemical peels is vital to ensure consistent, reliable outcomes. Chemical peeling agents are ideal for treating wrinkled skin or skin with blotchy, irregular pigmentation. There is also some evidence to show that peeling the skin of patients with dysplastic epithelium or actinic keratoses may reduce or prevent the development of skin malignancy. The patient must understand that there is a difference between chemical resurfacing and face lifting. The chemical peel will improve rhytids and pigmentary changes but does not treat the gravitational and volumetric effects of aging.

Patient evaluation requires accurate assessment of skin color and type, skin thickness, and the amount of skin damage (such as rhytids, actinic damage, and pigmentary changes). Thicker, more sebaceous skin can tolerate deeper peeling than thin skin can. However, peeling is not a good treatment for large pores; pore size is rarely reduced by the peeling process, and in fact, large pores can become more noticeable and may seem larger after the peel.

Traditionally, the ideal patient has been considered to be one with thin to moderate skin, a fair complexion, blue eyes, fine to moderate rhytids, and actinically damaged skin. However, recent experience and increased knowledge have led to the understanding that chemical peels can be safely used in a broader spectrum of patients. Still, not everyone is a suitable candidate. All patients must be fully informed of the risks of hyperpigmentation and hypopigmentation, as well as the possibility of a line of demarcation at the margin of the peel. As usual with all plastic surgery, a thorough history, physical examination, and pertinent investigations should be performed before the procedure. These include a complete blood cell count, an electrolyte assay, urinalysis, and a blood urea nitrogen test for renal function.

Fitzpatrick Classification of Skin Type

The Fitzpatrick classification system can be a useful guide for evaluating a patient's skin type and response to sun exposure. Generally speaking, patients who burn and do not tan (type I) have a lower incidence of postpeel hyperpigmentation and are more prone to hypopigmentation. Conversely, patients with higher skin types (types V and VI) are more likely to develop postpeel hyperpigmentation. Fitzpatrick types III and IV tan easily; this implies that melanocyte proliferation (known as *rebound*) may occur after peeling. This tendency must be controlled with a prepeel skin care regimen. Therefore the greater the skin pigmentation, the longer and more intense the skin pretreatment regimen must be to control this rebound phenomenon.

Fitzpatrick Classification of Skin Type

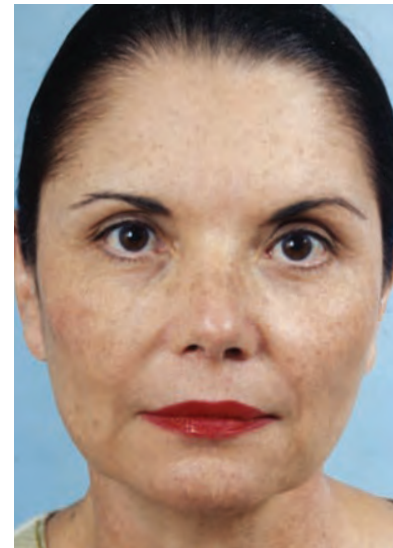
Type	Color	Tanning Response
I	White	Always burns, never tans
II	White	Usually burns, tans less than average
III	White	Sometimes burns mildly, tans about average
IV	Brown	Rarely burns, tans more than average and with ease
V	Dark brown	Very rarely burns, tans very easily
VI	Black	Never burns, tans very easily



Skin type I



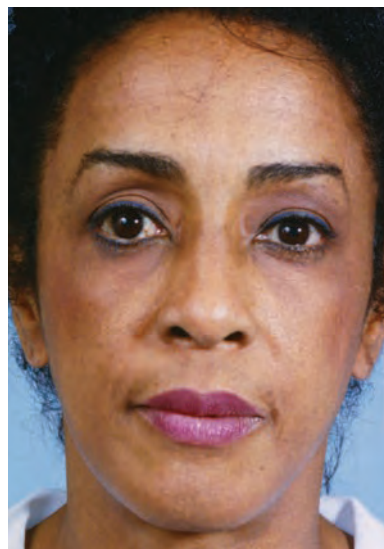
Skin type II



Skin type III



Skin type IV



Skin type V



Skin type VI

Glogau Classification of Photoaging

Glogau developed a classification system for photodamage based on the degree of skin wrinkling. This scale is commonly used to help determine skin type and thus treatment options.

Glogau Classification of Photoaging				
Group	Classification	Typical Age	Description	Skin Characteristics
I	Mild	28-35	No wrinkles	Early photoaging: mild pigment changes, no keratosis, minimal wrinkles; minimal or no makeup
II	Moderate	35-50	Wrinkles in motion	Early to moderate photoaging: early brown spots visible, keratosis palpable but not visible, parallel smile lines begin to appear; wears some foundation makeup
III	Advanced	50-65	Wrinkles at rest	Advanced photoaging: obvious discolorations, visible capillaries (telangiectasias), visible keratosis; always wears heavier foundation makeup
IV	Severe	60-75	Only wrinkles	Severe photoaging: yellow-gray skin color, prior skin malignancies, wrinkles throughout, no normal skin; cannot wear makeup because it cakes and cracks

Patients in Glogau II with moderate aging and pigment spots can be treated with a medium-depth peel. Medium-depth peels penetrate the papillary dermis and is effective for fine facial rhytids and pigmentary problems. Patients with Glogau III and IV skin have deeper rhytids and therefore require deeper peeling agents for effective results. Deep resurfacing agents such as phenol/croton oil may be more appropriate for these patients. Deep resurfacing is effective for fine and coarse rhytids, hyperpigmentation and epidermal dysplasia.

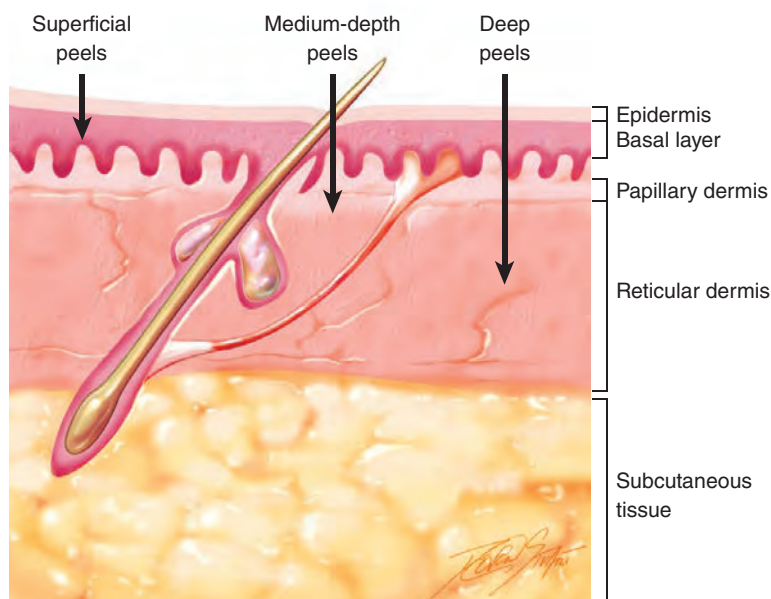
As discussed earlier, patients with darker skin types are less suitable for resurfacing. Other relative contraindications include a history of keloid scarring, cardiac abnormalities, and diabetes mellitus (unless the disease is well controlled and stable). Significant medical comorbidities such as hepatorenal disease or immunosuppression are contraindications to chemical peeling, as are abnormalities of collagen or elastin, such as Ehlers-Danlos syndrome, scleroderma, or collagen vascular diseases. As with

any plastic surgery, emotional or mental instability is a contraindication to chemical peeling. Peeling should be postponed until at least 1 year and perhaps longer after any treatment with oral isotretinoin (Roaccutane; Accutane) because of the increased risk of unpredictable scarring and keloid scar formation.

Pertinent Anatomy

Patients who request a chemical peel are commonly middle-aged and older women with aged or sun-damaged skin. Chronologic aging results from thinning of the epidermis and dermis along with loss of elasticity. Actinic changes are the photochemical effects of solar radiation damage. These changes manifest histologically as degeneration of the elastic network (elastosis), disorderly arrangement of the epidermis and collagen fibers, and flattening of the dermal-epidermal junction with loss of the rete ridges; thus the resulting dermis is more lax and less elastic. Melanocytes tend to increase in number but are less evenly distributed in the basal layer and contain variable amounts of melanin. Clinically, chronological and photoaging results in coarse, dry skin that shows wrinkles and tissue sagging.

Depth of Peeling



The comparative depth of penetration of peeling agents can be seen above. In superficial peels, the wounding extends to the stratum granulosum. Superficial peels therefore affect the epidermis only. Medium-depth peels extend into the papillary dermis, and deep peels extend into the mid-reticular dermis.

Histologic Changes With Chemical Peels

Biopsies taken 2 days after a Baker peel have shown necrosis of the epidermis. Depending on the depth of the peel, this necrosis can extend through the papillary dermis. There is a marked inflammatory response. A medium-depth peel, injuring the epidermis and papillary dermis, improves actinically damaged epidermis as well as producing neocollagen formation in the upper dermis. The wounded surface starts to reepithelialize from the follicular and eccrine duct epithelium. While the epidermis usually regenerates within 7 days, dermal regeneration is slower. New collagen formation begins within two weeks and may continue for up to a year. Obagi compared biopsies from 48 hours post-TCA peel with similar biopsies taken 6 weeks after a peel and found that medium-depth peels show a clearly defined new layer of fibrillar collagen and delicate elastic fibers in the upper reticular dermis. Deep peels showed that the neodermis formed almost the full thickness of the reticular layer. Therefore deeper peeling modalities produce a greater degree of neocollagen formation, which is spread deeper into the dermis. The neodermis shows horizontal, thin, compact bundles of collagen and a dense network of fine, elastic fibers. Melanocytes show fine, even distribution of melanin granules. However, melanin synthesis is impaired, and this can result in a generalized bleaching effect.

Prepeel Preparation

Regardless of the chemical peel to be used, adequate preparation of the patient is an important factor contributing to the success of the treatment. The patient must be motivated and understand the recovery period required. The reward is a dramatic long-term improvement in skin texture that is not easily replicated by any other modality. However, to achieve this, the patient must be prepared for the postpeel morbidity. The immediate postpeel phase, although not particularly long, can be trying for the patient; therefore it must be described realistically and in considerable detail. Detailed photographs of a representative patient's day-by-day recovery are shown to the patient and, if possible, to the patient's caregiver. Some patients will not tolerate the postpeel morbidity associated with medium to deep chemical peels. These patients can be treated with superficial peels, but they must understand that the clinical improvement will be less dramatic, and regular treatments may be required. Patients with coarse rhytids requiring deep resurfacing can gain a dramatic improvement but must be prepared for the significant postpeel recovery. It is worthwhile to have a prospective patient speak or, ideally, meet with patients who have had a similar peel. Seeing someone in person who has successfully gone through the process offers invaluable encouragement that although the recovery is difficult, it will be well worth it. The peel is well tolerated and the experience will be a positive one if the patient is well informed and the physician sets the proper tone.

Preparation of the skin before the peel is a means of preventing such complications as pigmentary changes. This is done by applying aggressive doses of tretinoin and hydroquinone 4%, as described below. Some companies offer a complete “set” of required products and a protocol for their use, such as the complete Obagi Nu-Derm system (Skin Specialists PC, Omaha, NE), which may be of value to practitioners. With an appropriate pretreatment regimen, the epidermis is stabilized, the dermis is stimulated to create more collagen, and the melanocytes are suppressed. The purpose is to regulate cell function and reduce the risk of postoperative pigment change. The skin is in essence “revved up” for the injury to come.

Preparation begins at least 2 weeks (ideally, 4 to 6 weeks) before the peel with applications of tretinoin 0.1%. Also known as Retin-A or Renova, this product is an acid form in vitamin A. It acts to decrease the cohesiveness of epidermal cells, which results in thinning of the stratum corneum. One inch (1 g) should be applied to the whole face once per day. The application should include the earlobes, tragus, and hairline, continue to 1 inch below the mandibular border, and up to 1 to 2 mm below the ciliary edge. The upper lids must be avoided, because application on this tissue could lead to irritation. The neck can be prepared in a similar fashion, less frequently, depending on whether irritation develops.

Hydroquinone 4% or other bleaching creams are used both preoperatively and postoperatively to reduce the risk of hyperpigmentation. Hydroquinone decreases melanin formation by inhibiting tyrosinase in melanocytes. Therefore it produces a reversible suppression and regulation of melanocytes. It is used for 2 weeks preoperatively (again, the ideal is 4 to 6 weeks), then again after the peel once the skin has resurfaced. Also, to prevent postinflammatory hyperpigmentation, glycolic acid 8% or phytic acid 2% is applied once daily to loosen desquamated cells in the stratum corneum and help accelerate exfoliation.

This process accelerates cellular turnover and results in erythematous, flaky skin; the patient must be prepared to accept this phase. Retinoid dermatitis is also common preoperatively. This can be lessened by decreasing the application of tretinoin to every other day for the first 1 to 2 weeks. The preparation should be stopped 4 or 5 days before the peel to allow the epidermis to settle.

The patient is instructed not to apply anything on the skin on the morning of the procedure.

This skin preparation regimen is certainly a nuisance, and there is controversy as to its absolute necessity. There are practitioners who successfully perform peels or laser resurfacing without it; greater experience and specific studies will be required before consensus is reached. Our experience has been that omitting or shortening the preparation has led to excessively long erythema.

Pretreatment Planning

Medications

Antiviral prophylaxis is routinely prescribed to all patients, regardless of whether they have a history of oral herpes. Valacyclovir hydrochloride 500 mg, 1 tablet two times a day, or the equivalent dose of acyclovir or famciclovir, is begun 3 days before the procedure and continued for 7 days after the peel. Although the postpeel phase is not particularly painful, narcotic pain medication is prescribed along with ibuprofen 800 mg 3 times daily. Steroids are administered intraoperatively, followed by a Medrol Dosepak begun the day after the peel. Sleep medication is prescribed and a mild sedative may be considered to help the patient cope with the inconvenience and isolation of the recovery period.

Solution Preparation

TCA

These solutions are generally prepared by a compounding pharmacist using appropriate weight-to-volume calculations (w/v) to achieve the correct percentages. As an example, a 35% TCA solution should be compounded by dissolving 35 g of anhydrous TCA crystals in a little distilled water, then more water should be added to bring the final volume to 100 ml. Dissolving 35 g TCA in 100 ml of distilled water is incorrect, as this will result in a more dilute solution than expected. The required variety of concentrations should be compounded by the pharmacist and not diluted from each other by the surgeon. If stored in acid-resistant plastic bottles, the stock solutions are stable for at least 2 years. Small volumes of each concentration can be poured from the stock bottles as required.

Using the correct concentration of TCA solution is vitally important. If the physician does not know a reliable compounding pharmacist, a national distributor can be used to ensure that the TCA mixture has been accurately prepared.

Croton Oil

Preparation of the acid peeling solutions is a critical step that ideally should be performed by the operating surgeon to ensure accuracy and consistency. The ingredients, including water, phenol, croton oil, and Septisol, are the same as in the classic Baker peel formula. They are inexpensive and can be obtained from compounding pharmacies or from Delasco (Council Bluffs, IA), a dermatologic supply company.

Traditional formulations used drops of croton oil which can be awkward to deal with and have the potential of dangerous variability especially when dealing with small volumes. The process is simplified significantly by delivering the croton oil in a

standardized stock solution consisting of USP phenol 88% 24 ml and croton oil 1 ml. This solution yields a reliably accurate concentration of 0.04 ml croton oil to 1 ml stock solution. This increased volume of ingredients allows easy measurement with standard syringes. As can be seen in the table below, the volumes of water and Septisol remain constant, and by varying the relative volumes of phenol and stock solution, different concentrations of croton oil are possible. As an example, to make a 0.8% croton oil solution, one would mix water 5.5 ml, Septisol 0.5 ml, and add USP phenol 88% 2 ml and stock solution 2 ml. The 2 ml of stock solution contains croton oil 0.08 ml. Because the total volume of the solution is 10 ml, the final concentration is 0.08 ml of croton oil in 10 ml total volume, or 0.8%. Weaker solutions such as 0.1% and 0.05% are very useful; to make these, one first makes 0.4% and 0.2% and these are further diluted, as noted in the table. The final concentration of phenol in all these formulas is 35% by volume. If a greater concentration of phenol is desired, the relative volume of the USP phenol 88% is increased and the volume of the water is decreased. *The stock solution, at 4% croton oil, should always be diluted—never applied full strength.*

Hetter Peel Formulas With a 35% Phenol Vehicle				
	Croton Oil			
	0.2%	0.4%	0.8%	1.2%
Water	5.5 ml	5.5 ml	5.5 ml	5.5 ml
Septisol	0.5 ml	0.5 ml	0.5 ml	0.5 ml
USP phenol 88%	3.5 ml	3.0 ml	2.0 ml	1.0 ml
Stock solution containing phenol and croton oil (see below)	0.5 ml	1.0 ml	2.0 ml	3.0 ml
TOTAL	10 ml	10 ml	10 ml	10 ml

0.1% = 1 ml of 0.4% + 1.2 ml phenol + 1.8 ml water.
0.05% = 1 ml of 0.2% + 1.2 ml phenol + 1.8 ml water.
Stock solution = 24 ml phenol + 1 ml croton oil (0.04 ml croton oil/1 ml stock solution or 4% croton oil).

A useful variation is to add olive oil to the solution to allow a smoother, more even application. For example, to make a 15% olive oil solution from the 10 ml formulas, one would include 1.5 ml of olive oil and decrease the water volume to 4 ml. In the weaker 4 ml total volume formulas, 0.6 ml of olive oil would be added and the water volume decreased to 1.2 ml.

Pretreatment Routine

Application of the peel is painful; therefore intravenous sedation or general anesthesia is usually necessary. Regardless, adequate blocking of pain is important to prevent excessive stimulation and allow the patient a pain-free emergence from anesthesia and a comfortable initial postpeel course. If the initial pain cycle is avoided, the entire recovery and general experience will be better. Some patients report mild tingling or burning on the first night, but they are usually pain free the following morning.

After sedation or general anesthesia, complete local sensory facial nerve blocks are performed with bupivacaine (Marcaine) with epinephrine. These include supraorbital, supratrochlear, infratrochlear, zygomaticotemporal, zygomaticofacial, infraorbital, dorsonasal, mental, and cervical nerve branches. Subcutaneous infiltration of dilute plain bupivacaine throughout the entire operative site is very useful. Color changes of the skin are important indicators of the depth reached; therefore epinephrine is not used in the superficial infiltration to prevent blanching. Intramuscular ketorolac tromethamine (Toradol) is administered as an adjunct to anesthesia if a concomitant operative procedure is not being performed. Steroidal agents are given intraoperatively, and a Medrol Dosepak is begun the next day.

Ophthalmic ointment and corneal protectors can be used during a peel to protect the eyes, but even when they are used, extreme caution around the eyes is imperative. If excessive ointment is used, any spilled or misplaced chemical may dissolve in the ointment and prevent immediate flushing out if it becomes necessary. Alternative measures include avoiding the use of ophthalmic ointment altogether or suturing the eyes shut.

The fear of cardiac toxicity has been historically associated with phenol peels, but rare reports of death are anecdotal, and it is impossible to implicate phenol toxicity rather than complications related to anesthesia. The occurrence of arrhythmias during peeling is well documented, and although rare, these are not clinically significant. Historically, traditional peels were performed with anesthesia or sedation but without local blocks. There is speculation that the catecholamine release from the intense stimulation caused by the high concentration of croton oil may have been the cause of the arrhythmias. With a lower concentration of phenol (35% versus 49%), a lower concentration of croton oil, and thorough local anesthesia of the face, cardiac complications have not been seen. Thomas Baker, who popularized the traditional peel, has stated that in his vast experience he has never encountered cardiac arrhythmias that required treatment. General recommendations include cardiac monitoring, adequate hydration, and peeling a full face in no less than 45 minutes. Following these precautions, we have encountered no cardiac complications in nearly 10 years of peel procedures.

TREATMENT

Application Routine

With the patient sedated and the nerves of the face well blocked, the skin is thoroughly cleaned and degreased with acetone or alcohol. This step is vital to allow even penetration of the peeling agent; a splotchy peel can occur as a result of uneven penetration if the skin still has residual oil or stratum corneum. Thereafter, the application process should be an orderly and nonintimidating one. The reason for this is that practitioners can choose an adequately weak concentration to slow down the process, depending on their preference and experience, to give ample time to judge the depth achieved. Furthermore, there are a number of factors at the surgeon's disposal (see below) that can be used to fine-tune the control of the application. In general, the different concentrations of solutions are placed in separate, easily identifiable bowls or cups. Materials for application are 2×2 gauze (preferably synthetic fiber, which is less abrasive) and cotton-tipped applicators.



Eyewash solution should also be kept in reach, in case an ophthalmic washout is required. For application, the gauze is folded twice, dipped into the solution, and carefully wrung out to avoid dripping. The solution is stirred before each application to ensure even mixing of the ingredients. An assistant helps dry the applying hand to prevent inadvertent application where it is not wanted. Consistent vigilance in this respect is imperative, especially in segmental peels, where errors will be obvious.

TCA Peel

Epidermal peels are performed with a 20% TCA solution, whereas medium-depth peels can be performed with more-concentrated solutions. We generally use a 30% to 35% solution for medium-depth peeling. Deeper peels are produced with 40% to 45% solutions. Concentrations higher than 50% are best avoided; at this high concentration, penetration into the dermis occurs rapidly and can be difficult to control.

The wet (not dripping) gauze sponge is used to apply the TCA solution in turn to each region to be treated. If the patient is awake, holding a fan close to the peeled area can help decrease the associated burning sensation. As the skin is treated, it develops a whitened color, known as a *frost*. There is a delay between the application of the solution and formation of the frost. In appropriately pretreated skin, the delay is approximately 60 seconds (45 to 120 seconds on average). Therefore, after each pass with the gauze, the physician should pause to observe the frosting before further application to the area. This process requires patience on the part of the physician but is essential to prevent undesirably deep peeling. Each region of the face is treated in turn until the desired depth of frosting is achieved, then attention is turned to the next region. We prefer to peel regions that require deeper penetration first (for example, the perioral region and the forehead) and regions to be peeled less deeply (such as the periorbital area) last.

Once the desired depth of peel has been achieved, ice-cold saline-soaked gauzes are placed on the peeled region. This relieves the burning sensation for the patient and helps to neutralize any remaining TCA solution on the skin surface to prevent further penetration. The gauzes warm up quickly and should be replaced or refreshed regularly with ice-cold saline solution. Removing the gauzes also allows the physician to assess the resolution of the frosting. Erythema appears after the frosting resolves, when serum in the tissue and vessels neutralizes the TCA and the coagulated proteins resolve. The time taken for the frosting to resolve and erythema to occur is directly related to the depth of the peel: frosting resolves more quickly with superficial peels than with deep peels. According to Obagi, superficial epidermal peels will resolve in less than 20 minutes. The frosting in medium-depth (papillary dermal) peels lasts up to 40 minutes. Deeper peels into the reticular dermis take longer to resolve, with frosting persisting for up to 60 minutes.

Factors That Influence the Depth of a TCA Peel

Low concentrations of TCA result in a more superficial peel. Higher concentrations peel more deeply. Peel depth is also related to the amount of acid and the preparation of the skin. Therefore depth can also be increased by applying more layers of

solution or by pretreating the skin with either Jessner’s solution or mechanical abrasion (for example, with a gauze sponge). This becomes particularly important if the patient has not completed the routine prepeel skin preparation regimen.

Assessing the Depth of a TCA Peel

Obagi has noted that the ability of the body to defend against the acid depends on the concentration and volume of acid applied, as well as on the thickness of the skin. Frost (or skin whitening) occurs as the skin proteins precipitate on application of TCA. The speed at which the frost develops varies with the concentration of the TCA used: dilute concentrations take 15 to 60 seconds to produce a frost, whereas higher concentrations may frost in less than 10 seconds. The precipitated protein disperses with time and therefore the frost disappears. Frosting of the skin is a helpful clinical sign to aid the surgeon in deciding when to end the peeling process, as the amount of frosting is related to the depth of the peel. Obagi grades frosting as level 1 through 3, as shown in the table.

Obagi Level of Frosting	
Obagi Level of Frosting	Clinical Relevance
1	Limited to the epidermal layer; a nonorganized, foggy or cloudy white frost on a pink (erythematous) background
2	Penetration to the papillary dermis; a regular, white-coated frosting with erythema still showing through
3	Penetration through the papillary dermis; a solid, intense white to yellow frosting, with no background erythema

In level 1, the peel penetrates the epidermal layer only and results in a combined pink and white frost that is disorganized or “cloudy.” Penetration into the papillary dermis produces a level 2 frost, which is a more uniform white frost, but with erythema still showing through. Penetration of the peel into the reticular dermis produces a solid white frost with no visible erythema; this is level 3. Deeper dermal penetration of the peel is undesirable; this produces skin with a grayish appearance and is associated with long-term scarring.



This patient is shown partway through the peeling process; she has also undergone an upper blepharoplasty followed by a full facial chemical peel with 30% TCA. Note the level 2 frosting of the forehead with visible erythema in the base, compared with dense level 3 frosting of the perioral region, where no erythema can be seen (*left*). At the end of the peeling process, there is level 1 irregular frosting of the nasal tip, regular level 2 frosting of the forehead, cheeks, and mental area, and level 3 frosting of the perioral regions (*right*).

Obagi also suggested the *epidermal sliding sign* to show when a TCA peel has penetrated the papillary dermis. At this level, the epidermis can slide over the firmer, immobile dermis, since the rete ridges have been disrupted. Skin firmness (turgor) can also be palpated. Untreated skin is soft to the touch, whereas a deeper peel results in firmer dermis caused by an increased amount of protein precipitation.

Recommendations for TCA Peels

The following are general recommendations of TCA concentrations in specific areas, but it is important to consider individual variations and to remember that concentration choice is only one factor influencing the depth of penetration of the peel. Regardless of concentration, it is imperative to always judge the depth of the peel as described in the previous section.

The whole face can be peeled with the same concentration of TCA, with depth varied by increasing the number of layers of solution applied, or by using varied concentrations of solution. In general, the author prefers to use a single concentration of solution, usually 30% to 35% TCA, to peel the entire face.

In general, the deepest peel should be performed in the perioral region. This is followed by the forehead and cheeks, with the lightest peels performed on the eyelids and earlobes. The perioral region has deeper rhytids and is peeled until a level 3 dense white frost is achieved.

Application

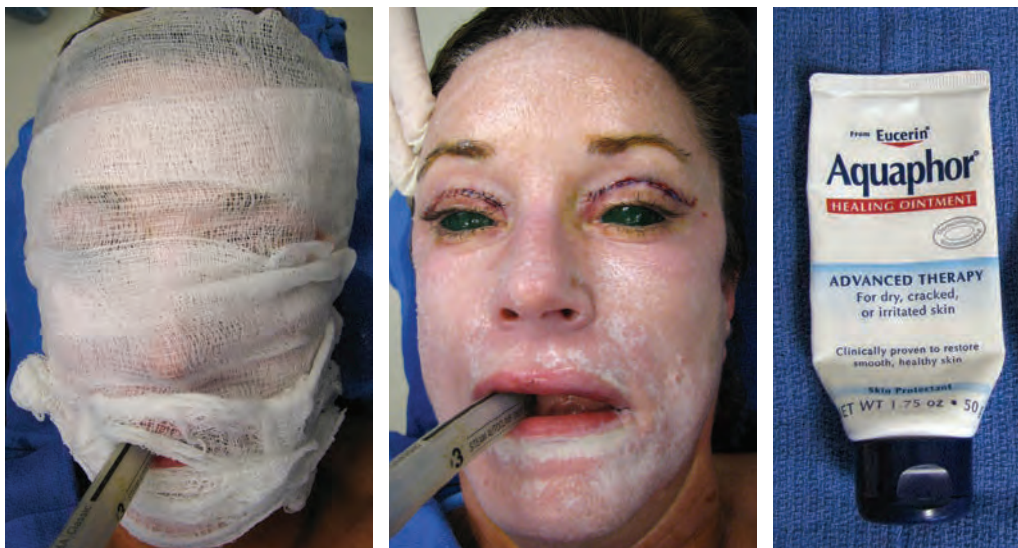


The 30% TCA is applied to the perioral region with a cotton-tipped applicator; this ensures accurate application of the solution into the perioral rhytids. The forehead and cheeks generally require a medium-depth peel, depending on the patient. Penetration into the papillary dermis is ideal; therefore frosting is carried to level 2. The solution is usually applied with gauze 2×2 squares to cover a large area evenly.



The solution is applied to the nose with a 2×2 gauze square on the dorsum and sidewalls, and cotton-tipped applicators are used to ensure penetration into the alar grooves. Because the eyelids have thin skin, the solution is carefully applied to this area with a cotton-tipped applicator. This is usually the last area of the face to which the solution is applied.

If the neck or décolleté region is to be treated, a lower concentration of TCA (such as 20%) should be used. This is because the skin in this area has fewer adnexal structures; therefore reepithelialization can be delayed with deeper peels. If the neck is not to be treated, the facial peel should be blended or feathered just below the mandibular angle by applying solution to this area very lightly.



After the peel is applied to the desired depth, iced saline-soaked gauze is placed across the patient's face to cool and relieve the burning. This is changed regularly to ensure the gauze stays cold and that the physician can review the resolution process. Once the frost starts to resolve, a thin layer of petrolatum-based occlusive ointment is applied across the peeled surface, and the patient is transferred to the recovery suite. Complete resolution of the frosting depends on the depth of the peel. The patient should be checked in the recovery suite, and the physician should note how long the resolution process takes. This is a good indication of the depth of the peel and aids the physician in developing judgment in the art of peeling.



The patient is shown 30 minutes after the peel, with resolution of the frosting.

Croton Oil Peel

Application



15-1 Croton oil peel

With the damp gauze in hand, the physician makes multiple passes, observing the color change of the skin to assess the frost formation. As the application progresses, the depth is gauged by the degree of frosting, which becomes progressively more dense and opaque. The speed at which the frost appears depends on the concentration used and the wetness of the gauze. With the typical concentrations described and use of a damp (not wet) gauze, the appearance of the frost is gradual and is seen in about 10 seconds. Unlike TCA peels, with a croton oil peel there is no need to wait several minutes to see the final depth. Once the acid solution is applied, there is no neutralizing agent and the effect is irreversible. The only recourse in this respect is that if a too-wet application is made, quickly blotting it will diminish the depth.

Factors That Influence the Depth of a Croton Oil Peel

The versatility and safety of the peel are based on the fact that there are a number of variables that determine the depth. Hetter's invaluable contribution was in demonstrating that the concentration of the croton oil is a key factor of the depth reached, and compared with older peels, is the demarcation between an excellent result and hypopigmentation. Regardless of the concentration used, the number of coats applied has an additive effect; therefore a weak concentration applied repeatedly can lead to deep involvement, even scarring. *The safety of a weak concentration is only relative and should never be taken for granted.*

As previously described, the croton oil concentrations are relatively weak, so the other main factor of the depth reached is the application technique, which is directly controlled by the surgeon. This is the fundamental difference between the modern croton oil peel and its predecessors. A damp sponge can be rubbed multiple times, variable pressures can be used, or the gauze can be wetter and fewer passes made. Theoretically, the same depth can be reached by using different techniques or even different concentrations.

The location on the face to which the peel solution is applied is significant because of the relative thickness and recuperative potential of the skin. For example, the perioral skin can sustain a deeper peel than the thinner, more delicate skin of the eyelids.

Assessing the Depth of a Croton Oil Peel

The key to success with these peels, as with any resurfacing technique, is choosing and safely reaching the appropriate endpoint. This depends on the degree of frosting, which is mainly a visual phenomenon, and therefore subjective and based on experience. Regardless of these apparent difficulties, photographs and available videos are very accurate references, and the process is not as daunting as it may initially appear. Anatomically, a superficial peel wounds all the structures of the epidermis. Such a peel may have an effect on pigmentary issues and be “refreshing,” but it cannot be expected to improve real wrinkles. Usually croton oil peels are deeper and affect change beyond the epidermis. A medium-depth peel goes to the papillary dermis. Deep peels go to the reticular dermis (upper to mid-dermis), and peeling to the lower reticular dermis can be problematic, leading to hypopigmentation and possibly scarring. The recovery, of course, is more involved with increased depth, but the harsh reality remains that to provide real change, there must be injury into the dermis.



The visual clues are a thin, transparent frost with a pinkish background denoting a peel to the papillary dermis. The pink hue is caused by the subdermal vascular plexus, still intact, showing through.

A solid, opaque, organized, even frost signifies that the upper to mid-reticular dermis has been reached.



A thick, gray-white sheet of frost with eventual red-brown overtones indicates that the mid-dermis has been reached—as deep as the peel should go. The red-brown overtones may take 15 minutes or more to become evident and are a reliable and accurate sign. Once a dense frost has been achieved, such as in the perioral area, it is worthwhile to wait to see whether the red-brown appears before considering further application.

Practitioners familiar with the different degrees of frosting with deeper TCA peels will have little difficulty transitioning to croton oil peels. *The important concept is that this is a gradual continuum that is slow enough, with the visual changes easily recognizable and predictable. An experienced practitioner can control the process, peeling slowly enough to recognize the various stages and is able to stop at the appropriate depth and go no deeper.*

Another indicator in evaluating the level of peel is epidermal sliding, which is seen when the peel reaches the level of the papillary dermis; the epidermis is separated from the underlying reticular dermis and slides as a thin, independent sheet. This sliding disappears when the reticular dermis is reached and the epidermis and dermis bond together, forming a single protein block. Epidermal sliding is most obvious in thin-skinned areas such as the eyelids and lateral forehead, as opposed to around the mouth. Epidermal sliding is a particularly telling indicator in the very thin eyelid skin, where the margin for error is small.

Defrosting, or loss of the frost, can also be used to assess or confirm the peel depth, although it is already after the fact.

Defrosting Times

Papillary dermis	5-10 min
Upper to mid-dermis	15-20 min
Mid- to lower dermis	20-30 min

Recommendations for Croton Oil Peels

The following are general recommendations for croton oil concentrations in specific areas, but it is important to consider individual variations and to remember that the choice of concentration is only one factor. Regardless of the concentration, it is im-

perative to always judge the depth of the peel, as described in the previous section. The perioral area (including the lower nose) is quite resilient and can be peeled with a strong concentration, such as 0.8%. This is extended beyond the chin onto the mental crease. Individual rhytids are stretched out to allow even penetration. The peel can be extended into the vermillion to improve lip wrinkles and gain beneficial lip eversion. The commissures heal well and can be peeled to a relatively deep level.

General Peel Recommendations*

Location	Croton Oil Concentration
Forehead, temporal area	0.2%-0.4%. The glabellar area can be peeled deeper than the lateral forehead and temporal area. Precise deeper peeling of individual lines is possible with a wetter cotton-tipped applicator and blotting dry as frost appears.
Perioral area (including lower nose)	Precise deeper peeling of individual lip lines is useful.
Cheeks, preauricular area	0.2%-0.4%. Deep peeling is rarely needed.
Eyelids	0.1% lower eyelids; 0.1% upper eyelids. Consider 0.05% in upper lids, especially below the tarsal fold.
Neck	0.1%. This is light peeling for blending of color, not for improvement of wrinkles.

*Predictable problem areas that require careful attention include the temporal area, immediate preauricular area, geniomandibular area, and the medial upper lid where it abuts the nasal skin. These are general recommendations. The key to the peel is to always judge the depth by the visual clues described, whatever technique or concentration is used. There is only relative safety in using a weaker concentration, and similar depths can be reached by the use of different techniques, even different concentrations.



The cheeks and forehead are peeled with 0.4% concentration. The glabellar area and central forehead are relatively thick and can be peeled to the mid-dermis (solid white frost). The lateral forehead and temporal area are more delicate and peeling to the papillary dermis is usually more appropriate (a white frost will appear, with a pinkish background). The peel can be safely extended to the hairline and brows to avoid lines of demarcation. Deep peeling of the cheeks is not often needed. Caution should be exercised in the preauricular area and geniomandibular groove.



The eyelids are peeled with 0.1%, and 0.05% is a consideration for the upper lids. In the lower lids, the peel is extended close to the ciliary margin. The peel is applied with a cotton-tipped applicator, and as in other areas, the relative dampness and number of passes affect the depth of the peel. The thin eyelid skin responds well and in a predictable way to these weak concentrations. Epidermal sliding and an even white frost are easily recognizable and reliable findings that denote the proper depth. If there is obvious redundancy of skin in the upper lid, the peel can be safely extended below the tarsal fold, possibly with a concentration of 0.05%.

The peel is extended onto the neck using 0.1% (or weaker) with light, wispy strokes, because this skin is thin and does not heal as well as the face. The endpoint is a light, scattered frost that is not at all organized. The neck skin is too thin to withstand a peel deep enough to improve wrinkles; doing so will result in hypopigmentation and quite possibly scarring. The purpose of the neck peel is to prevent the obvious demarcation that is commonly seen with laser resurfacing and deeper peels.



Precise deeper peeling of individual rhytids without affecting surrounding areas is a great advantage, especially in the perioral area and chin. This is done with a wetter cotton-tipped applicator, painting the individual line and then quickly drying it as a dense frost appears. This is very useful in troublesome radial lip lines. More precise application, as in the crow's-feet, can be done with the splintered wooden end

of the applicator. Focal repeeling of persistent rhytids is easy to do with the patient under local anesthesia. Repeat peeling either in part or whole has an additive effect. If peeling appears to be uneven or if there is a sharp demarcation between areas peeled with different concentrations, a weak concentration such as 0.2% or 0.1% is used to blend these sections.

The best way to learn these peels is to gain experience, but this must be done safely. Like any difficult procedure worth performing, whether a deep SMAS dissection or a TRAM flap, diligent study and attention to details are required. It is always worthwhile to watch another surgeon perform a peel, but this may be impractical. Good color photographs in publications and available videos are valuable to familiarize oneself with the visual aspects of the frost. One approach is to purposely plan on a lighter peel using a maximum concentration of 0.4% with the thought of performing a repeat peel should it become necessary. Thus the surgeon gains experience mixing and handling the solutions and visualizing the appearance of frost after application. It is never wrong to underpeel, and once this threshold is crossed, it is not difficult to progress to full-fledged peels.

Variation of Chemical Peels

Segmental peels are possible with any resurfacing agent but carry the risk of a mismatch in coloration; therefore good judgment must be exercised. Skin with widespread solar damage carries a risk of demarcation, so a full-face peel is preferable. Segmental perioral peels can be done, peeling to a medium depth at most. The color takes 8 to 10 weeks to blend adequately and the patient can manage color differences in the meantime with makeup.



In selected individuals with isolated upper lip lines, peeling of the mustache area can produce excellent results.

The skin of the lower eyelid responds very well to chemical peeling. When peeled to the appropriate depth, the thin eyelid skin contained within the borders of the orbital rim is very forgiving. Healing is well tolerated and easily camouflaged with makeup or glasses, making this an excellent location for segmental peeling. However, we would add a note of caution when treating this area: very low concentrations of peeling agents should be used. With croton oil peels we limit the concentration to 0.1%, and with TCA we limit the concentration to 20% or a very light pass with 30%.



Considerable improvement was achieved after a segmental peel in this 42-year-old man, whose wrinkled lower eyelid skin was incongruent with his otherwise youthful looks.

A major advantage of the lower eyelid peel is that it can easily be done under local anesthesia and in a gradual fashion. If a patient requests a procedure with a quicker recovery, a lighter peel can be done and repeated in the future with additive effect. In a real sense, the lower eyelid can be peeled to the patient's satisfaction. Treatment of the lower lids is a good option for chemical peeling because of its safety and predictability; it is a good starting point for patients who are reluctant to begin with a full-face peel. Regardless of the technique chosen, the wise surgeon will avoid serious problems by accepting that wrinkles cannot be completely removed with a peel procedure.

A novel use of these procedures is to perform a lighter peel in younger individuals to improve early imperfections while providing an easier recovery. These peels successfully improve early wrinkling and solar damage, restoring a brightness or lucency to the skin that evokes a look of youth. The aim of peels is to keep up with aging; they can be an excellent adjunct to many facial procedures, except surgeries in which major skin flaps are elevated.



This 45-year-old woman exhibited generalized elastosis and etching of the chin. Considerable improvement without loss of pigment is seen at 1 year, and her results remain stable after 6 years. Other than the original Baker peel, no other modality has been able to claim this kind of longevity of results.

Posttreatment Care

Once the peel is completed, the patient is observed until all the frosting subsides. The peeled area is then covered with an occlusive dressing, which acts as a mechanical barrier to enhance the results of the peel. This has been shown to increase the depth of phenol penetration. Previously, a waterproof mask of adhesive tape was commonly used for this purpose. However, this has to be removed usually 48 hours after the peel and is associated with increased patient discomfort, especially during removal. In addition, the physician is unable to view the peeled surface during the coverage period. More commonly today, a petrolatum-based occlusive dressing is used, such as Vaseline or Aquaphor. Alternatively, one tube of Polysporin (Pfizer) and one tube of lidocaine jelly can be mixed together and briskly beaten into an even emulsification. This antibiotic/anesthetic cream can then be applied over all the peeled areas to provide analgesia as well as occlusive coverage. The remainder of the mixture can be placed in a container and given to the patient for use at home.

The purpose of the petrolatum-based dressing is to moisturize the peeled skin to prevent crusting and provide analgesia. An advantage to this approach is that the wound is always in view for evaluation, and it is less painful for the patient. This regimen is inexpensive and effective; with more experience and more practitioners involved, other, better approaches may be developed.

The early phase of the recovery lasts 7 to 10 days as the skin gradually reepithelializes from the deeper layers upward. During this period, the wounded skin is moist and oozes serous fluid. Frequent application of the ointment is necessary to prevent drying and crusting. The patient is strongly admonished not to pick at or dislodge any crusts, because this may cause scarring. The surgeon must also exercise restraint in this respect.

Management of the postpeel phase begins before the peel with adequate information. Patients must fully understand what the experience will be like and how they will look. Showing photographs of the day-by-day recovery is valuable and ensures that the patient will be a willing participant based on accurate information. The early recovery can be challenging, but patients do well if they are well prepared.



Pretreatment

1 day after peel

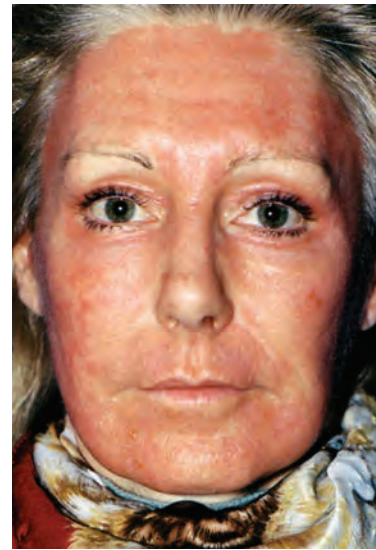
Depending on the depth of the peel, the appearance on the first day can be impressive, and the patient may be almost unrecognizable. This 49-year-old woman had advanced wrinkling, sun damage, and smoker's lines. On day 1 after the peel (with anesthetic/antibiotic ointment applied), there is serous oozing and some blistering along the neck. Despite this appearance, most patients are not uncomfortable.



3 days after peel



5 days after peel



7 days after peel



4 weeks after peel



14 weeks after peel

On days 3 to 5 after the peel, there is resolution of the edema, and gradual reepithelialization is under way. On day 7, epithelialization is complete and marks the beginning of the erythema phase. Makeup may be worn at this time. At 4 weeks after the peel, the erythema is beginning to blend. At 14 weeks, the color has blended naturally without depigmentation. The next phase of the recovery is notable for erythema, which predictably lasts 8 to 12 weeks and is usually well tolerated with camouflage makeup. Intense erythema can be seen with deeper peels and can be improved with judicious short-term use of topical steroids.



Examination of the same patient's pretreatment views and her results 8 months later shows general tightening of the skin and notable improvement of deep wrinkling in the perioral and forehead areas. These photographs, taken with bounce flash, provide a more accurate rendition of her skin texture and demonstrate the generalized improvement particularly evident in the glabellar and periorbital areas.

Problems and Complications

Complications from croton oil peels are the same as with any other deep resurfacing technique. The main complications, scarring and hypopigmentation, are largely preventable by controlling the depth of peel. Delayed healing and thickening is evidence of peeling to the deep reticular dermis. This thickening or mild scarring can progress to a full scar but can be arrested and reversed by injecting triamcinolone acetonide 10 mg/ml and 5-fluorouracil (off-label use) in a ratio of 3:2 or 1:1.

Both hyperpigmentation and hypopigmentation can occur as blotchy areas or homogeneous abnormalities. They are less likely to occur in lighter-skinned patients. Hypopigmentation can occur if the peel penetrates deep enough. Alteration in pigmentation is more common in older patients; it seems to be related to decreased melanocyte synthetic function. For individuals with pronounced rhytids, adequate improvement may necessitate peeling to a depth that will result in hypopigmentation. The improvement is well worth it, and the porcelain look of the skin that was typical of formerly used peels is not seen.

Prevention of hyperpigmentation relies on the pretreatment skin care regimen, which acts to suppress the melanocytes. Transient hyperpigmentation may be seen during the recovery period; this responds well to prompt treatment with tretinoin and hydroquinone 4% over several weeks. Sun protection must be emphasized to the patient as an important factor in prevention of hyperpigmentation.

Infection in peeled skin can be bacterial, viral, or fungal. Bacterial infections tend to develop on postpeel days 2 to 5 and are usually caused by common pathogens such as *Staphylococcus aureus*, streptococci, or *Pseudomonas aeruginosa*. Bacterial infections are heralded by pain, fever, and purulence and are treated with topical wound care and appropriate antibiotics. Herpes simplex virus (HSV), the most common viral infection, is often the result of reactivation of a latent infection. It is usually heralded by dysesthesia or intense pruritus. Notably, as the epithelium is disrupted, the presentation of HSV is atypical, with erythematous erosions rather than vesicles being present. Treatment includes doubling the dose of oral antiviral therapy and adding a topical antiviral agent, which should be applied with a cotton-tipped applicator to prevent spreading the infection. A herpes outbreak can be very impressive but typically does not leave any permanent scars. Fungal infections most commonly occur with *Candida albicans* and present as painful ulcerations. Diagnosis is made with a potassium hydroxide (KOH) smear, and treatment is with oral antifungal agents such as fluconazole.

Hypertrophic scarring is perhaps the most feared complication with chemical peeling and one of the most difficult to treat. It most commonly occurs in areas of thinner skin such as around the lips or skin overlying bony prominences (for example, the malar region or chin). As with poor scarring in general, they often occur in areas where wound healing is delayed beyond 14 days. Treatment is generally nonsurgical, involving the application of steroid creams or topical silicone. If this therapy is ineffective, a course of triamcinolone steroid injections is recommended. However, given the difficulty in effectively treating postpeel scarring, prevention is undoubtedly the best cure through the judicious use of peeling agents, particularly while the physician is learning the techniques of chemical peeling.

Ectropion can result from excessive peeling of the lower lids. As with blepharoplasty, caution should be exercised in patients with lid laxity. Sequential lighter peeling and temporary suspension of the lower lid are helpful in preventing this complication. Mild tension in the lower lids is not uncommon and responds promptly to massage.

Milia are keratin-retaining cysts, which can be seen early or late in the healing process. They occur in up to 20% of patients 6 to 8 weeks after a deep peel. They sometimes respond to an increased intensity of the skin treatment regimen, specifically increased tretinoin. Failing that, gentle excision with a fine needle or electrocautery may be required.

Erythema usually resolves in 10 to 12 weeks after the peel procedure, but prolonged erythema (longer than 12 weeks) can be troublesome for the patient. Some physicians routinely use a steroid cream for the postpeel skin care regimen as a preventive measure. If not used already, steroid should be added into the regimen if erythema seems excessive and extended. Bleaching creams such as hydroquinone can also contribute to erythema and may need to be discontinued or an alternative pigmentation prevention treatment can be used, such as azelaic acid 20% cream.

Outcomes and Results

An invariable observation of the results obtained with croton oil peels is the overall qualitative improvement of the skin. The supposition is that there has been a fundamental change in the skin anatomy, which not only dramatically improves wrinkles but also significantly ameliorates the effects of sun damage. The skin reflects light differently and brightens the dull, ashen look of older, actinically damaged skin. This is the critical factor that has been missing in surgical facial rejuvenation.

A constant observation of the Baker peel is the long-lasting (if indeed not permanent) results. This has been substantiated by multiple histologic studies that have shown the deposition of a significant layer of collagen in the dermis after a peel procedure that is aligned in an orderly manner and is thought to be the mechanism for the effacement of wrinkles. This layer remains constant for years, even decades.

Since 2000, results with croton oil peels show remarkable improvement in deep wrinkles and actinic damage without depigmentation. These improvements are completely stable, and rather than showing diminishing results, the skin appears to improve with time.



This 47-year-old woman had brittle, sun-damaged skin and smoker's lines. Considerable qualitative improvement is seen after a croton oil peel with a stable result 4 years after treatment.



This 53-year-old woman is shown before a croton oil peel treatment and 4 years after the peel and a face lift. She also had an endoscopic brow lift and upper and lower blepharoplasties.



Pretreatment



1 year after peel



4 years after peel

Note the periorbital details in the same patient before treatment, with posttreatment improvement of texture after 1 year, and evidence of further improvement after 4 years.

Although not yet confirmed histologically, it is reasonable to expect that this stability is modulated by a similar deposition of collagen in the dermis, while not disrupting the function of the melanocytes. The fact that repeated peels produce additive effects suggests that there is more deposition of collagen each time. The skin looks younger because in essence, younger skin is being created.

Histologic studies have also shown eradication of actinic keratoses in deeply peeled skin. The anecdotal impression of experienced practitioners has been that individuals who have undergone peels do not develop facial basal cell cancer or squamous cell cancer. In a recent study in the dermatology literature, Hantash et al showed that laser resurfacing, fluorouracil, and 35% TCA peels were equally effective in keeping susceptible individuals free of nonmelanoma cancers for the studied 5-year period. The deeper croton oil peels are expected to have a similar or better effect, further expanding the benefits and utility of this approach.



The qualitative degradation of skin with time is obvious, and many patients consider textural changes to be equally or more important than structural changes. It could be argued that the qualitative and textural improvements achieved with a peel in this 61-year-old woman had greater impact than surgery could have.



There are many advanced surgical techniques to deal with gravitational and volume changes, but surgery can only minimally and indirectly improve textural issues and has no effect on the perioral area, where it is often needed most. This 59-year-old woman could certainly have benefited from a face lift, but her pronounced perioral lines would have been unaltered and a detriment to the results. The overall qualitative improvement, especially around the mouth, seen here 1 year after her peel, have had a greater impact than surgery would have.

The phrase *comprehensive facial rejuvenation* is frequently used, but unless these textural changes are dealt with as well, it is a mere platitude.



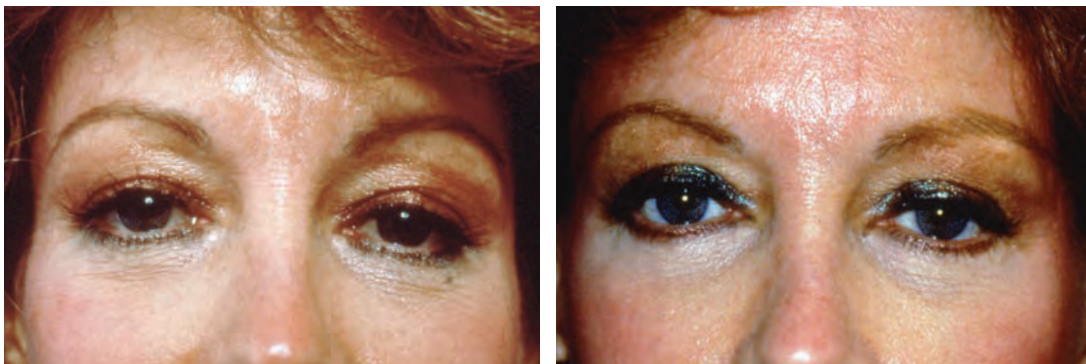
The preoperative view of a 75-year-old woman shows advanced structural and textural changes of aging. Neither surgery nor resurfacing alone could provide a complete result. The second image shows the patient at age 81, 6 years after a face lift and 1 year after a full-face peel. Croton oil peels provide a powerful and effective tool to complement surgery and make comprehensive facial rejuvenation a reality.



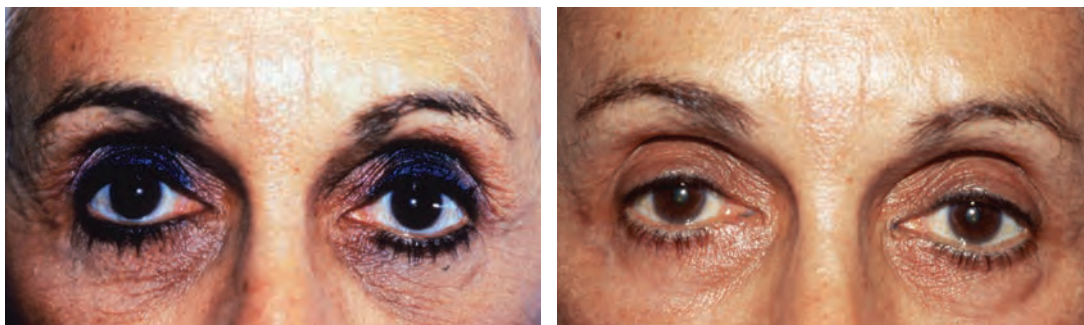
This 67-year-old woman had undergone two previous face lifts and overresection of the lower eyelids with rounding of the outer canthi. A corrective face lift and internal suspension of the orbicularis oculi muscles certainly improved the situation, but the subsequent peel was critical in completing the look of youth.



This patient had splotchy pigmentation from actinic exposure and upper lip rhytids. Note the improvement after a 35% TCA peel and upper lip dermabrasion.



This patient sought treatment for her fine facial wrinkles, particularly in the periorbital region. She is shown 5 months after a 35% TCA peel.



This patient was displeased with her periorbital rhytids and lower lid pigmentation. A 35% TCA peel was performed with good results.

Concluding Thoughts

Hetter's work and subsequent experience have greatly clarified the earlier issues regarding deep chemical peels, which are generally classified, possibly inaccurately, as phenol peels. A weaker concentration of phenol does not penetrate more deeply than a stronger one, refuting long-held beliefs. This allows greater latitude in the preparation of solutions. Croton oil has been identified as the critical peeling agent, and a high concentration of phenol is not necessary to obtain a desired peel. This knowledge also opens the door to investigate other solvents that may act as carriers of the croton oil and avoid the use of phenol altogether.

The "all-or-none" phenomenon attributed to the Baker peel, which was one of the main sources of intimidation for surgeons, is simply that the croton oil concentration was so high that the operator had little control over the application process. By lowering the concentration of croton oil, application technique and concentration choice now become the main factors that determine the depth of the peel. In this manner, the main complication of the traditional peel can be avoided while still providing the desired clinical result. The principal objections to deep "phenol" peels were misconceptions based on the experience of older peels that are now obsolete: hypopigmentation is largely avoidable by controlling the depth and by exercising rudimentary precautions, cardiac toxicity is simply not clinically seen.

Obagi's work with TCA in the 1990s was also an important addition to the field. Concentrations from 20% to 50% were found to be effective at producing superficial to medium and deeper peels, while largely avoiding the complications of scarring and hypopigmentation. With multiple concentrations of croton oil and TCA available as peeling agents, surgeons have significant control and specificity. This fact makes chemical peeling available to any age group and skin type. The possibility of doing weaker peels on younger patients with the thought of keeping up with aging

is an exciting prospect that has the potential of greatly expanding the patient base. Weaker concentrations of peeling agent can likewise be used to great advantage on delicate eyelid skin. Precise deeper peeling can be done on problem rhytids without adversely affecting other sectors of the face. The potential use of these peels in the prevention of basal cell and squamous cell carcinomas is a new frontier ripe for investigation.

The main drawback of modern chemical peels is the difficult recovery, but to date, there is no way to obtain comparable results without injuring the dermis and dealing with the recovery.

Clinical Caveats

Modern croton oil peels are a cost-effective means to achieve long-lasting results in facial resurfacing without hypopigmentation.

Skin pretreatment and patient education are important aspects of the process to decrease postpeel erythema and assist the patient in dealing with the postpeel recovery period.

The recognition of croton oil as the critical peeling agent allows the formulation of solutions with different croton oil concentrations.

Choice of concentration and control of the application technique allow the surgeon to choose the depth of peel desired.

The depth of peel is determined by the appearance and quality of frosting. This is a predictable and easily recognized phenomenon.

The above points give the surgeon great control and specificity. This allows treatment of a large range of ages and skin types.

The novice can approach the learning curve by peeling lighter with the thought of repeeling. This is a safe way to gain experience.

Repeated peels give additive effect. This is especially valuable in the effective treatment of lower eyelid skin.

Modern chemical peels are an important tool in the plastic surgeon's armamentarium. Surgery can deal with the gravitational and volume changes associated with aging, while chemical peels are an excellent adjunct to treat the textural and pigmentary skin changes that result from age and solar damage. By use a combined approach, the goal of facial rejuvenation can be attained.

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The authors provide clinical evidence supporting the fascinating proposition that skin resurfacing may be protective against the development of nonmelanoma skin cancer.

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The author analyzes the classic peel formula and identified croton oil as the critical peeling agent. This article describes the basis for the modern croton oil peels.

Hetter GP. An examination of the phenol-croton oil peel: Part II. The lay peelers and their croton oil formulas. *Plast Reconstr Surg* 105:240-248, 2000.

This is a fascinating article that describes the colorful history of chemical peels in the United States and the evolution of various formulas.

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Johnson JB, Ichinose H, Obagi ZE, et al. Obagi's modified trichloroacetic acid (TCA)-controlled variable-depth peel: a study of clinical signs correlated with histological findings. *Ann Plast Surg* 36:225-237, 1996.

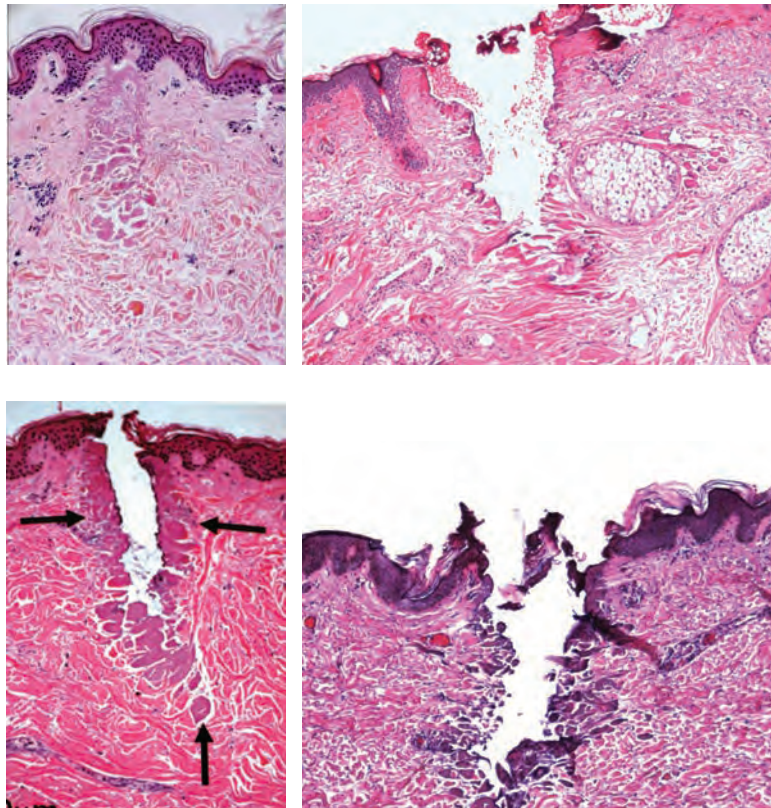
This article discusses the results of 20 patients who undergo TCA peeling with a modified 50% solution. Biopsies were taken 5 minutes, 48 hours, and 6 weeks postpeel to assess histologic changes with peeling. Key evidence of neocollagen formation is presented.

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CHAPTER 16



Lasers and Devices in Plastic Surgery

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DAVID J. GOLDBERG

Cosmetic surgeons and other care specialists have expanded their practices to include many nonsurgical devices and procedures, and the technology associated with these procedures has become more diverse and complex. For example, liposuction has become extremely technical, with lasers and other energy devices used to precondition or tighten skin. Data from the American Society for Aesthetic Plastic Surgery reveal the changing nature of our practices. Comparisons of procedures performed in the United States in 1997 and 2008 (see below) demonstrate the increasing popularity of nonsurgical procedures. Cosmetic surgeons who do not offer these procedures may find themselves at a distinct disadvantage, because many patients who are seen in a practice for nonsurgical procedures tend to look to the same provider when more invasive surgical procedures are needed.

Ranking of Frequency of Cosmetic Procedures Performed in the United States*

Rank	1997	2009
1	Chemical peel	Neurotoxin injection
2	Collagen injection	Hyaluronic acid injection
3	Liposuction	Laser hair removal
4	Blepharoplasty	Microdermabrasion
5	Laser resurfacing	Chemical peel
6	Rhinoplasty	Laser resurfacing
7	Breast augmentation	Sclerotherapy
8	Face lift	Pulsed light
9	Hair transplantation	Breast augmentation
10	Forehead lift	Liposuction

*Data from the American Society for Aesthetic Plastic Surgery.

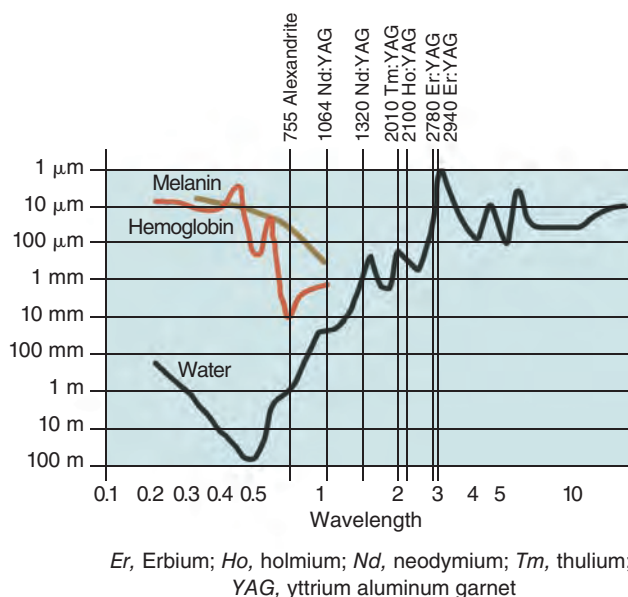
It has become difficult for physicians to differentiate manufacturers’ promotional claims from reality in determining which lasers and energy sources will be both beneficial for their patients as well as good long-term investments for their practice. The decision-making process is complex and depends on the scope of the practice, a willingness to accept risk, the number of physicians in the practice, the physical layout of the office, patient demographics, marketing, and other considerations.

There are many types of lasers/devices available for plastic surgery procedures, including skin resurfacing and skin tightening, tattoo placement, treatment of vascular lesions, hair removal, and treatment of cellulite.

The nature of the practice greatly influences the choice of technology. For instance, the addition of a device for treating cellulite probably does not make sense in a plastic surgeon's office in which the focus is primarily hand surgery, but such equipment may fit nicely in a body-contouring practice. Some of these devices are relatively esoteric, such as the excimer laser used to treat vitiligo, whereas others, such as pulsed light devices, will be used frequently. In this chapter we will review the devices used in our practices and discuss their applications and potential value. We will also assess newer devices and their potential for long-term use.

Laser Basics

The acronym *laser* stands for “light amplification for the stimulated emission of radiation”; in medical use this means a device that is composed of an energy source, a crystal or other laser medium, and a resonating tube. The medium may be a solid, liquid, or gas, and the laser is often named by this medium, such as carbon dioxide. The goal of the device is to create a photon that by definition is in the same phase, direction, wavelength, and frequency as the other photons emitted. The photon or laser beam created is monochromatic (a single wavelength). This is in contrast to an intense pulsed light device (discussed later), which is composed of many wavelengths. The wavelength determines the type of tissue interaction. Ideally, the laser beam is absorbed by the target tissue or chromophore, although the beam can transmit through the tissue, be scattered by the tissue, or be reflected by the tissue. The basis for medical laser use is *selective photothermolysis*, in which a specific wavelength of light is absorbed by a specific chromophore. For example, a vascular laser emits a beam that is absorbed by a blood vessel and heats the vessel until it is coagulated without damage to adjacent structures.



There are a few chromophores that are used for medical purposes: melanin, hemoglobin, and water. The corresponding wavelength peaks of absorption are shown for these chromophores.

Devices Used in Plastic Surgery and Dermatology

Pulsed Light

Pulsed light devices are powerful flashbulbs that emit a broad spectrum of light, usually from 400 to 1300 nm. These devices are different from lasers in that they have multiple wavelengths of emitted light. These devices either use different handpieces or cutoff filters that restrict light below a certain wavelength. There is usually a peak of energy at the wavelength just above the lower cutoff. For example, a 515 filter cuts off light below 515 nm and has a peak of energy just above this wavelength. These devices are used for many applications, such as pigment removal, vascular treatment, hair removal, skin tightening, and activating photodynamic agents. Excellent devices are available from various manufacturers. Specific differences between devices include disposable costs (how long the heads last), integrated cooling, programmability, and power. These devices are among the most versatile in a plastic surgery office and often are the first recommended for purchase.

Pigment Removal

Pulsed light treatment for facial pigment removal is often called a *fotofacial* or *photofacial*. The wavelengths used are in the low 500 to 550 nm range. As such, they are used on Fitzpatrick skin types 1 through 3 but may be used in Fitzpatrick type 4 skin types with lower fluences. Multiple treatments are usually recommended as a series of three or four sessions spaced 3 to 4 weeks apart. The pigmented areas appear darker immediately after treatment but fade thereafter. This technique is an excellent way to remove mottled photodamage in a nonablative fashion with minimal downtime.



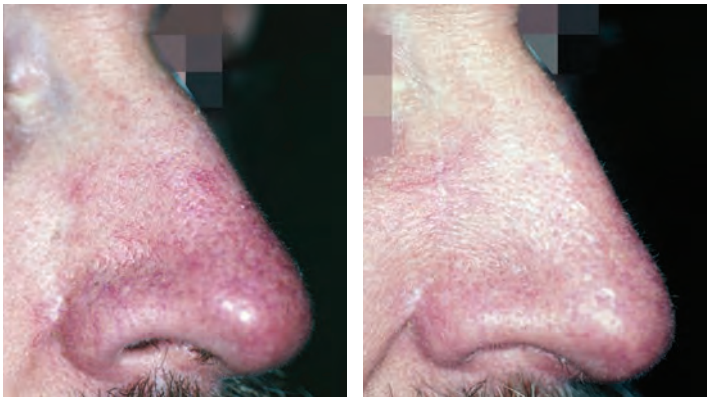
This patient is shown before and 6 months after three pulsed light treatments of the face for pigment removal.



This woman required pulsed light treatment of the décolleté. She is shown before and 1 year after five treatments.

Vascular Lesions

Pulsed light treatment for removal of vascular lesions is for small vessel treatment and rosacea. Filters or handpieces used are near the vascular absorption peak in the high 585 to 595 nm range. These treatments work best on the face. Multiple handpieces or filters may be used in one treatment session to treat red and brown pigmentation. These devices may also be used for photodynamic therapy and will be discussed in that section.



This patient is shown before and 3 months after three vascular treatments at 4-week intervals.

Vascular Laser Devices

Historically, vascular lesions were one of the first targets for laser therapy. Lasers such as copper vapor (578 nm), krypton (568 nm), and argon dye (577 nm) were used and eventually abandoned because they produced unacceptable levels of scarring. The pulsed dye laser is still considered by most the benchmark for vascular lesion removal. Newer generations avoid the purpura produced by older devices. For portwine stains and hemangiomas, the pulsed dye laser is best, but as a device for a plastic surgery office, it probably will not be the most useful or cost-effective vascular laser. The 1064 nm laser and combination lasers of 532 nm/1064 nm and 585 nm/1064 nm are probably the most useful, because they can be used in all skin types and for hair removal as well.

Intense pulsed light devices are also very useful for vascular lesion treatment. However, their use is limited to patients who are not tan and with skin types 1 through 3 because of the melanin absorption. Their use is also limited to smaller vessels, whereas the 1064 nm devices can be used in vessels up to 2 mm in diameter.

Devices Used to Treat Vascular Lesions			
Device	Wavelength (nm)	Skin Types	Tan
Pulsed dye	585-595	1-3	No
KTP	532	1-3	No
Nd:YAG	1064	1-6	Yes
IPL/BBL	585+	1-3	No

BBL, Broadband light; *KTP*, potassium titanyl phosphate; *IPL*, intense pulsed light.

Facial vessel treatment is quite easy with any of the devices listed. Leg vein treatment is another story, and proper treatment usually requires multimodality treatment, such as venous mapping, evaluation of perforators and flow, sclerotherapy, and laser treatment for small vessels and for sclerotherapy “cleanup.”



This patient is shown before and immediately after vascular laser treatment to the nose with a 1064 nm laser.

Hair Removal Lasers and Devices

Laser hair removal is an extremely popular procedure: data from the American Society for Aesthetic Plastic Surgery list it as the second most frequently performed aesthetic procedure in 2008. There are many excellent devices by various manufacturers for hair removal.

Devices Used for Hair Removal

Device	Wavelength (nm)	Hair Color	Skin Type	Tan	Currently Used
Ruby	694	Dark	1-3	No	No
Alexandrite	755	Dark	1-3	No	Yes
Diode	810	Dark	1-6	Yes	Yes
Nd:YAG	1064	Dark	1-6	Yes	Yes
IPL/BBL	690+	Dark	1-3	No	Yes

Hair Basics

Human hair is currently thought to have stages of growth. These are the anagen (growth) phase, the catagen (regression) phase, and the telogen (resting) phase. In general, the anagen phase is variable in duration, the catagen phase usually lasts 3 weeks, and the telogen phase is approximately 3 months long, but there is some site-specific variation. The hair follicle has three regions—the lower segment, comprising the bulb and suprabulb; the middle segment (the isthmus); and the upper segment (the infundibulum). The bulb is made up of the hair matrix and dermal papilla. The dermal papilla is thought to be responsible for initiating and directing hair growth, whereas the hair matrix is the actively growing portion that gives rise to the hair shaft and root sheath.

For long-term hair removal, the laser or device must cause some damage to a growth section of the hair. The actual target is still somewhat controversial, but most researchers agree that the pluripotential cells of the bulge, dermal papilla, and hair matrix must be treated in the anagen phase to be effective. Melanin is the target for most hair removal lasers.

Treatment Considerations

Many variables affect laser or device hair removal: skin color, hair color, hair thickness, the area of the body treated, device type, wavelength, fluence used, spot size, pulse width, skin temperature and cooling, and treatment timing. Assessment of these variables is beyond the scope of this chapter; we encourage readers who are interested to read some of the books listed in the bibliography.

Devices

The many devices currently used for laser hair removal are grouped into lasers (specific wavelengths) and light devices (IPL/BBL: intense pulsed light/broad-based light—nonspecific wavelengths). Excellent devices are available from a number of manufacturers. The choice of laser/device depends somewhat on patient mix in one's practice (such as darker skin types or tan patients). The most popular devices are alexandrite lasers, diode lasers, Nd:YAG lasers, and IPL/BBL devices. As outlined in the table on p. 543, alexandrite and pulsed light devices should not be used on darker skin types or tanned patients. Diode lasers and Nd:YAG lasers may be used for these patients; Nd:YAG devices are considered safest for these skin types.



A patient who underwent treatment of a vascular lesion of the lip with a 1064 nm laser is shown 8 months after two treatments.

Treatment Protocols

The timing of treatment is a factor of anagen duration, which varies by age, season, anatomic region, sex, hormonal levels, and genetic predisposition. Some practitioners recommend a specific timing interval of 4 to 6 weeks, whereas others recommend a certain amount of regrowth before treatment.

Recommendations

Laser hair removal is a useful addition to a plastic surgery practice. We recommend a long pulse width Nd:YAG device for its usefulness in all skin types and a BBL/IPL device for its overall usability.



This patient is shown before and 3 months after six treatments with 1064 nm laser for hair removal.

Laser Skin Resurfacing

There are a wide variety of devices used for laser skin resurfacing. These are broadly classified into ablative and nonablative devices. Ablative lasers remove skin, whereas nonablative devices cause some degree of thermal damage to the epidermis or dermis without removing skin. These devices are further classified into fractional and full field devices.

Full Field and Fractional Resurfacing Devices

Name	Wavelength (nm)	Ablative	Nonablative	Full Field	Fractional
CO ₂	10,600	Yes	No	Yes	Yes
Erbium	2940	Yes	No	Yes	Yes
YSGG	2790	Yes	No	Yes	Yes
Thulium	1927	No	Yes	No	Yes
Er:Glass	1540	No	Yes	No	Yes
Nd:YAG	1440	No	Yes	No	Yes
Nd:YAG	1319	No	Yes	Yes	Yes
Nd:YAG	1064	No	Yes	Yes	No

YSGG, Yttrium-scandium-gallium-garnet.

Ablative Full Field Devices

Ablative laser resurfacing with the carbon dioxide laser was introduced in the mid-1990s and was responsible for creating significant interest in lasers among plastic surgeons and dermatologists. The CO₂ laser has a wavelength of 10,600 nm and a chromophore of water. There is laser absorption just above the ablation threshold, which vaporizes the tissue. Continuous mode devices were used initially, but too much thermal damage was created, which led to scarring. The continuous mode devices fared better as a cutting tool and are still in use today. A modification by one company (UltraPulse Laser; Lumenis Ltd., Yokneam, Israel) broke the continuous beam into short pulses, which caused tissue ablation with much less thermal damage. Originally the device was used with a nonscanning small spot handpiece, but the inaccuracy of the handheld probe led to overlapped pulses with excessive heat deposition through pulse stacking and/or else inadvertent deep resurfacing, both of which had the potential for delayed healing and scarring. The development of a computer pattern generator solved this problem by scanning the pulses sequentially onto the skin with a defined geometric pattern and spacing. A different approach was used by another manufacturer (SilkTouch and FeatherTouch lasers (Shurplan Lasers, Lon-

don, UK); they used an optomechanical flashscanner to scan a continuous laser beam in a spiral pattern. This allowed another method of creating a short exposure time by rapidly moving a continuous laser beam in a spiral, keeping the exposure or dwell time at any particular point below 1 millisecond. These devices led to excellent results in eradicating wrinkles and tightening lax tissue. The problem with this series of carbon dioxide lasers was the considerable downtime created for the patient and the permanent pigmentary problems that occasionally arose.

Erbium:YAG lasers (2940 nm) were introduced as a safer alternative for superficial resurfacing. Initially machines were low powered and lacked pattern generators. The second generation of systems had more power and were used instead of carbon dioxide lasers for deeper resurfacing. Complications were fewer, yet downtime appeared to be similar to that of carbon dioxide systems. Combination systems of carbon dioxide and erbium lasers were popular for a short time (Derma-K, Lumenis), with the beams being delivered either sequentially or simultaneously. Variable or long pulse erbium lasers (Sciton Inc., Palo Alto, CA) are popular today. These devices allow variation of pulse width in addition to energy per pulse, which allows control over the amount of residual thermal injury produced for a given amount of tissue removal. These variable pulse Er:YAG systems seem to produce skin tightening and wrinkle reduction similar to carbon dioxide lasers, with a much shorter period of erythema and much lower risk of hypopigmentation.



This woman is shown before and 1 year after full field erbium resurfacing.



This patient underwent full field erbium resurfacing and is shown 3 years later.

Yttrium-scandium-gallium-garnet crystal (YSGG) lasers (2790 nm) were introduced by Cutera (Brisbane, CA) to offer a device with a middle alternative to the CO₂ and erbium wavelengths. Erbium has the highest affinity for water in the absorption spectrum at 2940 nm. The laser was designed to create a wavelength with half the absorption that occurs at 2790 nm, the purpose of which is to create more heat driven down into the dermis for stimulation and remodeling. The mechanism of action is in three parts:

1. *Ablation*: Safe removal of a portion of the epidermis is achieved with a controlled amount of vaporization; 10 to 30 microns of epidermis are vaporized in this process.
2. *Coagulation*: Simultaneously, sufficient heat to produce coagulation is generated in the remaining epidermis. Depending on the energy selected, the coagulation region can vary from partial to full epidermal damage. This coagulation region creates a natural protective dressing on the skin that remains intact during the restorative process.
3. *Collagen remodeling*: Finally, residual heat in the dermis generates new collagen growth.

The YSGG laser can be operated as a horizontal ablative resurfacing unit or as a fractional device. Combination treatment called *fusion* can combine clinical situations of pigmentation, fine lines, and stimulation with the fractional effects of deeper dermal imperfection such as acne scarring, deep lines, and skin laxity.



This 74-year-old woman was treated for all of these conditions with a YSGG laser. Downtime is typically 3 to 5 days, and application of a thin ointment is the only required postprocedure care. She is shown before and 10 days after one treatment.

Plasma skin resurfacing used nitrogen plasma energy to coagulate a very controlled depth of skin. Healing times and results appeared to be similar to those with erbium devices. However, the company (Rhytec) that was manufacturing the plasma device is no longer in business.

Full field ablative resurfacing enjoyed an initial heyday from 1994 to 2001, but the associated prolonged healing times and hypopigmentation led to wariness of the technology. Consumers and physicians reversed direction, opting for procedures with minimal morbidity and downtime. This brought about the development of nonablative resurfacing devices.

Nonablative Devices

These devices were developed from the theory that full field ablative devices had two skin effects: removal of outer damaged layers and heating of the collagen/dermis to provoke a wound-healing response. The initial devices used were q-switched 1064 nm lasers. These extremely short pulsed lasers caused superficial dermal water heating and led to eradication of some fine lines and rhytids. However, there was some pinpoint bleeding, petechiae, and occasional purpura. Further development of

these devices led to use of other wavelengths with no epidermal injury through more water absorption and more dermal heating. The most popular of these devices were in the 1319 to 1320 nm range, although longer pulse width 1064 nm lasers and 1450 nm lasers were also used. These devices all caused some degree of dermal injury that led to a dermal wound-healing response. This then led to skin improvement with removal of some fine lines and wrinkles. The disadvantages of these devices are that results are inconsistent, and it takes months for results to occur.

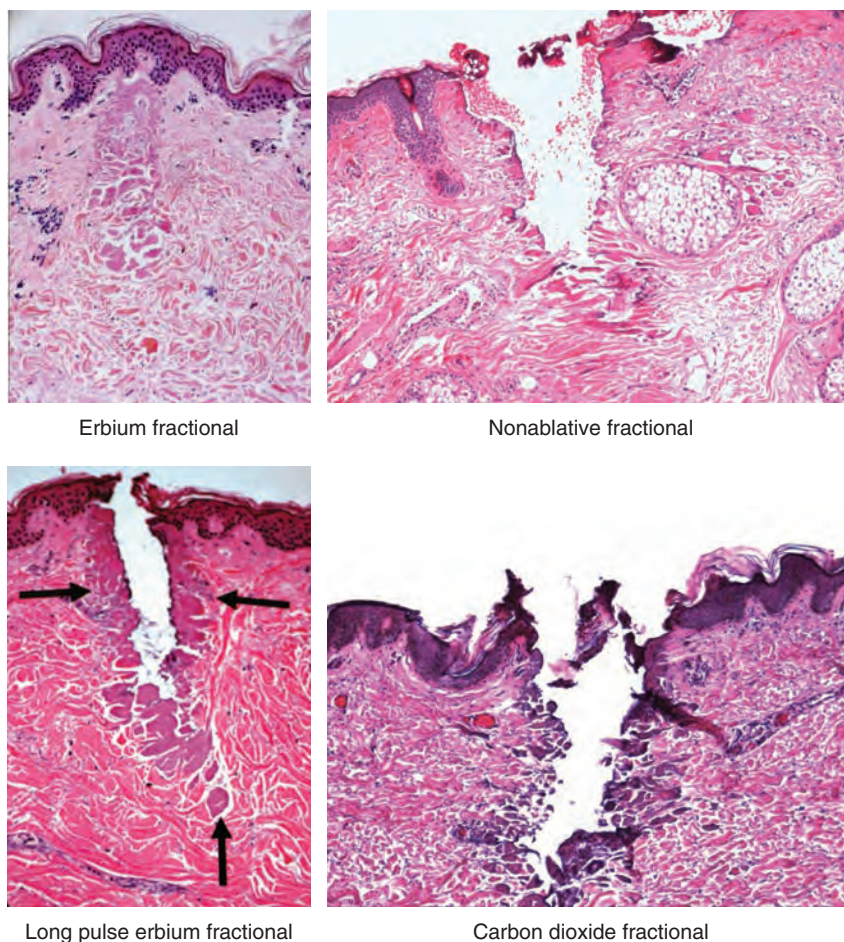
Fractional Lasers

Fractional lasers have revolutionized laser resurfacing. *Fractional photothermolysis* refers to classes of devices that cause zones of epidermal and dermal thermal damage (nonablative fractional lasers) or that cause epidermal or dermal mini-holes or ablation channels (ablative fractional lasers). The adjacent areas are left free of damage, and healing occurs from areas deep and lateral to the damage.

The first fractional laser to be developed was the Fraxel laser (Solta, CA), a nonablative fractional device that used an erbium-doped fiber laser with a wavelength of 1550 nm. This device created microthermal zones (MTZ) between 125 and 250 per square centimeter. Multiple passes were performed, with a final density of 1000 to 3000 zones per square centimeter, a small fraction of the skin. Multiple sessions were used (usually three to five) spaced 2 to 4 weeks apart. Other manufacturers developed nonablative fractional lasers with different wavelengths (1319, 1440, and 1540 nm), energies, and spot sizes. The most recent ablative wavelength to be introduced is the thulium laser (1927 nm). This device may have some advantages, especially in treating actinic keratosis. Since different devices have different spot sizes, scanners, and depths of injury, it is difficult to compare devices. The easiest way to understand the degree of tissue injury is to understand depth of injury, width of thermal injury, and fraction of area treated.

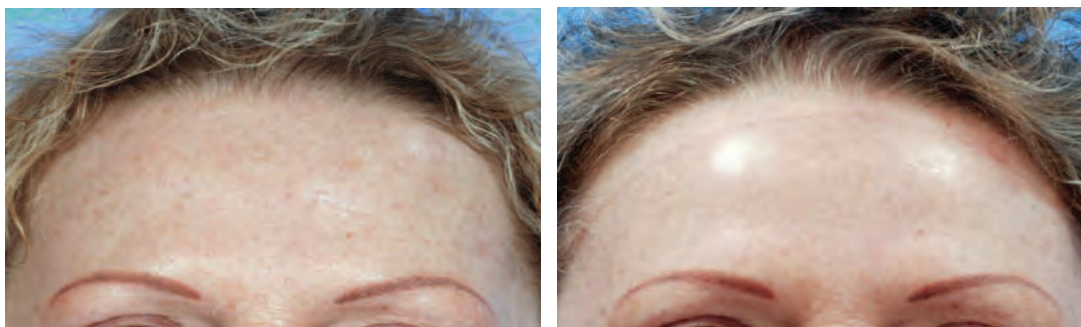
These devices are in use today and are used to treat fine lines, deeper rhytids, photodamage, acne scarring, and melasma. Both facial and nonfacial areas can be treated. Downtime is related to the depth and density of the treated areas, but in general, downtime is minimal, with a mild bronzing of the skin for a day or so after treatment. These devices have enjoyed worldwide acceptance for all skin types; they produce minimal complications. The problem with treatment with nonablative fractional lasers is the relative lack of efficacy compared with full laser resurfacing. Currently these devices are used for mild photodamage and acne scarring, especially in darker-skinned individuals and areas off the face.

The development of fractional ablative lasers has increased the efficacy over nonablative fractional lasers. Three wavelengths are currently used for fractional ablative resurfacing: carbon dioxide, 10,600 nm; erbium, 2940 nm; and YSGG, 2790 nm (see the table on p. 546). The differences among these wavelengths are related to the differences in water absorption and in the resultant amount of thermal damage created.



A comparison of fractional technologies is shown, although not the variation in lateral thermal damage. YSGG (not illustrated) is similar to erbium long pulse. Also shown are the types of channels created. A newer development is the variable pulse width erbium fractional laser (Sciton). This device provides a short pulse followed by a longer pulse or a series of pulses to increase the amount of thermal damage. Studies of this device with maximum pulse duration or coagulation setting show histologic results similar to that with the carbon dioxide laser. Another new development is the introduction of grooves of ablated areas rather than the spots of fractional lasers.

As with fractional nonablative resurfacing, these devices are used to treat fine and deeper lines and rhytids, acne scars, dyschromias, and photodamage. These devices can create more skin tightening than nonablative fractional lasers. Comparison of devices and treatments is sometimes difficult because of treatment parameters, including spot size, depth of treatment, density of treatment, and thermal damage per spot. Treatments are usually performed with topical or regional anesthesia. Downtime depends on wavelength, depth, and density but in general is much less than for full field resurfacing.



This patient underwent one erbium fractional treatment of the forehead and is shown 3 months after the procedure.

Complications of ablative and nonablative fractional resurfacing are the same as one might get from full field resurfacing except for a much lower frequency. These include scarring, infections, prolonged erythema, and pigmentary changes, including hypopigmentation and hyperpigmentation. Scarring incidence is extremely low but is more common in nonfacial areas, especially when high energies (deep depth of treatment) and high densities are used. High densities with large amounts of thermal damage may approach full field resurfacing with a corresponding increase in complications. Infection rates appear to be low, most likely because of the widespread use of antiviral medications with treatment. Erythema is a product of inflammatory response, and duration of erythema increases with depth, density, and the degree of thermal damage.

The latest developments in laser resurfacing are combination treatments used to increase efficacy. One combination involves ablative and nonablative resurfacing. Early results of this combination show results that are superior to either modality used individually. Another combination is a light full field ablative treatment followed by a fractional ablative or nonablative treatment. The advantage of this approach is the full epidermal texture improvement seen. Downtime and efficacy depend on the depth of full field treatment and the depth and density of fractional treatment. Intense pulsed light treatment may also be added to these combination treatments to further correct pigmentation or vascularity.



Before treatment



Immediately after treatment



1 day later



2 days later



3 days later



1 week later

The progression of healing is shown following a combination superficial erbium and erbium fractional treatment.



This patient is shown before and after a fractional carbon dioxide treatment.

Skin Tightening

The concept of nonsurgical skin tightening is the holy grail of plastic surgery and dermatology. Many devices have been used for both facial and nonfacial skin tightening. The tightening is thought to result from dermal thermal damage, which causes release of heat shock proteins. The initial nonablative devices discussed previously did not cause enough injury to cause tightening. The next-generation devices currently in use are best described as being in one of three groups: radiofrequency, light-based, and ultrasound.

Radiofrequency devices used for skin tightening are based on radio waves. Various devices use different frequency waves and are measured in megahertz. The devices are either (1) bipolar, in which both electrodes are at the treatment site and charged particles are rotated between electrodes causing heat, or (2) unipolar or monopolar, in which the return electrode is distant. The depth of penetration with monopolar or unipolar devices is greater. Devices also differ in their power; some have far greater energy than others. These devices have been extensively studied. Initial protocols of one of the first to market devices, Thermage (Solta), caused deep tissue heating and undue complications, including burns and fat atrophy. Modifications and refinements to these systems have improved efficacy and decreased complications. The skin tightening in some cases is profound; in others it is virtually nonexistent. Current research is attempting to determine who are the best responders and why.

Primaeva, recently purchased by Syneron (Yokneam, Israel), has developed a skin-tightening technique that uses bipolar radiofrequency needles that actually pierce into the skin. Energy is delivered directly within the reticular dermis. With this tech-

nique, there is real-time feedback of tissue temperature and impedance. Energy is delivered in a fractional pattern, so healing is optimized. A local anesthetic is required.

A similar situation exists for light-based devices. These devices are long pulse width IPL devices. Different manufacturers have devices with different wavelengths. Light-based nonablative treatment has existed for years. The Titan (Cutera) uses a very long pulse, 6 seconds, to cause deep heating in the deep dermis. A tricyclic pulse of cooling, heating, and cooling safely deposits the energy at a wavelength range of 1100 to 1800 nm. Initially used for facial tightening, other applications include body areas such as the neck, arms, abdomen, and some newer gynecologic applications. SkinTyte (Sciton) has a wavelength from 800 to approximately 1400 nm. These devices have integrated cooling and long pulse widths in the seconds range. Their chromophore is water, and they heat up the dermis to induce collagen changes. As with the radiofrequency devices, responders are inconsistent, with excellent tightening being achieved in some and minimal tightening in others.



This patient is seen before and 1 year after three treatments with a light-based skin-tightening device.

These devices are used in patients with lax facial and body skin who have residual laxity after surgery or who will not or cannot undergo surgery. It is thought by some that the best responders are younger individuals, with less-photodamaged collagen.

The newest devices on the market are ultrasonic. The first to achieve FDA approval is by Ulthera (Mesa, AZ); this novel device has a diagnostic ultrasound unit to discern target depth, and treatment heads that deliver small ultrasonic thermal bursts to the previously measured area. The initial FDA approval is for brow elevation, but European experience suggests that tightening of the SMAS and platysma bands may produce face lift-like results.



This patient is seen before and 90 days after a single Ulthera treatment.

Concluding Thoughts

The modern practice of plastic surgery includes many nonsurgical aspects, including lasers and laserlike devices. Some of these may take the place of surgery, while others are complementary to surgical options. As progress continues, a day may come when a face lift is uncommon and facial tightening devices provide face lift–like results. The beauty of plastic surgery is that we can mold and adjust ourselves to accommodate technologic advances.

Clinical Caveats

Pulsed light devices may be used for treating pigmentary irregularities, vascular lesions, and hair removal in lighter skinned, nontanned patients.

Leg vein treatment requires multimodality therapy.

Many types of hair removal lasers and devices are available. Selection depends on the patient's skin type and tanning, and on surgeon preference.

Laser resurfacing can be performed in full field or fractional treatments.

Laser resurfacing can be performed with carbon dioxide, erbium, or YSGG devices.

Combination therapy is often used with laser devices.

Fractional devices may use laser, radiofrequency, or ultrasound technology.

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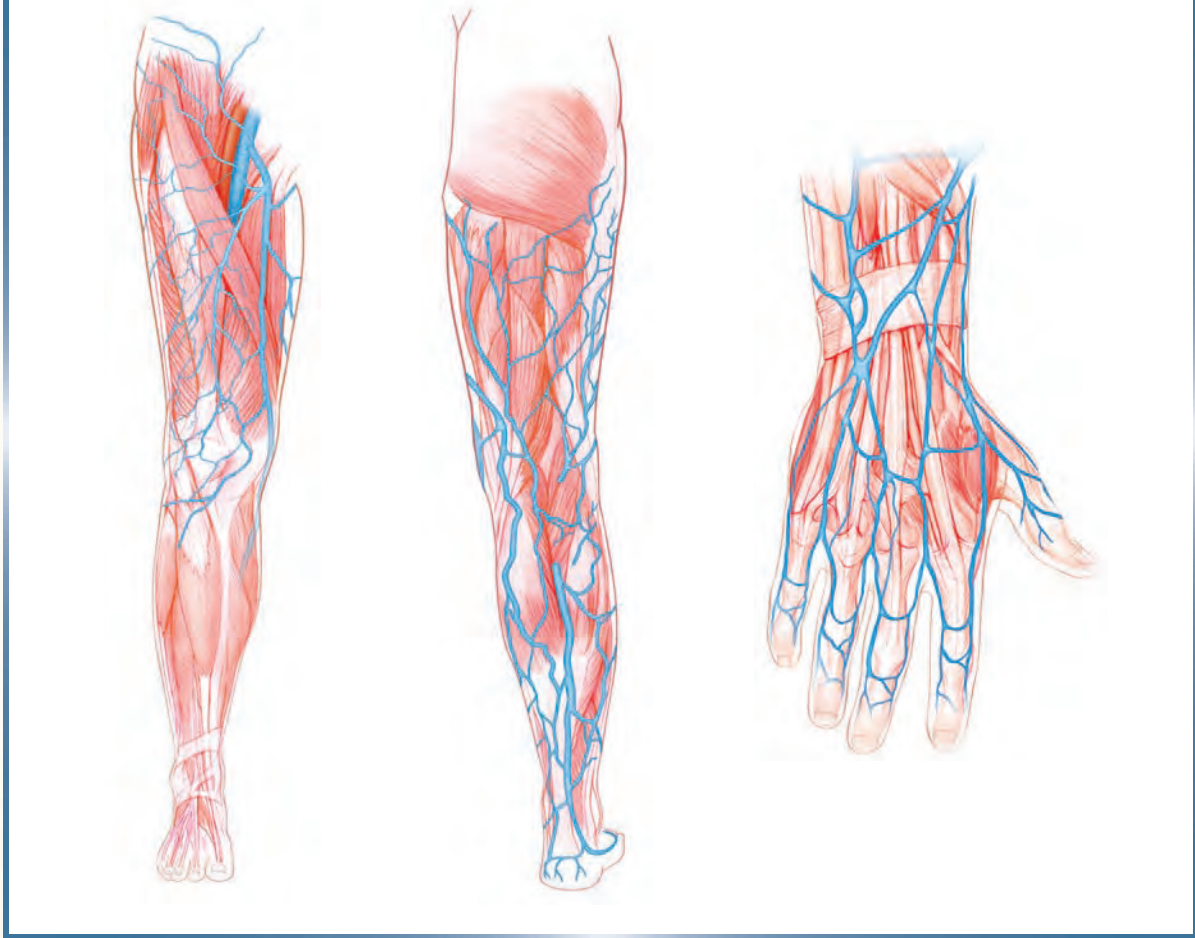
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CHAPTER 17



Sclerotherapy and Laser Vein Treatment

GIRISH S. MUNAVALLI, SIRUNYA SILAPUNT,
ROBERT A. WEISS

Venous disease encompasses a wide spectrum of clinical manifestations, including asymptomatic spider veins on the legs; intermittently bulging branches of the greater saphenous vein that extend across the knee; and dull, achy pain in the posterior calf after prolonged standing. The science of treatment of venous disease, *phlebology*, has roots dating to 400 BC: the ancient Greeks recognized venous disease as an undesirable and unsightly condition. Procedures involving the use of instrumentation to traumatize veins were described by Hippocrates in the fourth century BC, and procedures such as vein stripping were routinely practiced in the years that followed.

Today venous disease still presents a formidable challenge to diagnose and treat; it affects 40% to 55% of the population, with common symptoms of leg pain, swelling, and skin changes. Venous insufficiency, which is caused by valvular incompetence in the deep or superficial venous system, is the most common form of venous disease. Deep venous insufficiency occurs when valves are damaged by thrombosis and is beyond the scope of this chapter. Superficial venous insufficiency occurs when high-pressure leakage develops between the deep and superficial systems or within the superficial system itself. This elevated venous pressure results in sequential failure of the venous valves in superficial veins. Venous insufficiency in this system allows venous blood to escape from its normal flow path and to flow in a retrograde direction down into an already congested leg. Over time, incompetent superficial veins acquire the typical dilated and tortuous appearance of varicosities. Furthermore, insufficiency can lead to chronic morbidity in the form of stasis dermatitis, lipodermatosclerosis, atrophie blanche, and ulcerative, edematous skin changes in the lower extremities.

Farther downstream, changes involving the smaller branching vessels, such as unsightly or symptomatic venulectasis and/or telangiectasias, are a major consequence of superficial venous valvular insufficiency. These entities occur in 29% to 41% of women and 6% to 15% of men in the United States. Although up to 53% of patients with leg telangiectasias have associated symptoms, the most common reason patients seek consultation is cosmetic.

In the upper extremity, the forearm and dorsal hand veins represent the equivalent of varicose veins of the lower extremities. Sun, gravity, and other environmental exposures subject the hands to unique combinations of physiologic and environmental stress. With the passage of time, the hands lose volume as a result of muscle atrophy, bone demineralization, and loss of adipose tissue. Elasticity is lost and skin texture dramatically changes. This process is accelerated by solar-induced damage, which results in wrinkled, dyschromic skin and prominent and tortuous varicosities of the superficial veins of the hand and forearms, such as the cephalic vein and the basilic vein.

Pretreatment Assessment

Lower Extremity

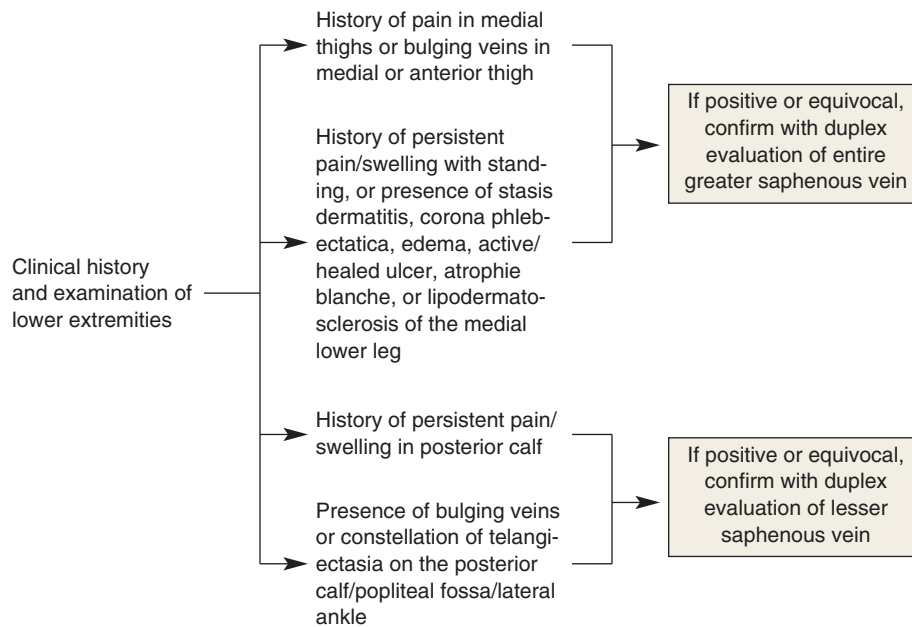
Careful patient assessment is essential for patients seeking amelioration of the symptoms of venous disease. Evaluation and treatment in the lower extremity should be directed in a systematic fashion toward the size and type of vessel, starting with the proximal, larger vessels and working down to the distal, smaller vessels. Vessel types classified in the superficial venous system (from largest size to smallest) include:

- The greater and lesser saphenous veins with their respective direct tributaries
- Nonsaphenous vein varicosities (often visibly bulging veins)
- Reticular or feeder veins (often bluish colored)
- Spider veins or telangiectasia (located just below the epidermis)

The majority of symptomatic lower extremity venous insufficiency is attributable to the superficial venous system and specifically includes reflux of the great saphenous vein. Reflux of the lesser saphenous vein accounts for approximately 5% of superficial venous disease, whereas reflux of the remaining division of the superficial system is called the *lateral subdermic venous system*. Younger patients, in their twenties and thirties, usually present with telangiectatic webs on the lateral thigh originating from reverse flow or reflux in the lateral venous system. When there is a family history of large varicose veins, reflux originating from the greater saphenous vein or lesser saphenous vein must be suspected. A duplex ultrasound study in patients who presented for “cosmetic” treatment of leg veins demonstrated a relatively high incidence of early associated axial or truncal reflux in the greater saphenous vein.

During an initial consultation, reflux in the greater saphenous vein is first suspected based on active symptoms elicited during a thorough history and physical examination. Often these patients have a strong family history of venous disease, especially the presence of varicose veins in immediate family members. Symptoms of venous disease are most often localized to the medial surface of the leg and exacerbated by prolonged standing, or during the premenstrual period in women, and are typically relieved by cold, ambulation, or rest with leg elevation or by wearing compression stockings. Characteristics of venous pain can include a dull ache, burning, heavy legs, throbbing, leg cramping, or pruritus that worsens at the end of the day. Generally speaking, abnormalities on physical examination of the lower extremities such as pain, bulging veins, or skin findings such as discoloration or ulceration located on the medial thigh and ankle correspond with the greater saphenous vein distribution, whereas those located on the posterior calf and lateral ankle correspond to the lesser saphenous vein distribution.

EVALUATION OF LOWER EXTREMITY VENOUS DISEASE



Select Conditions Precipitating Telangiectasia Formation

Hormonal Factors

- Pregnancy
- Estrogen therapy
- Topical corticosteroid preparations

Physical Factors

- Trauma (contusion, surgical incision, lacerations)
- Infection
- Radiation dermatitis
- Erythema ab igne (chronic thermal injury)
- Actinic neovascularization

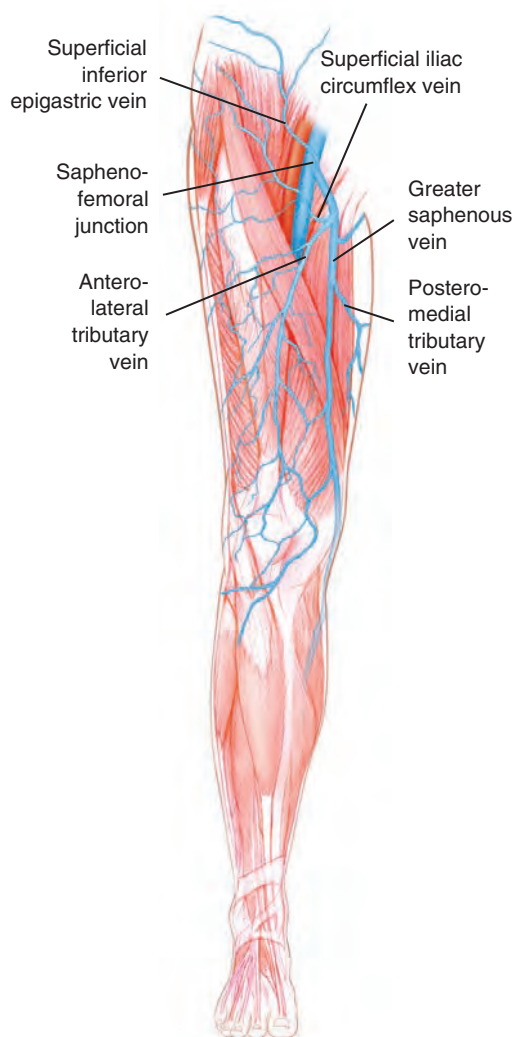
Component of a Primary Cutaneous Disease

- Varicose veins
- Necrobiosis lipoidica diabetorum
- Capillaritis (progressive pigmentary purpura)

Unlike the symptomatology associated with reflux in the larger vessels, telangiectatic lesions more often present as a cosmetic concern. The term *telangiectasia* was first used in the early 1800s to describe a superficial vessel of the skin visible to the human eye. These typically measure 0.1 to 1 mm in diameter and can be either a distended arteriole or venule. A host of conditions can precipitate telangiectasia formation. Varicose veins most likely lead to the formation of telangiectasias through either associated venous hypertension with resulting angiogenesis or vascular dilation. These varicose veins may or may not be clinically evident at the time of telangiectasia presentation but should trigger the systematic proximal-to-distal vein evaluation of the affected extremity in efforts to unmask subclinical venous disease.

Pertinent Anatomy

Normal Venous Anatomy of the Lower Extremity



Knowledge of superficial venous anatomy and the location of important perforating vessels is fundamental to recognition of normal patterns of varicose veins.

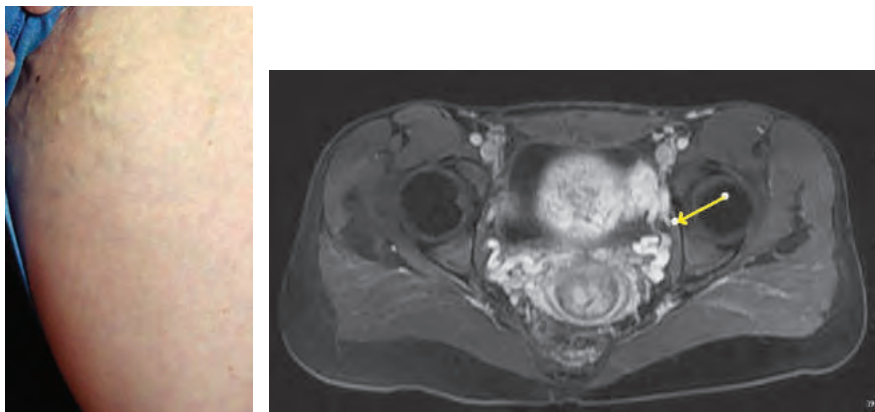
The greater saphenous vein is of primary concern when treating venous problems in the lower extremity. The saphenous vein originates on the dorsum of the foot in the dorsal venous arch, passes anterior to the medial malleolus, progresses through the medial calf across the posteromedial aspect of the popliteal space, ascends in the medial thigh, and terminates in the femoral vein at the saphenofemoral junction. It dominates the anteromedial superficial drainage system. As the saphenous vein reaches its termination, it receives important tributaries medially and laterally. Duplex ultrasound examination may identify reflux in one or both of these vessels.

The anatomy of the greater saphenous vein is relatively constant. It is understood that this vein lies on the deep fascia of the leg and thigh, but it is less well recognized that it lies below or deep to the superficial fascia. Current descriptions of the anatomy of the lower extremity vasculature do not always make this distinction, yet this fact is crucial to understanding the development of varicosities.

In varicose venous anatomy, the important tributaries to the greater saphenous vein extending upward from below are the posterior arch vein (vein of Michelangelo), which receives the three Cockett's perforating veins (posterior tibial perforators); the anterior tributary vein to the saphenous system, which lies below the patella and collects blood from the anterior and lateral surface of the leg; and the posterior tributary vein, which also empties into the greater saphenous vein in the upper anteromedial calf. Other tributaries that may terminate high in the saphenous system near the groin are the posterior medial thigh vein and the anterior lateral thigh vein. Either or both of these veins may become the site of varicose clusters.

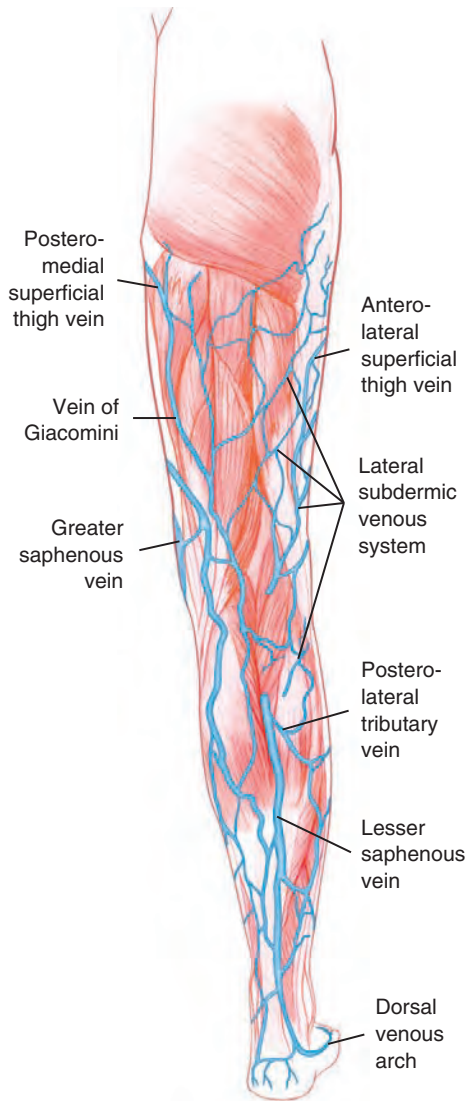
Less common in primary varicosities, and more important in recurrent varicose veins after treatment, are other tributaries in the greater saphenous vein as it terminates in the fossa ovalis. These include the superior external pudendal vein, the superior epigastric vein, and the superficial circumflex iliac vein.

Leg varicose veins could be the result of retrograde flow from pelvic vein varicosities from the connection of pelvic veins, the external pudendal vein, and the saphenofemoral junction. The findings of varicose veins of the medial groin, medial buttocks, and pubic area in patients with chronic pelvic pain should lead one to suspect pelvic congestion syndrome.



This 34-year-old woman presented with recurrent varicose veins of the left groin and thigh 2 years after she underwent endovenous laser ablation for left greater saphenous vein reflux. She reported feeling heaviness and intermittent pain of the left pelvic area and groin for several years; her symptoms worsened with prolonged standing and during menstruation. Physical examination revealed reticular veins and bulging varicose veins of the left medial groin in addition to a varicose vein of the left thigh.

Duplex ultrasound showed several dilated veins in the left groin that continued proximally to the pelvic area. Her MRI/MRV showed an enlarged left gonadal and pelvic vein. She was diagnosed with pelvic congestion syndrome and was treated, with no subsequent recurrence of varicose veins.



Posteriorly, the most important of the axial veins is the lesser saphenous vein. This vein originates on the lateral aspect of the foot in the dorsal venous arch and ascends virtually in the midline of the calf, between the bellies of the gastrocnemius muscle. Unlike the greater saphenous vein, the lesser saphenous vein may penetrate the deep fascia at any point from the middle third of the calf upward. This fact explains the segmental rather than total nature of reflux that is found in the lesser saphenous vein.

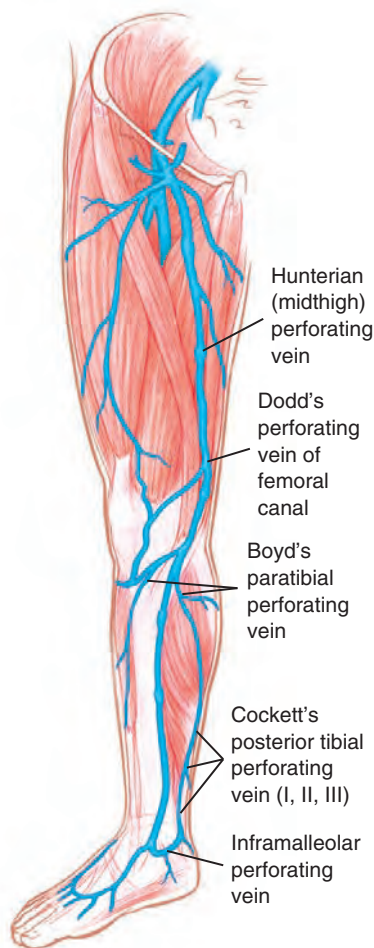
Important tributaries to the saphenous vein are variable in location or existence but may include the posterolateral tributary vein. Superiorly, this tributary may be associated with a lateral thigh vein called the *anterolateral superficial thigh vein*. Another important and frequently encountered vein is the vein of Giacomini, which connects the lesser and greater saphenous veins. It may originate from the lesser saphenous vein or from its thigh extension and ends in the greater saphenous vein or its posterior accessory.

The value of knowing the gross anatomy of the superficial veins of the lower extremity is that any one of the systems may be the site of the growth of clusters of varicosities.

Significant Perforating Veins

The perforating veins connect the superficial venous system to the deep venous system and penetrate the fascia. Any one of these veins, alone or in combination, may be the source of hydrodynamic forces of venous hypertension that produce superficial varicosities. It is the abnormally high pulses of hydrodynamic pressure transmitted through incompetent valves that affect relatively unsupported superficial veins. Such pulses of increased fluid force originate to some extent from increased abdominal pressure and to a greater extent from increased compartmental pressure during muscular contraction.

The best recognized connections between the superficial venous system and the deep venous system are the saphenofemoral and saphenopopliteal junctions. Incompetence of the check valves at their termination has been suggested as the cause of distal varicosities from gravitational reflux. This reverse flow is said to dilate veins in a progressive fashion, from proximal to distal.



Because it is frequently the site of the first varicose veins or the first reticular veins that become varicose, the Boyd perforating vein in the anteromedial calf now receives great attention by physicians who treat venous problems. Experience with the duplex scanner reveals that venous incompetence at this level may be isolated and may be the first reflux to appear. Such incompetence may be asymptomatic; however, when the incompetence is symptomatic, it produces aching pain, fatigue, and even a throbbing discomfort as mentioned previously. These symptoms can be relieved by firm local pressure. Progressing proximally from the Boyd communicating vein are the perforating veins in the distal third of the thigh. These veins are named for English surgeon Harold Dodd and may be found in any location along the saphenous pathway in the distal third of the thigh. The third important series of communicating veins, the Hunterian (mid thigh) perforators, are named for Scottish surgeon and anatomist John Hunter.

Recognizing the normal anatomy and the most common perforating vein sources of varicosities makes identification of patterns of varicosities relatively easy.

Telangiectatic Leg Veins

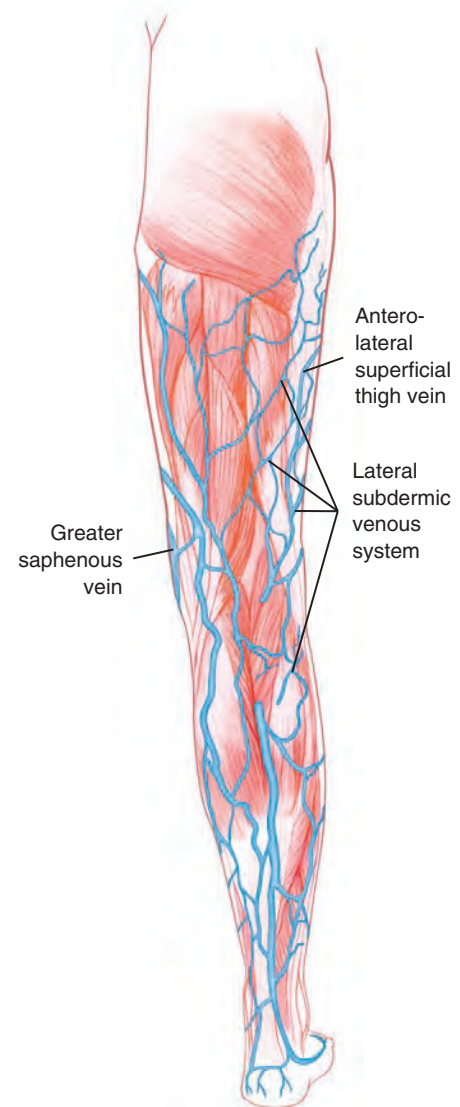
Telangiectatic leg veins may be described as venous spiders, spider veins, sunburst veins, starburst veins, venous plexuses, dilated venules, venous blemishes, dilated venules and venulectasias, superficial or minor varicosities, essential cutaneous telangiectasias, vanity veins, and cosmetic veins. All of these terms describe the type of telangiectatic networks that may cause physical symptoms of pain and discomfort. More than 50% of patients presenting for treatment of these “spider veins” express

aching associated with them. These symptomatic veins are best categorized as arborizing networks (according to the Redisch and Pelzer classification). They are actually combinations or networks of telangiectasias (0.1 to 1 mm) and venulectases (1 to 2 mm). Painful telangiectasias on the leg are usually grouped; they are rarely present as isolated telangiectatic vessels or spider angiomas with a central arteriole. More important, symptomatic telangiectasias and venulectases commonly are associated with slightly larger blue veins, which have been called “feeder” veins, reticular veins, or minor varicose veins. These small subdermal blue veins may be tributaries of the saphenous system. Reticular veins are most commonly part of a superficial venous system that is separate from either of the saphenous systems, originally described as the “lateral subdermic venous system” by Albanese et al.

To diagnose and treat painful telangiectasias in a logical way, a precise classification is helpful. This includes telangiectasias (type I), venulectases (type II), associated blue reticular veins (type III), and reflux from primary varicose veins (types IV and V).

A disturbance of normal venous physiology with back pressure and reverse flow or reflux through incompetent valves results in transmission of pressure through reticular veins into venules, causing their expansion into telangiectasias and venulectases.

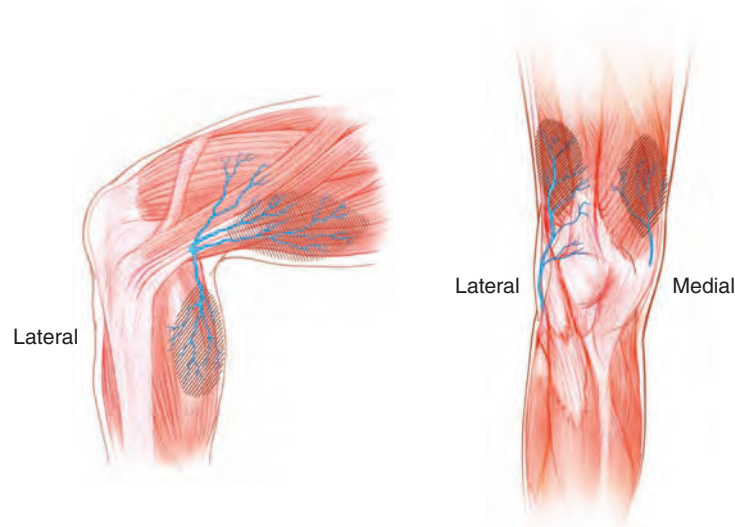
Telangiectasias located on the anterior aspect of the thigh could occur as a consequence of reflux in the following vessels: anterolateral tributary of the greater saphenous vein, inguinal fold reticular veins, incompetent saphenofemoral junction, superficial axial branches of the greater saphenous vein, or anterior branches of the lateral subdermic venous system. Although painful telangiectasias and venulectases may appear anywhere on the leg, they are most likely to occur near the knee.



Revised Vessel Classification

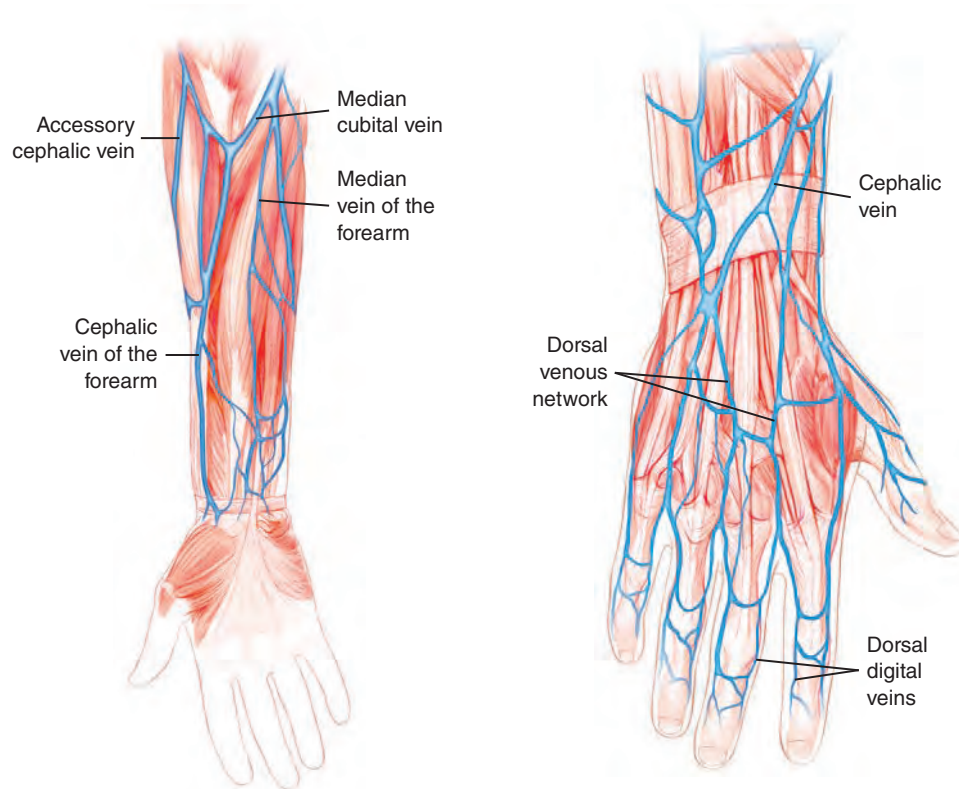
This simplified classification eliminates the mixed telangiectasia/varicose category. Because most patients have a combination of multiple varicose vein types, a description of type I in association with type II or type III varicosities is simpler. Classifying varicose veins in this way facilitates a more straightforward treatment plan.

Type I	Telangiectasia, spider veins 0.1-1 mm diameter Usually red (rarely, may be cyanotic) Type IA – Telangiectatic matting – <0.2 mm diameter network, bright red
Type II	Venulectasia (usually protrudes above skin surface; distinguished from telangiectasia by deeper color and larger diameter) 1-2 mm diameter Violaceous, cyanotic
Type III	Reticular veins (“minor” varicose veins, “feeder” veins) 2-4 mm diameter Cyanotic to blue
Type IV	Nonsaphenous varicose veins (primary varicosity of saphenous tributary usually related to incompetent perforator) 3-8 mm diameter Blue to green
Type V	Saphenous varicose veins (varicosities associated with reflux at saphenofemoral or saphenopopliteal junction or major perforators of saphenous system causing enlargement of long or short saphenous vein) Usually >8 mm diameter Blue to bluish-green



Regions in which painful groups of telangiectasias and venulectases are most likely to occur are shown by the shaded areas above. Patients most often complain of focal burning, throbbing, and aching in these areas.

Upper Extremity



The veins of the upper extremities, primarily the cephalic and basilic veins, are analogous to the greater and lesser saphenous veins of the superficial venous system in the lower extremities. Because of the proximity of these veins to the radial and ulnar veins, they are commonly used as bypass routes for procedures such as arteriovenous shunts in patients with renal disease. Sclerotherapy of upper extremity veins is not commonly performed for several reasons. Because these veins are not subject to the same hydrostatic pressures as the lower extremity veins, valves in cephalic and basilic veins do not commonly exhibit reflux and associated symptomatology. These veins usually do not appear overly distended or tortuous, and varicosities/telangiectasias do not generally develop in the upper extremities. A noted exception occurs with upper extremity exercisers, such as weight lifters, who perform frequent Valsalva maneuvers during exercise. Prolonged increase in intrathoracic pressure will increase flow through upper extremity veins and can result in clinically noticeable vein distention. This is a normal physiologic response and not considered pathologic. In our experience, branches of the cephalic vein in the forearm and dorsal hand are the most common areas treated with sclerotherapy. Detailed upper extremity venous anatomy is beyond the scope of this chapter.

Treatment Options

Ideally, treatment for unwanted leg veins would be performed in one session, cause no pain, and be 100% effective in clearing vessels, with no associated side effects. Unfortunately, the variation in vessel size, flow, depth, and type preclude the possibility of a single effective treatment modality. However, there are a number of effective treatments that can produce excellent results, including conventional and duplex-guided sclerotherapy for the treatment of larger vessels and telangiectasias and laser treatment of reticular and spider veins.

Conventional (Visual) and Duplex-Guided Sclerotherapy

Conventional sclerotherapy is indicated for the elimination of unwanted reticular veins and telangiectasias. When leg veins are managed in a systematic approach, feeder vessels or larger varicose veins are first eliminated surgically, with radiofrequency or laser ablation, and sclerotherapy proceeds from largest to smallest vessels, with 80% to 90% of vessels responding to one or two treatments. As with endovenous ablation, sclerotherapy is performed in patients of all age groups, ranging from patients in their late twenties to early seventies. If treatment is initiated early in the course of the disease and with proper proximal-to-distal treatment techniques, patients can expect to achieve excellent results. Although hypertonic saline solution is the sclerosant most widely available and used in the United States, there are many others from which to choose that are less painful to inject and less ulcerogenic if extravasated. Vessel size and, to some extent, location are two of the most important factors to consider when choosing a sclerosant.

In expert hands, nearly any vessel can be treated with traditional sclerotherapy techniques. It is more difficult to treat larger vessels, vessels with a high-grade source of reflux, vessels with a complex pattern of reflux, and vessels that lie deeper beneath the surface of the skin. Failures can be caused by incorrect assumptions about the patterns of flow, incomplete understanding of the anatomy, or incorrect placement of the delivery catheter or needle.

Direct duplex ultrasound visualization offers an alternative to “blind” sclerotherapy that has one very important advantage—after a treatment under direct visualization, there can be no doubt that sclerosant has been delivered where it was intended and that all areas of reflux have been exposed to the sclerosing solution. An important secondary benefit is that observable spasm is a predictor of vessel closure.

Indications for Sclerosant Usage

Solution (effective concentrations)	Trade Names	Mechanism	Advantages	Disadvantages
<i>Reticular Veins</i>				
Polidocanol (0.5%-1%)*	Asclera	Detergent (emulsifier)	Always painless Cutaneous necrosis low Effective at low concentrations	Urticaria (immediate) at injection site Skin necrosis from painless arteriolar injection
Sodium tetradecyl sulfate (0.2%-0.5%)	Sotradecol	Detergent (emulsifier)	Painless intravascular Painful extravascular Strong for varicose veins Effective at low concentrations	Skin necrosis with extravasation of concentrations >0.25% Expensive Hyperpigmentation postsclerosis Dissolves rubber—must use latex-free syringes to avoid allergic response
Hypertonic saline solution (20%-23.4%)	None	Hyperosmolar	Low risk of allergic reaction Readily available Rapid action	Painful stinging and cramping Highly ulcerogenic—high risk for skin necrosis if extravasation occurs
Saline and dextrose (25% dextrose and 10% sodium chloride phenethyl alcohol)*	Sclerodex	Hyperosmolar	High viscosity—remains in treated veins Low risk of allergic reaction Low risk of necrosis	Too weak for larger varicosities Slight stinging One concentration only
<i>Telangiectasias</i>				
Polidocanol (0.25%-0.6%)*	Asclera	Detergent (emulsifier)	Always painless Cutaneous necrosis low Effective at low concentrations	Urticaria (immediate) at injection site Skin necrosis from painless arteriolar injection
Sodium tetradecyl sulfate (0.1%-0.5%)	Sotradecol, Fibroven, Thrombovar	Detergent (emulsifier)	Painless intravascular Painful extravascular Strong for varicose veins Effective at low concentrations	Skin necrosis with extravasation of concentrations >0.25% Expensive Hyperpigmentation postsclerosis Dissolves rubber—must use latex-free syringes to avoid allergic response
Hypertonic saline solution (11.7%-23.4%)	None	Hyperosmolar	Low risk of allergic reaction Readily available Rapid action	Painful stinging and cramping Highly ulcerogenic—high risk for skin necrosis if extravasation occurs
Saline and dextrose (25% dextrose and 10% sodium chloride phenethyl alcohol)	Sclerodex	Hyperosmolar	High viscosity—remains in treated veins Low risk of allergic reaction Low risk of necrosis	Too weak for larger varicosities Slight stinging One concentration only <i>Not FDA approved</i>
Glycerine (chromated glycerin 72% solution mixed 2:1 with 1% lidocaine with epinephrine 1:100,000)	None	Osmotic	Relatively painless Lower potential to cause hyperpigmentation Cutaneous necrosis low Lower potential to cause telangiectatic matting	Can cause hematuria at high volumes (>10 ml per treatment session) High viscosity Cannot be used with lidocaine- or epinephrine-sensitive patients <i>Off-label use in United States</i>

*Now FDA approved.

Common indications for injection with duplex ultrasound visualization include the following:

- Greater saphenous vein without junctional incompetence
- Lesser saphenous vein without junctional incompetence
- Truncal or tributary vessels with large failed perforating veins
- Varicosities with saphenofemoral incompetence
- Varicosities with saphenopopliteal incompetence
- Resistance to other techniques of sclerotherapy
- Nontruncal varicosities larger than 5 mm in diameter
- Venous component of arteriovenous malformations
- Varicosities eroding into soft tissues
- Vulvar or scrotal varices
- Varicosities with large open connections to the deep venous system

Although it is generally safe and effective, situations do arise in which sclerotherapy is contraindicated. Any patient with a medical history significant for deep venous thrombosis should be thoroughly evaluated with duplex examination of the deep and superficial venous systems before treatment. Patients with a history of arterial insufficiency or hypercoagulable states should not be considered candidates for treatment. Additionally, sclerotherapy should not be performed on patients who are pregnant, bedridden, or severely diabetic.

Laser Treatment of Reticular Vessels and Telangiectasias

Although sclerotherapy and ambulatory phlebectomy remain the mainstay of treatment of varicose and reticular veins, lasers certainly play a role in the treatment of lower extremity telangiectasias. Upper extremity or dorsal hand varicose veins are best treated with sclerotherapy. Lasers typically have no role in the treatment of upper extremity varicosities.

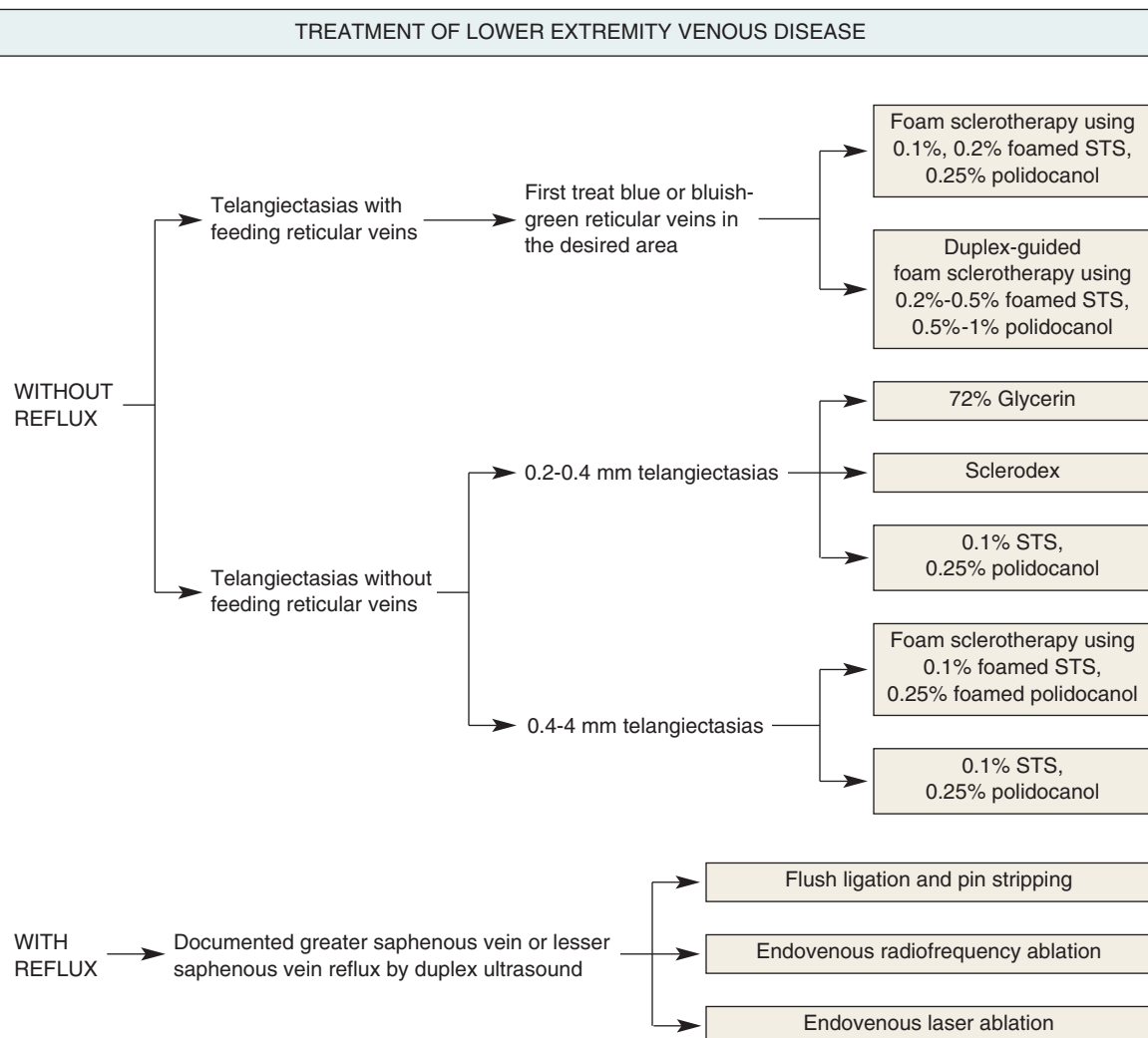
In general, treatment with lasers and light sources is more expensive, results are less predictable, responses are more variable, and the risk of side effects is at least as high as with sclerotherapy. Candidates suitable for laser or light source treatment are those who are needle phobic, have failed sclerotherapy, or have developed untoward side effects from sclerotherapy. Others suited for laser treatment are fair-skinned individuals who either have vessels smaller than the caliber of a 30-gauge needle or foot and ankle vessels that are notoriously difficult to treat with sclerotherapy.

Lasers are typically reserved for the smallest telangiectasias of the leg, but newer long-wavelength lasers can be useful for spider veins up to 2 mm in diameter.

Lasers have the greatest utility in vessels smaller than the diameter of a 30-gauge needle. Additionally, lasers are a good option for treating vessels that are resistant to sclerotherapy. There are instances in which laser and light source treatments should

be considered rather than superficial sclerotherapy, such as patients who are fearful of needles or who do not tolerate sclerotherapy, patients whose vessels fail to respond to sclerotherapy, and those who are prone to developing telangiectatic matting following sclerotherapy treatment. Additional carefully monitored controlled studies are essential to better define the role of each of the available lasers and light sources, and the optimal treatment parameters for leg telangiectasias.

Despite the fact that sclerotherapy has a long list of potential side effects, including pain, swelling, urticaria, systemic allergic reaction, hyperpigmentation, telangiectatic matting, skin necrosis, and phlebitis, it remains the treatment of choice for most leg veins less than 4 mm in diameter.



STS, Sodium tetradecyl sulfate.

Overview of Sclerotherapy Treatment Regimen

When sclerotherapy is planned to treat varicose disease, the first treatment session is considered a test treatment and is usually limited to one or two sites. The goals of this test are as follows:

- To observe the patient for any allergic reactions
- To determine the patient's ability to tolerate the burning or cramping of a hypertonic solution
- To judge the effectiveness of a particular concentration of sclerosing agent
- To observe any reactions to the tape used for compression

The patient returns 4 to 6 weeks later so the test site can be compared with pre-treatment photographs. At each follow-up session the patient is asked if the painful symptoms have decreased and if the appearance of the varicosities has improved. When the symptoms have resolved, the physician can be confident that the treatment has been successful, even before visual improvement is evident. Conversely, if visual improvement is noted but the symptoms have not resolved, the source of reflux has not been eliminated, and a recurrence in the treated area is highly likely.

The usual number of treatments is two to five per region, with a typical interval between treatments of 4 to 8 weeks. After a series of successful treatments, a rest period of 6 months is preferred to observe for second-generation vessels and to allow venous pressure to normalize. Reevaluation is done at 6 months if new or recurrent vessels appear.

Patient Education

Before treatment is initiated, the patient is asked to view a sclerotherapy consultation video that explains the pathophysiology of spider veins, treatment options, pre-operative and postoperative care, and the need for compression therapy among other issues. After the test treatment and before the next treatment session, the patient is instructed to eat beforehand to avoid a vasovagal response. Female patients are told not to shave their legs or use moisturizers on the day of treatment, to wear shorts during treatment sessions, and to bring support hose to the visit.

Compression therapy is very important to improve and maximize the results following sclerotherapy. External compression collapses and decreases blood flow in the treated veins, allowing maximal sclerosant effects on the vessel walls. To achieve adequate compression, it is recommended that patients use class I (20 to 30 mm Hg) compression stockings for at least 2 weeks.

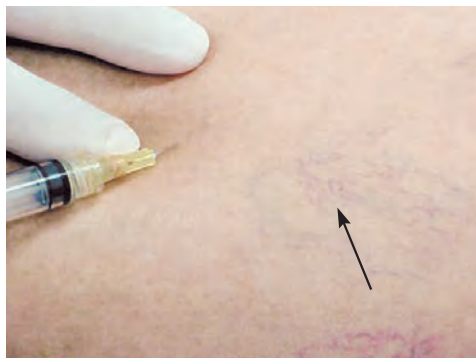
It is not uncommon for patients to present for a treatment session and request that lasers be used in place of sclerotherapy. Patients must be counseled that lasers are a second-line treatment for spider and varicose veins. They are not as effective as conventional sclerotherapy in their current technologic state. Treatment with currently available lasers requires longer sessions, is generally more painful, and poses more risk of causing harm.

TECHNIQUE

Glycerin Sclerotherapy

Glycerin is usually supplied in 100% or 72% solutions, in the chromated form. Because glycerin injected at 100% is painful and too viscous, it is usually diluted 2:1 volume/volume with 1% lidocaine with 1:100,000 epinephrine. It acts as an osmotic corrosive agent, causing damage to the vessel wall directly, and works very well on vessels 0.5 mm or smaller. To minimize the risk of hematuria, the use of more than 10 ml of glycerin per treatment is not recommended.

Lateral Thigh Telangiectasias



This 35-year-old woman presented with concerns about a spider vein on her right thigh (*arrow*). The veins had appeared after the birth of her first child 4 years earlier and persisted without worsening.

A clustering of 0.5 to 0.8 mm bluish-colored telangiectasias was evident on the right anterior thigh. These vessels were associated with a 2 mm reticular vein, which was injected. These associated telangiectasias were not located in the typical distribution for the greater saphenous vein.

The patient underwent a test treatment with two different sclerosants: 72% glycerin solution (compounded by the University Compounding Pharmacy, San Diego, CA) and 0.1% sodium tetradecyl sulfate (STS) (Fibro vein; V.S. Ltd., Birmingham, England) and wore compression stockings, 20 to 30 mm Hg, for the next 2 weeks to ensure the best results.

Treatment

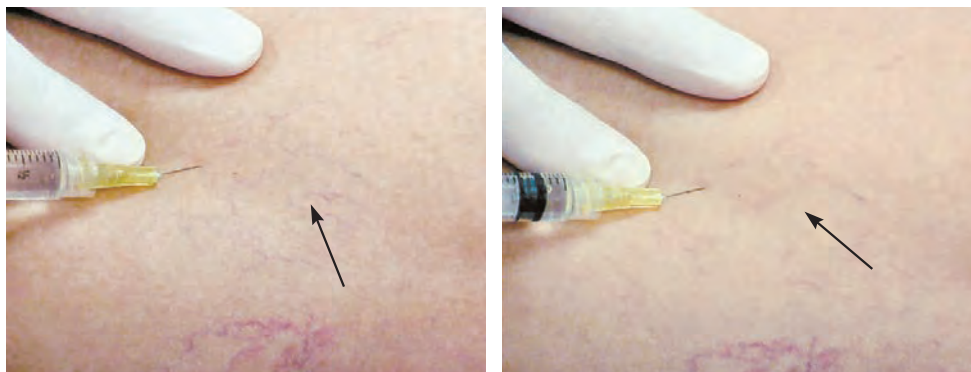
The patient returned for a full sclerotherapy session 4 weeks after the test treatment. The previously treated areas were evaluated and showed good resolution of vessels, without evidence of hyperpigmentation.

The patient was placed in the supine position on a surgical table with a sclerotherapy tray nearby. After wiping with isopropyl alcohol, a disposable 30-gauge needle connected to a 3 ml syringe and filled with 1 ml of the 72% glycerin solution was used to cannulate the vein. The needle was bent at a 30-degree angle to facilitate cannulation. The solution was slowly injected into several places in the vein.

Standard Sclerotherapy Tray Contents

Cotton balls, dry and soaked with 70% isopropyl alcohol
Protective nonsterile gloves
30-gauge disposable plastic-hub needles
Cotton balls or rolls for compression
Transpore or paper tape
Nitroglycerin paste for prolonged blanching
Clearly labeled sclerosing solutions in 3 ml disposable latex-free syringes





On withdrawal of the needle, immediate but transient blanching of the telangiectasias was noted. After treatment, mild erythema and urtication were noted along the course of the treated vessels.

Foamed Sodium Tetradecyl Sulfate Sclerotherapy

Foamed sclerosant is an alternative to traditional liquid sclerosant; it offers several advantages:

- Better displacement of the venous blood to allow intimate and prolonged contact with the vessel wall
- Ability to maintain its concentration more than liquid sclerosant, which is diluted by venous blood
- Ability to travel farther along the vessel than liquid sclerosant

Currently, foam sclerotherapy is an off-label use.

Anterolateral Tributaries of the Greater Saphenous Vein



Foamed sclerosant was used to treat this patient, who complained of a bulging varicose vein, approximately 7 mm, located on the lateral aspect of her right thigh. To evaluate her problem, duplex ultrasound evaluation was performed on the right greater saphenous vein, with emphasis on the saphenofemoral junction. This was found to be within normal limits; however, the anterolateral branch showed evidence of reflux along its course.

Treatment



The patient was placed in the supine position on a surgical table with a sclerotherapy tray nearby. A disposable 27-gauge needle connected to a 3 ml latex-free syringe was used to canalize the vessels.

After flashback was visualized, the sclerosant solution, 0.5 ml of 1.0% foamed STS, was slowly injected into the proximal varicosity.

On withdrawal of the needle, the areas treated were gently massaged in a proximal direction. This process was repeated distally along the course of the vein, approximately every 4 to 5 cm. The patient is shown after treatment.

Dorsal Hand Veins

A foamed sclerosant was also used for hand sclerotherapy in patients who have cosmetic problems on their enlarged dorsal hand veins.

Careful consideration during the medical examination includes any history of hand trauma, weakness, carpal tunnel syndrome, need for frequent intravenous medications, and foreseeable need to canalize hand veins. Consent must include the fact that the treated vein would no longer be usable in the future, in the event that it would be needed as a route for intravenous access. During the physical examination, the brachial and antecubital veins need to be identified, which could be accessible in the event of a future need for intravenous access.

Treatment



The patient is placed in the supine position, and the arm and forearm on the side to be treated should be placed along the bedside. A disposable 30-gauge needle connected to a 3 ml latex-free syringe is used to canalize the vessels. The sclerosant solution, 0.5% to 1.0% foamed STS, is commonly used for hand sclerotherapy. Alternatively, the newly FDA-approved sclerosant, 0.5% to 1.0% polidocanol (Asclera) can also be used, foamed or nonfoamed. The sclerosant should be injected slowly after confirming a flash of blood in the needle hub. Vein distention and mild blanching occurs while the foam is being injected.



This 49-year-old woman presented with cosmetic concerns about her hands. She thought they looked old and “worn down.” She inquired about any treatments that could revitalize the appearance of her hands. She was distressed about the dorsal hand veins, which were especially prominent and had become more noticeable over the past 5 years. On physical examination, a bluish superficial varicose vein of approximately 5 mm was noted on the dorsal aspect of the left hand.



One year later, marked reduction of dorsal hand veins is seen on the left hand compared with the untreated right hand.

Postoperative Care

The patient should elevate the treated hand immediately after injection to minimize dilution of the foam sclerosant with venous blood and to maximize the contact of the sclerosant with the vein walls. Compression wrapping or a gauntlet is placed on the treated hand while the entire upper extremity is still elevated. The patient is instructed to carefully monitor for any changes in sensation, temperature, color, and decreased motion in the fingers on the treated hand. If these symptoms occur, the patient should loosen the compression bandage; otherwise, it should be kept on overnight.

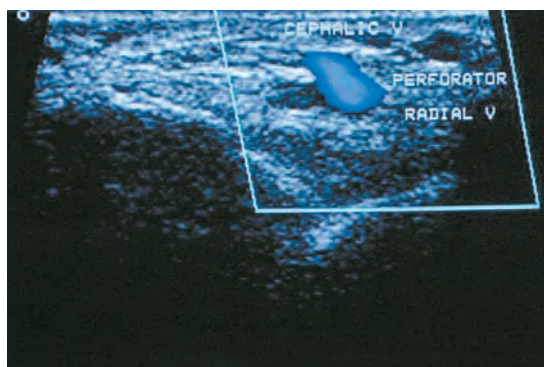
Duplex-Guided Foamed Sodium Tetradecyl Sulfate Sclerotherapy

Volar Wrist Arteriovenous Malformation

The deep and superficial venous systems of the upper extremities are analogous to those of the lower extremities. The deep venous system contains the majority of the blood volume at any given time. Perforators connect the two systems, just as they do in the lower extremities. Reflux of these perforators or in the superficial system itself can cause a systematic weakening of the superficial vessel walls with distention and pooling of blood. Congenital dysfunction in these systems predisposes to arteriovenous formation.

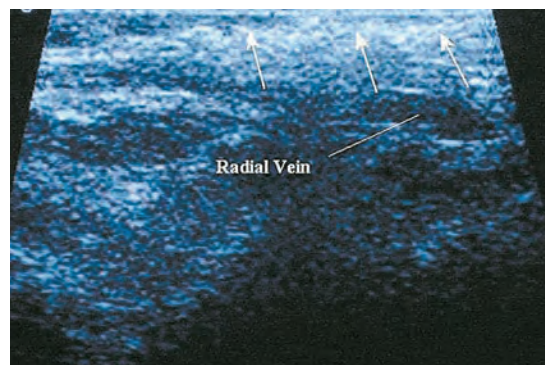


This 52-year-old man was seen for evaluation and treatment of a lifelong, intermittently tender, protruding mass on the volar aspect of his left wrist. He noted that the swelling and lumpiness had worsened with age and were associated with increased sweating, redness, and heat sensation on his left hand in comparison to the right hand. He had been evaluated 10 to 15 years earlier by radiologic examination and was found to have an arteriovenous malformation. An approximately 5 cm spongy, bluish-purple mass was noted on the flexor aspect of the left wrist, with extension to the thenar and hypothenar eminences. The lesion blanched slightly with pressure.



The patient underwent a duplex ultrasound examination of the venous tributaries of his left wrist, which revealed an incompetent, refluxing perforator communicating between the radial vein and the more superficial cephalic vein. Additionally, slow flow was noted in the cephalic venous malformation. Duplex examination did not identify any other communicating perforators or aberrant vascular structures. The patient was willing to undergo duplex-guided sclerotherapy for treatment of the reflux.

Treatment



Under duplex guidance, a solution of 0.1% foamed STS was slowly injected with a 27-gauge 1-inch needle after withdrawing slightly to visualize blood flashback in the needle hub. A total of 1.5 ml of foamed STS was injected during the first visit. Foamed STS was achieved using the Tessari technique, in which 1 ml of the sclerosant in a latex-free syringe was mixed with 2 cc of air in an empty syringe using a one-way stopcock. Foam position was verified with duplex as being confined to the superficial cephalic vein, with little to no foam traveling to the deeper radial vein. In addition, firm pressure was applied just distal to the injection site to better localize the sclerosant. Immediate blanching and slight spasm of the vessel was noted after treatment. The patient had no complaints of pain at the conclusion of the treatment.



At the follow-up visit 5 weeks later, the patient noted a mild decrease in the lesion size and was treated again with 1.5 ml of 0.5% STS, resulting in the improvement shown.

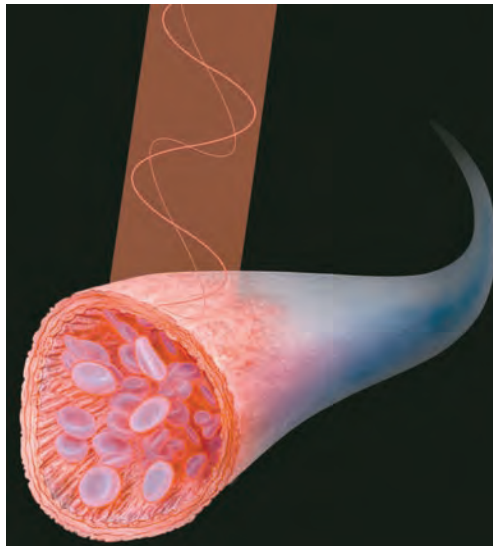
Postoperative Care

In the immediate postoperative period, the patient's arm was elevated and the wrist massaged from the proximal to distal direction. A compression dressing was placed on the area and secured with Coban wrap. The patient was told to remove this dressing the following day. No further care was needed.

Long-Pulse Laser Therapy

Long-pulse Nd:YAG 1064 nm lasers have been developed in an effort to target deep relatively large-caliber cutaneous vessels. The primary benefit of this wavelength is its capacity for relatively deep penetration to approximately 0.75 mm in human skin, allowing targeting of vessels in the middermis. The wavelength is well absorbed by water and hemoglobin, but not by melanin, thus allowing treatment even in deeply pigmented individuals. However, high energies must be used for adequate penetration in these individuals. Only with sufficient fluence and facilitation of heat dissipation can the posterior wall of a larger diameter (1 to 2 mm) vessel filled with deoxygenated hemoglobin be reached and heated.

The newer pulsed 1064 nm lasers have pulse durations between 1 and 200 msec and are capable of more than 350 J/cm² at small spot sizes. In general, treatment with long-pulse 1064 nm laser light is relatively painful and requires cooling and topical anesthesia. Large-caliber vessels greater than 0.5 mm in diameter respond best. Vessels up to 3 mm can be treated with long-pulse Nd:YAG lasers. Some of the effects of hydrostatic pressure may be addressed by treating these larger vessels, although the pain experienced by patients significantly increases beyond a 2 mm vessel. Recent data suggest that by using smaller spots and even higher fluences, even small vessels respond.



It is likely that the 1064 nm laser achieves its vasodestructive effects by penetrating deeply enough to cause complete, circumferential thermal damage to the vessel wall. For patient comfort and epidermal sparing, some type of cooling must be employed, whether in the form of contact cooling, cryogen cooling, or ice-cold gel.

Anterior Thigh Telangiectasias



This 41-year-old woman presented with a 5-year history of anterior right thigh telangiectatic vessels. She had long wished to be rid of the unsightly, asymptomatic veins but had an overriding fear of needles, which prevented her from seeking treatment.



She agreed to undergo a series of test pulses with the long-pulsed Nd:YAG 1064 nm laser (Laserscope Gemini) to a small segment of the veins. She underwent a duplex examination of the right greater saphenous vein and right saphenofemoral junction, which revealed no abnormalities. Duplex examination did reveal enlarged antero-superior branches of the lateral subdermic venous system. The patient was unwilling to undergo duplex-guided sclerotherapy for the reflux and instead opted for 1064 nm laser treatment of her spider veins. She was informed that the results of this treatment would likely not be permanent.

Treatment



Courtesy Girish S. Munavalli, MD



Before treatment



Immediately after treatment



10 minutes after treatment



1 week after treatment

A grouping of telangiectasias on the patient's thigh were selected and treated at a constant fluence of 120 J/cm^2 with a spot size of 2.5 mm and varying pulse durations from 10 to 40 msec. Ice-cold gel was applied to the skin before laser treatment. A pulse duration of 30 msec produced the best immediate contraction, as illustrated by handheld digital microscopy.

Postoperative Care

The patient requires minimal care in the postoperative period. He or she should be made aware of the potential for posttreatment hyperpigmentation, which results from the hemosiderin degradation products of blood trapped in the vessel during and after treatment. The larger the treated vessel, the more likely the chance that hyperpigmentation will occur. Most hyperpigmentation resolves spontaneously within 3 to 6 months.

Concluding Thoughts

Sclerotherapy is a safe, effective treatment for leg and hand varicosities. The surgeon must recognize various patterns of varicose veins, thoroughly understand the pertinent anatomy, be familiar with sclerosants and injection techniques, and the use of compression therapy; these are the key to successful treatment. Underlying superficial or deep venous insufficiency requires management before one attempts to treat clinically apparent reticular or spider veins to avoid failure of the sclerotherapy and potential complications.

Clinical Caveats

Sclerotherapy

Be aware of your body position; avoid neck and back strain.

Avoid halogen surgical lighting—indirect lighting is best.

Use magnification (1.5 to 33).

For smaller matting, use double-polarized light.

Apply alcohol to decrease white scale reflection.

Stretch the skin taut for easier cannulation.

Bend the needle 30 degrees.

Obtain 30-gauge disposable needles with a plastic hub (needles are available at www.air-tite.com); the needle should be changed frequently if it dulls.

Do not attempt to withdraw blood into the hub with vessels less than 0.55 mm in diameter; intravascular placement cannot be confirmed except by the smooth flow of solution.

Before solution is injected, producing a tiny air bubble (approximately the volume in the hub) may be helpful to clear the existing blood.

Inject very slowly, with little pressure, 0.1 to 0.3 ml at each site.

For immediate pressure, apply cotton balls and tape for 24 hours.

Advise the patient to wear compression hose (20 to 30 mm Hg) for 2 weeks after treatment.

Foam Sclerotherapy

Be aware of the anatomy and orientation of each individual patient.

Use latex-free syringes when using STS.

Produce a small bolus of air or foam preceding injection of the sclerosant when possible.

Draw venous blood (low pressure and darker) freely back into the syringe before injection.

Visualize the initial injection of foam or sclerosant.

Stop if distention or bulging around the vein occurs.

Stop if the patient complains of discomfort at the first moment of injection.

Note immediate vessel contraction as a treatment endpoint.

Duplex-Guided Sclerotherapy

Try to identify reticular veins, which may be difficult to clinically appreciate but feed smaller vessels; if they are identified, treat those first.

Draw venous blood (low pressure and darker) freely back into the syringe before injection.

Visualize the initial injection of several drops of foam or sclerosant.

Stop if distention around the vein is seen on ultrasound.

Stop if the patient complains of discomfort at the first moment of injection.

The proper endpoint is total contraction.

Foam resting in the vein is often seen on duplex imaging.

Long-Pulse Laser Therapy

Use 1064 nm laser for treatment of leg telangiectasias.

Always check that safety glasses are in use by all.

Target only superficial reticular and telangiectatic vessels.

Use long-pulse laser therapy for vessels larger than 0.5 mm.

If the vessel is 0.5 mm or larger, start with a modest fluence of 60 to 80 J/cm² at a pulse duration of 30 msec (given a 2.5 cm spot size) and gradually increase the fluence.

If the vessel is 0.5 mm or smaller, start with a pulse duration of 15 to 16 msec.

Have ice-cold gel on hand to decrease the sensation of pain and avoid epidermal injury.

Strongly avoid double-pulsing or pulse-stacking the laser at these settings; vessels can be re-treated after several minutes if the settings need to be modified.

After successful treatment, note the vessel contraction, perivessel erythema, and edema.

Annotated Bibliography

Bowes LE, Goldman MP. Sclerotherapy of reticular and telangiectatic veins of the face, hands, and chest. *Dermatol Surg* 28:46-51, 2002.

Prominent, tortuous veins of the face and hands may result from the process of aging and constitute a source of distress for many patients. Marked telangiectases of the chest and face are similarly distressing to some patients. In this article the authors discuss the safety and efficacy of sclerotherapy for telangiectatic veins of the face and chest, and varicose veins of the hands.

Cabrera J, Cabrera J Jr, Garcia-Olmedo MA, et al. Treatment of venous malformations with sclerosant in microfoam form. *Arch Dermatol* 139:1409-1416, 2003.

Treatment of congenital venous malformations poses a major clinical challenge. Surgery is difficult and frequently unsuccessful, radiologic intervention with embolization has an ill-defined role, and conventional sclerotherapy has little to offer. The authors evaluate the efficacy and safety of sclerosant in microfoam form for treating congenital venous malformations.

Duffy DM, Garcia C, Clark RE. The role of sclerotherapy in abnormal varicose hand veins. *Plast Reconstr Surg* 104:1474-1479, 1999.

Large, tortuous veins involving the dorsa of the hands often become more prominent with the passage of time and are a common source of patient dissatisfaction. This article evaluates the results of sclerotherapy for the management of unsightly varicose veins of the dorsum of the hand. Adverse events are also discussed.

Tessari L, Cavezzi A, Frullini A. Preliminary experience with a new sclerosing foam in the treatment of varicose veins. *Dermatol Surg* 27:58-60, 2001.

Recently a new method of using a foam sclerosing agent for the treatment of leg veins has been described. The authors present a pilot study of Tessari's technique for producing the sclerosing and its use in sclerotherapy of major and minor varicosities. The authors evaluate the safety and efficacy of different doses and concentrations of the drug, as well as different methods of preparing the foam. The results of this technique are also evaluated.

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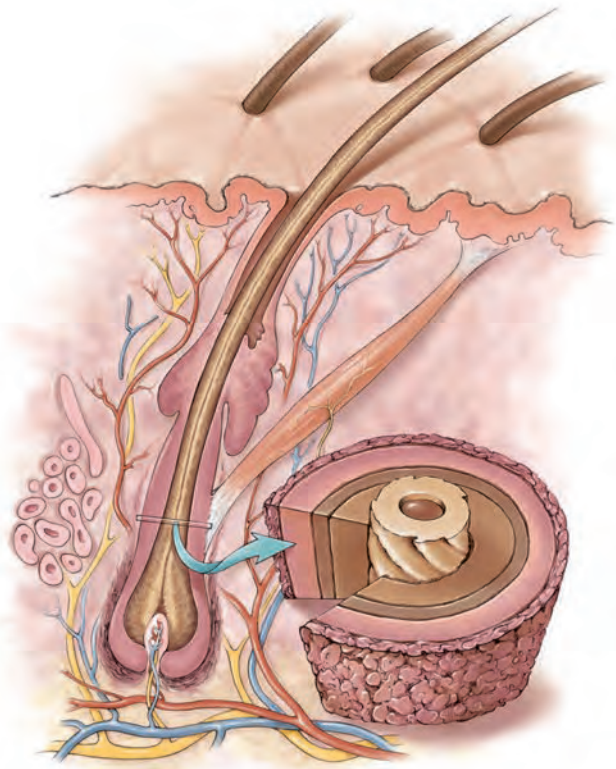
PART IV

HAIR TRANSPLANTATION



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CHAPTER 18



Applied Anatomy in Hair Transplantation

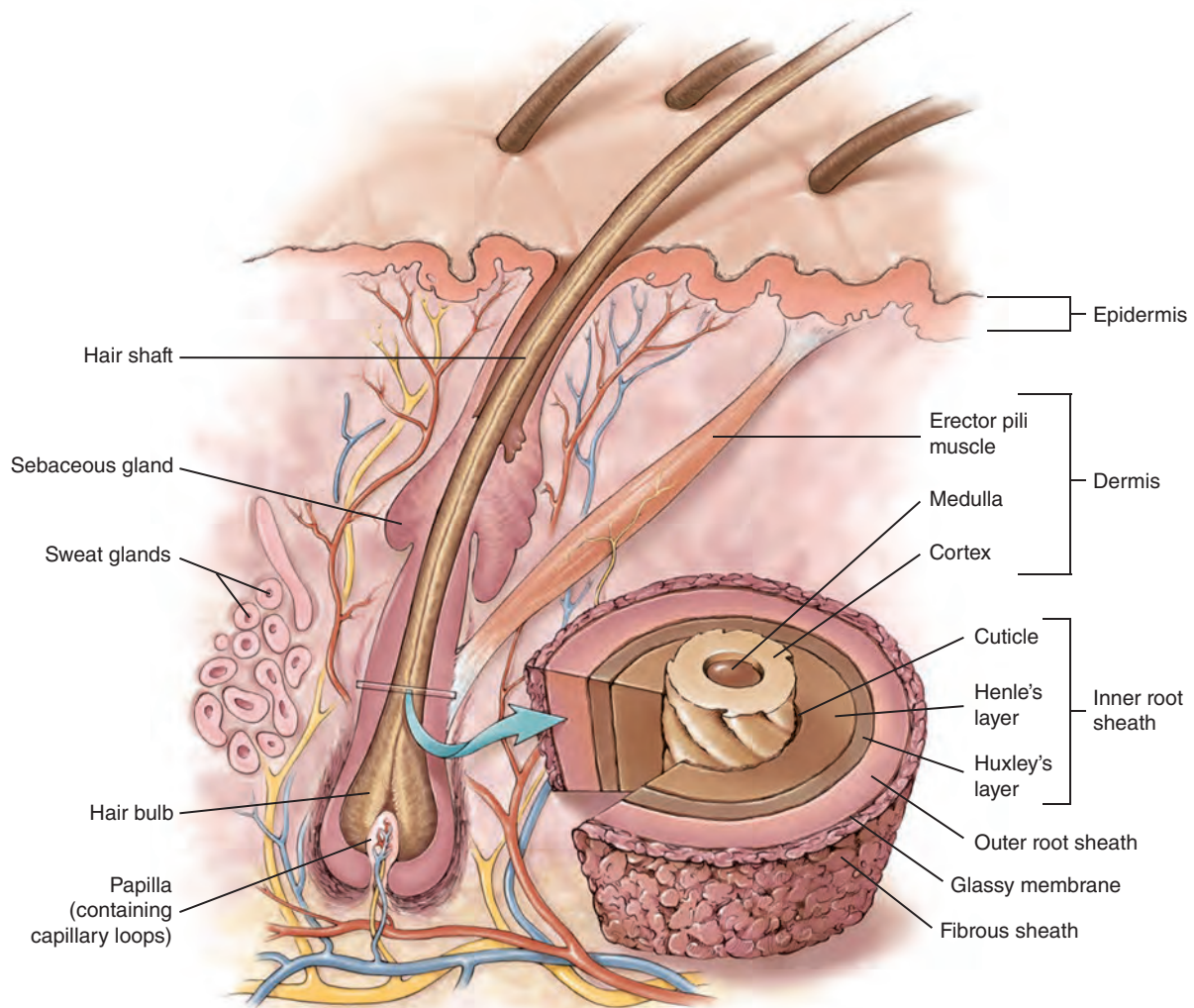
ALFONSO BARRERA

Historically, hair has been a source of pride to humans and serves as a distinguishing feature that adorns as well as protects. It is also one of our most variable characteristics. Wide differences in color, density, texture, length, and style characterize different races and ethnic groups. Hairstyling and adornment have evolved throughout the ages. Today men as well as women place a premium on hair fashion and products to enhance their appearance. Considering its significance, it is easy to understand why hair loss often causes severe emotional distress and why people seek hair restoration.

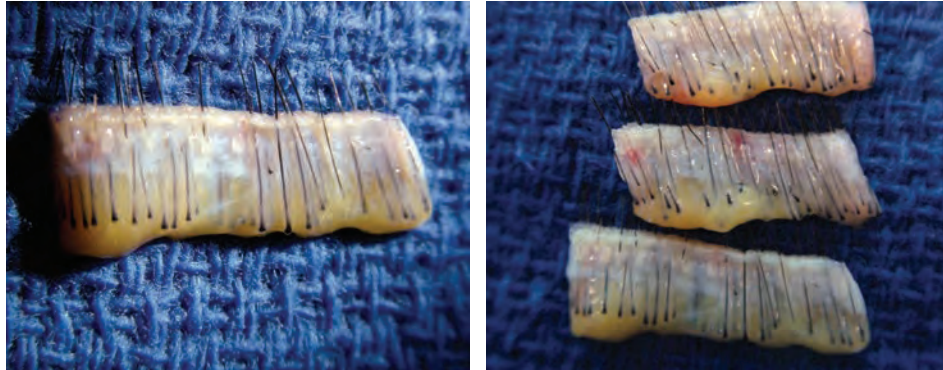
For a surgeon performing hair transplantation, it is important to have a basic understanding of anatomy and aesthetics to obtain optimal results. The character and texture of hair vary, depending on its stage of development and location. *Lanugo* hair is the soft, fine, and usually clear, nonpigmented hair that covers the fetus and generally sheds around the eighth gestational month. *Vellus* hair is the fine, clear, almost invisible hair seen on the forehead. *Terminal* hair, which is coarse, long, and of variable pigment, characterizes the adult years. Subtypes of terminal hair are found on the scalp, eyebrows, upper lip, chin, axillas, chest, and pubis. Vellus hair may become terminal hair; for example, facial vellus hair in adolescents may develop into a beard, and terminal hair on the scalp may turn into vellus hair in male pattern baldness and androgenic alopecia in females.

In an embryo, the hair follicles originate from both ectoderm and mesoderm in the third gestational month and continue to develop over the next 3 months. Hair follicles develop from microscopic indentations of ectoderm, the outermost of the three embryonic tissue layers. These indentations meet and combine with small elevations of mesoderm, the middle layer of embryonic tissue. The cells that form the hair dermal papillae, the fibrous sheath of the follicle, the blood vessels, and the erector pili muscles originate from the mesoderm.

The cells that form the hair matrix and the melanocytes are of ectodermal origin. The melanocytes produce the color granules in the central, hollow core of the hair shaft that give hair its natural color. The cells from the matrix divide and are pushed upward; they are continuously replaced by new cells forming beneath them. Later, two buds are formed from special cells to create the sebaceous glands and the erector pili muscles.



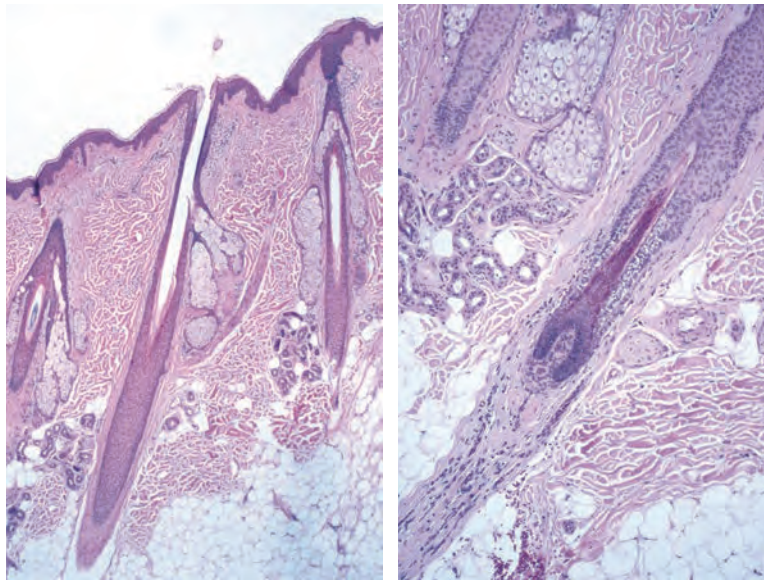
As the matrix cells continue to be pushed up and outward and become dehydrated by an extrusion process, they form a tubular hair shaft of dead protein called *keratin*. This hollow tube is then filled with color granules (melanin) that give hair its natural color. As we age, the melanocytes cease functioning, resulting in gray or white hair.



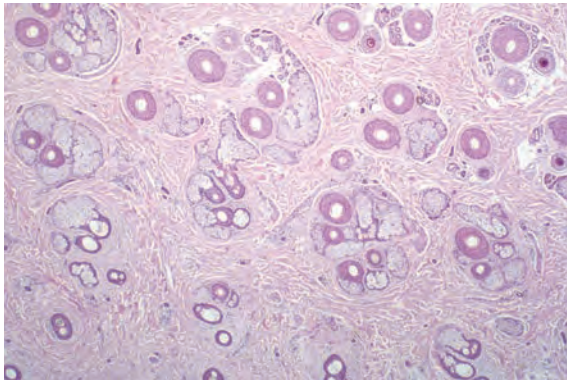
The anatomy details of the hair follicles are clearly seen in these photos. The epidermis, dermis, and almost immediately deep to that a slight brown bulging structure can be seen. This corresponds to the sebaceous glands. The hair shaft continues deep to the hair bulb, surrounded by subcutaneous fatty tissue.

Histology

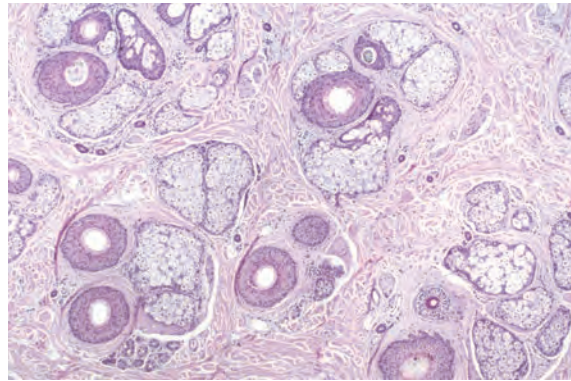
To accomplish natural, aesthetic results in hair transplantation, one must pay attention to many small details, starting with the important histologic features of hair follicles.



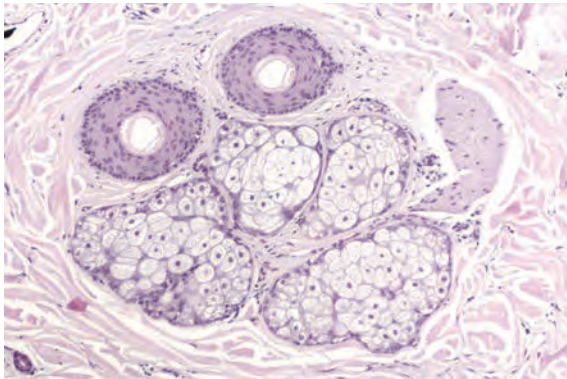
Epidermis, dermis, dermal appendages, and subcutaneous fatty tissue can be seen on vertical histologic sections of skin taken for skin biopsies or when checking tissue margins after excision of skin lesions.



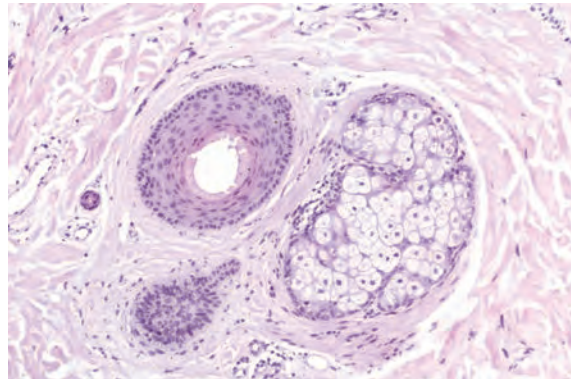
Multiple follicular units of various sizes



Close-up view



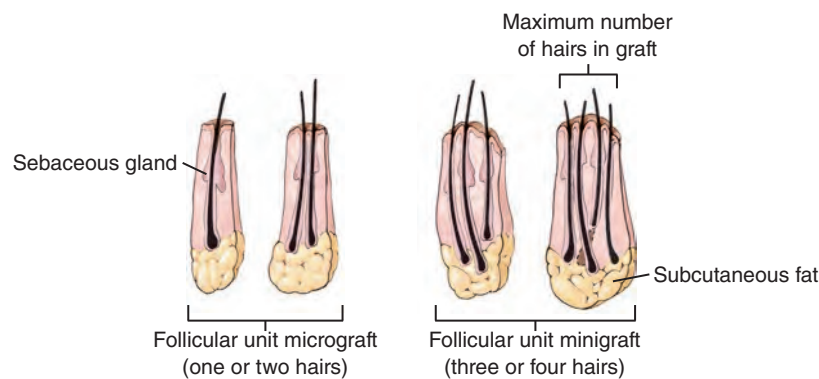
Two-hair follicular unit



One-hair follicular unit

Transverse sections demonstrate that hair follicles grow in follicular units. In his landmark 1984 article, Headington described the *follicular unit* as including one to four terminal hairs, one vellus hair (rarely two), nine sebaceous glands, insertions of erector pili muscles, a perifollicular vascular plexus, a perifollicular neural network, and perifolliculum (a circumferential band of fine adventitial collagen that defines the unit). This suggests that a unit constitutes at least to some degree a physiologic entity.

Follicular Units

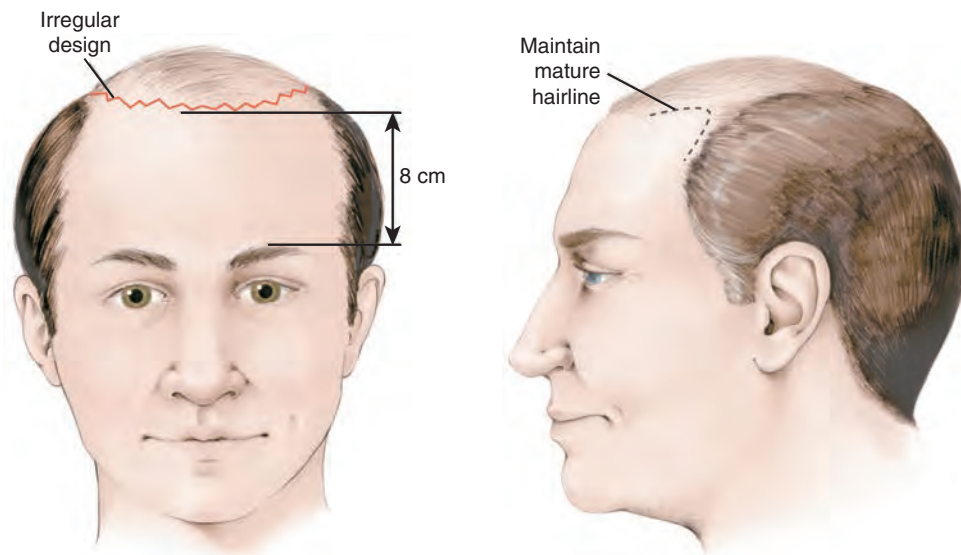


IDEAL HAIR GRAFTS

When planning hair transplantation, it is important to maintain the follicular units as intact as possible. As long as the surgeon uses grafts with no more than four hairs per graft, the appearance of clumpiness (the “plug” look) can be avoided altogether.

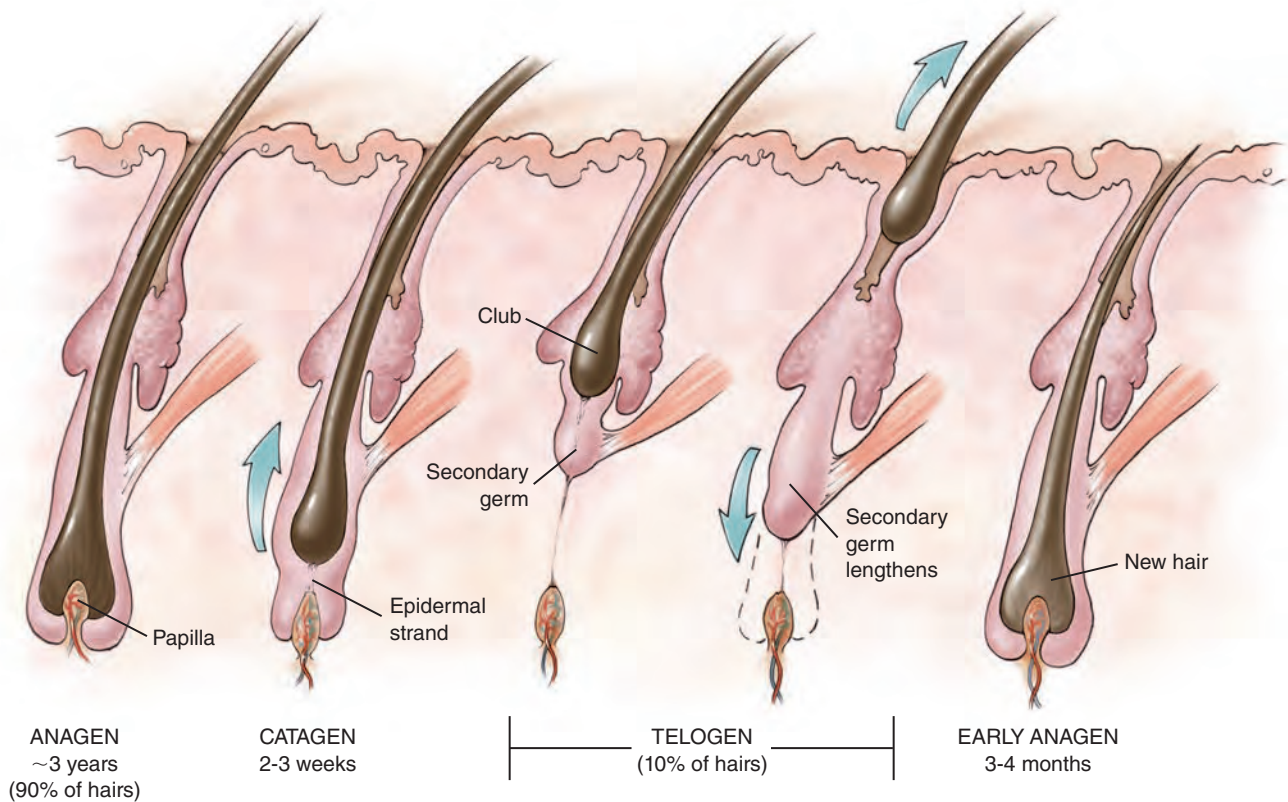
Two two-hair follicular units may be used together as one graft, or one one-hair follicular unit may be used with a two-hair follicular unit as one graft. In selected areas it may be desirable to use primarily one- or two-hair follicular units (*micrografts*), as in the front hairline. In other areas a mixture of one- or two-hair follicular units and three- or four-hair follicular units (*minigrafts*) are desirable. In yet other areas, such as behind the front hairline, three- or four-hair follicular units are ideal, because they provide more density.

Design of the Hairline



The design of the hairline or the area to be transplanted is crucial, the idea being to mimic nature as much as possible. The position of the front hairline is critical for a natural result; conservatism is in order. The goal is to achieve a mature hairline. The size and shape of the head vary from person to person, as does the position of a mature hairline. Generally, the midline of the new hairline is approximately 8 cm from a horizontal line immediately above the eyebrows. In some patients a slightly longer or shorter distance is appropriate, depending on the specific facial features, shape, and size of the head as well as the interrelationship and proportions of the face and skull.

Growth Cycle



There are three life cycle phases of hair growth. The living cells at the base of the hair follicle first show active, mitotic growth, eventually forming a compact column that extends toward the surface of the skin. A zone of keratinization then forms directly above the actively dividing cells. The living cells become dehydrated, eventually die, and are converted into a mass of keratin. The keratin filaments are finally cemented together by a matrix rich in cystine. The average rate of growth of scalp hair is approximately 0.35 mm/day or 1 cm/month. The dermal papilla, which is situated just under the actively dividing cells of the follicle, plays an important role in the regulatory control of the hair's growth cycle.

The first phase, *anagen*, is the active growing phase in which the follicular cells are actively multiplying and keratinizing. In a nonbalding scalp, approximately 90% of the hairs are in this phase, which lasts about 3 years. During the second phase, *catagen*, the base of the hair becomes keratinized, forming a club, and separates itself from the dermal papilla. It then moves toward the surface and is eventually connected to the dermal papilla only by a connective tissue strand. This phase lasts 2 to 3 weeks.

The third phase, *telogen*, is also known as the “resting phase.” During this phase the attachment at the base of the follicle becomes weaker until the hair finally sheds. During this period the follicle is inactive and hair growth ceases. This phase lasts 3 to 4 month—and commonly occurs after hair transplantation. For this reason, significant growth of the hair grafts is not seen until this phase is over. In addition, some of the native hair often goes into the catagen phase and then into the telogen phase from the insult of the surgery; this is called telogen effluvium.

Approximately 10% of hair follicles in a nonbalding scalp are in the telogen phase. When the rate of hair loss exceeds the rate of growth, thinning and eventually baldness develop.

Applied Anatomy

Male pattern baldness is a gradual conversion of hairs from the terminal (healthy, thick) to the vellus (clear, microscopic) state. In the most common type, male pattern baldness primarily affects the top of the head while the hair on the temporal and occipital areas is preserved. Hair loss in women, female androgenic alopecia, occurs less frequently and is more diffuse. In women, the front hairline is usually preserved. Both of these are naturally occurring and have primarily a genetic origin. This is a hereditary condition that appears to be controlled by a single, dominant, sex-linked autosomal gene. The expression of this gene is dependent on the level of circulating androgens. The initial signs of thinning clearly correlate with puberty in males, when the levels of androgens (testosterone) start to rise, gradually converting terminal hair into vellus hair. Initially this results in a receding hairline and, depending on the genetic features inherited, may progress until only a temporal and occipital fringe remains.

Testosterone secreted by the testes is the principal androgen circulating in plasma in men, whereas in women the adrenal steroids dehydroepiandrosterone sulfate, androstenediol sulfate, and 4-androstenedione are the most abundant proandrogens. A *proandrogen* is a 19-carbon steroid that is converted at the target tissue into active androgen. The enzymatic reduction of testosterone and the previously mentioned androgens in females by 5- α reductase into dihydrotestosterone is necessary for the induction of androgenic hair loss in both men and women.

Although genetic predisposition is the cause of most forms of hair loss, other sources of hair loss include (in order of frequency in my practice):

- Hair loss associated with aesthetic facial rejuvenation surgery, coronal and endoscopic forehead lifts, such as loss of sideburns, temporal hairline, and distortion of the retroauricular hairline

- Scalp and facial hair loss associated with burns or other traumatic injuries

Congenital abnormalities of the face or scalp, such as vascular malformations and melanotic nevi that require surgical excision
Postoncologic resections resulting from the excision of skin or scalp tumors

Surgeons must be equipped to restore sideburns, the temporal hairline, the retroauricular hairline, eyebrows, eyelashes, mustache, beard, and areas of the scalp. Many remedies have been described over the centuries to enhance and/or regrow hair—none of which has been truly effective. However, as we have learned more about the anatomy and physiology of the hair, it has become clear that optimal graft survival and ultimate hair growth depend on transplanting more than just the bare hair shafts.

Slightly chubby grafts and intact follicular unit grafts thrive much better, as demonstrated by Seager in 1997. Dissecting a micrograft to the bare hair shaft deprives it of vital structures that ensure its survival. Whether it is the perifollicular vascular plexus, the sebaceous glands, or other appendages that are necessary for survival is unknown. Seager reported 113% hair survival and growth with follicular unit grafts. Presumably, hairs that were in the telogen phase were not initially counted but ultimately grew hair. These hairs in the telogen phase are also included when slightly chubby micrografts and minigrafts are transplanted.

Concluding Thoughts

It is extremely important that all surgical assistants have a clear understanding of the anatomy of the hair follicles. The ultimate result of hair transplantation will depend to a great extent on the accuracy of their dissection of the donor strip into grafts. Minimizing transactions of hair follicles and hair shafts is very important, and they must be handled atraumatically.

Clinical Caveats

When harvesting the donor ellipse, the surgeon must keep the incision superficial to the fascia to preserve the occipital nerves and vessels. Dissection should separate the plane between the subcutaneous tissue and fascia.

The elasticity of the scalp in the donor area is usually greatest in the midline and becomes less elastic laterally toward the ears and temple.

The density of hair is usually greatest at the midline and diminishes as one proceeds laterally.

Continued

Clinical Caveats—cont'd

Minigrafts and micrografts should be inserted in the recipient site following the same angulation and orientation of the residual hair to mimic the natural direction of hair growth.

The epidermis of the graft should remain superficial to the epidermis of the scalp to avoid ingrown hairs and epidermal inclusion cysts.

Minimal incisions at the recipient site will avoid detectable scarring.

Grafts larger than one follicular unit will produce an unnatural appearance because of compression.

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Another point of view on the histology and anatomy of the scalp.

Thomas JF. Transverse sectioning of the scalp (Headington technique) in the 19th century. *J Cutan Pathol* 35:82-85, 2008.

The article provides information of historical interest concerning two slides of human scalp that were prepared in the latter half of the nineteenth century and recently became available. Dr. Thomas details the methods of preparation and their similarity to today's methods.

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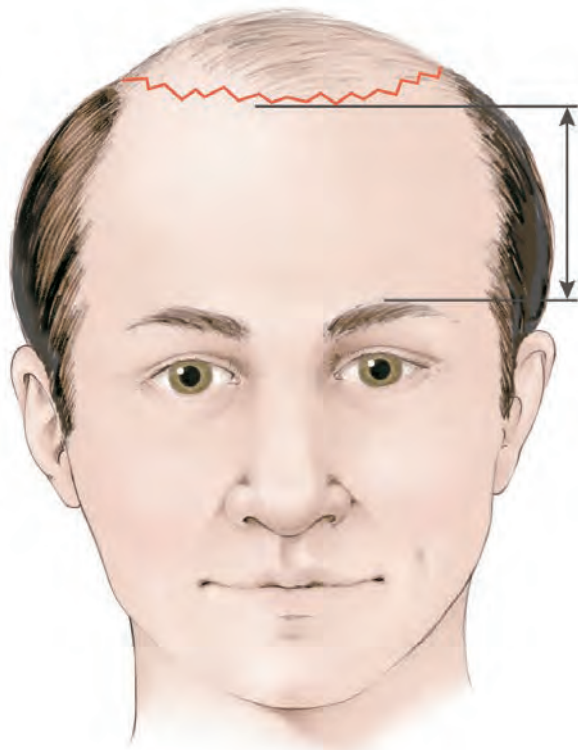
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CHAPTER 19



Clinical Decision-Making in Hair Transplantation

ALFONSO BARRERA

To date, we have no method for creating new hair where none exists. All current techniques for hair restoration involve redistributing the patient's existing hair. Therefore candidates for hair transplantation are limited to those who have a favorable donor site surface area and hair density relative to the size of the area to be transplanted. Several centers worldwide are working on tissue engineering in an attempt to clone hair follicles or culture and multiply hair follicles in the laboratory setting. When this is successful, we will be able to treat patients with limited donor hair and will need only harvest a sample of hair follicles.

Unfortunately, male pattern baldness is a progressive condition. However, the rate of hair loss may slow down after an individual is about 40 years of age, although it never stops completely. Thus the preoperative plan must ensure a natural-looking, long-term result.

Preoperative Assessment

Careful patient selection and good communication are essential. Patients must have realistic expectations about the result that can be achieved. They must understand that the procedure involves redistributing their existing hair and that currently there is no method for creating new hair. Therefore there are limits to the hair density that can be expected. To obtain the best result possible often takes two sessions and in some cases three; however, a reasonable improvement can often be obtained in just one megasession.

I have found that patients under 30 years of age are often the most demanding. They must understand that because they are young, it is impossible to determine in advance the endpoint of their hair loss. A conservative approach is recommended in these cases.

When patients receive proper instruction and have realistic expectations, I have found that 97% are satisfied after a single hair transplantation session. The 3% of patients who have been dissatisfied with their hair density after surgery have subsequently undergone second sessions to improve the density and were ultimately pleased with the results.

Hair-Loss Patterns

The most frequent types of hair loss include male pattern baldness, postsurgical alopecia, posttraumatic alopecia, and congenital hair loss.



Male pattern baldness is by far the most frequent type of hair loss, followed by androgenic (pattern) alopecia in females.



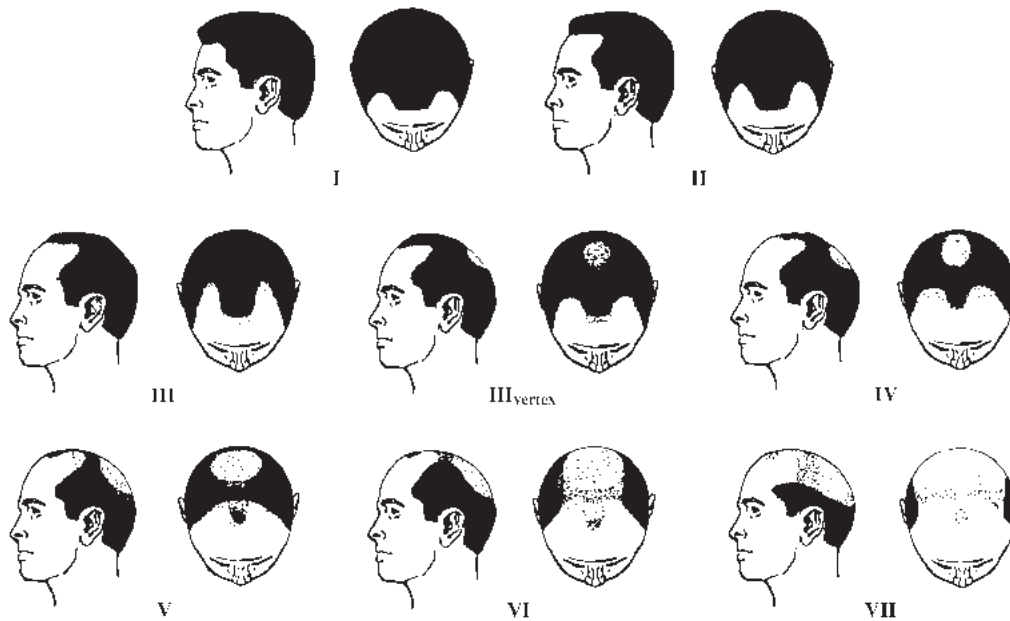
Postsurgical alopecia (*left*) may occur after oncologic resection of the scalp or eyebrows. After facial rejuvenation or craniofacial procedures, loss of sideburns and of frontal, temporal, and/or retroauricular hair is not uncommon. Posttraumatic alopecia (*right*) includes hair loss from injuries such as burns, traumatic injuries of the scalp and eyebrows, and scalp avulsion.



Examples of congenital hair loss include the absence of mustache hair in cases of bilateral cleft lip (not obvious until after puberty), triangular temporal alopecia, and nevus sebaceous of Jadassohn.

Classification

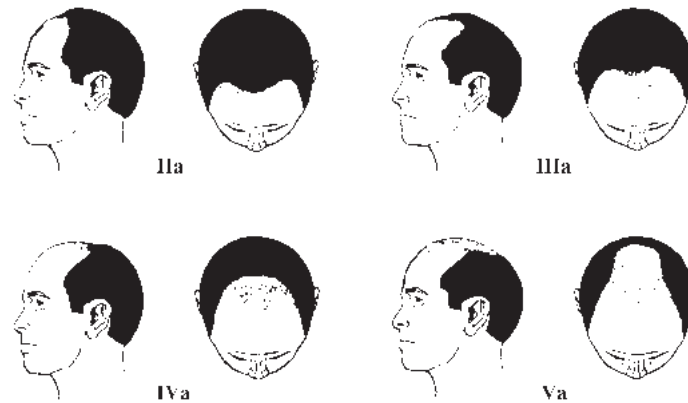
NORWOOD CLASSIFICATION—MALES



The most commonly used classification system for male pattern baldness is the one described by Norwood:

- | | |
|----------------------------|---|
| Type I | There is minimal or no anterior hairline recession at the frontotemporal areas. |
| Type II | Triangular, symmetrical frontotemporal recessions extend posteriorly no more than 2 cm anterior to a coronal plane drawn between the external auditory canals. |
| Type III | The frontotemporal recessions extend posteriorly beyond 2 cm anterior to a coronal line drawn between the external auditory canals. |
| Type III _{vertex} | Hair loss is primarily in the vertex area but may be accompanied by a frontotemporal recession that does not exceed that described for type III. |
| Type IV | The frontotemporal recession is more severe than in type III. Hair is absent or sparse hair in the vertex area, but both areas are separated by a band of moderately dense hair that goes across the top of the head. |
| Type V | Hair loss in both the frontotemporal and vertex areas is more extensive and is only separated by a narrower and sparser band of hair across the top. |
| Type VI | The band of hair that separated the frontotemporal area and vertex is gone. The two areas are interconnected. The entire area has extended laterally and posteriorly. |
| Type VII | This is the most severe form of male pattern baldness. There is only a narrow horseshoe-shaped band of sparse, fine hair. |

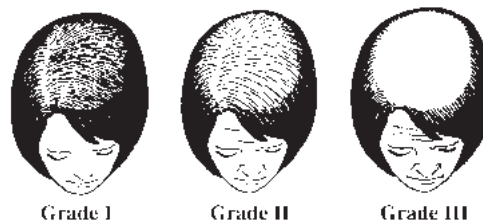
NORWOOD CLASSIFICATION—MALES



Norwood also described a less common variant (type a) that applies to about 3% of cases of male pattern baldness; in this variant the baldness starts at the anterior hairline without a peninsula of hair and advances in a posterior direction. The type a anterior variance patterns are classified as follows:

- Type IIa The entire anterior hairline is high on the forehead. The midfrontal peninsula is represented only by a few sparse hairs. The area of denudation extends no farther than 2 cm from the midfrontal line.
- Type IIIa The area of denudation essentially reaches the midcoronal line.
- Type IVa The area of alopecia extends posterior to the midcoronal line.
- Type Va This is the most advanced degree of alopecia and extends farther posteriorly. If it progresses, it may be indistinguishable from types V and VI.

LUDWIG CLASSIFICATION—FEMALES



The most common classification system used for female androgenic alopecia is the Ludwig classification, grades I through III. Thinning is usually more generalized, in most cases sparing the front hairline, with significant thinning of the vertex, temple, and parietal areas. The occiput tends to be the only area of reasonably good hair quality and density. Women who develop androgenic alopecia do not necessarily have an abnormal increase in circulating androgens or hormonal imbalances; many, in fact, have normal adult female androgen levels. It may be that the androgen receptors in the hair follicles are hypersensitive to or have a greater binding affinity to dihydrotestosterone, which may or may not be genetic in origin.

Indications and Contraindications

Based on the principles we have learned for the treatment of male pattern baldness, and with slight modifications, we are able to help most cases of hair loss by transferring primarily micrografts (one- and two-hair follicular unit grafts) and minigrafts (three- and four-hair follicular unit grafts). In select cases, flaps or tissue expansion may be used. The following patient examples represent the range of clinical challenges encountered in a hair restoration practice.

Patient Profiles



This 32-year-old man with male pattern baldness type IV had good donor hair; his hair is coarse, which can help to obtain nice coverage in one session. He underwent 1500 follicular unit grafts in a single session, primarily to the frontal scalp and a few to the crown.

Further grafting to the crown should be deferred until the patient is older, when his hair loss pattern can be more accurately assessed and the amount of donor hair available determined. The patient must understand that because of his young age, further sessions will be needed in the future as hair loss progresses.

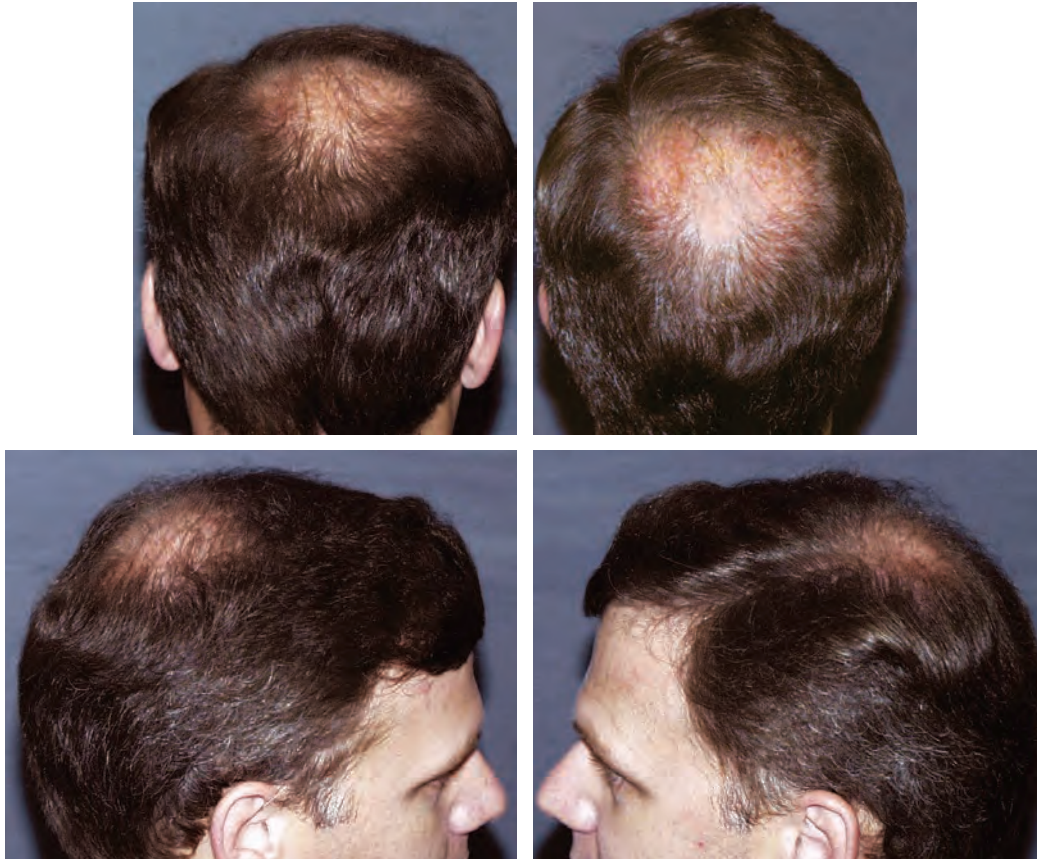


This 53-year-old man with male pattern baldness type VI is an ideal candidate, because his pattern of hair loss is well established and will probably not change dramatically. In such cases a maximal density procedure (2000 to 2500 follicular unit micrografts and minigrafts) can be planned. His donor hair has good density and thickness, and the entire area of baldness will be grafted. A hairline pattern consistent with the patient's mature age is the preferred approach to produce the most natural result. Thus a slight frontotemporal recession will remain.



This 56-year-old man with male pattern baldness type VI had a more mature pattern of baldness than the previous patient. Although his hair loss will continue to progress, his hair-loss pattern as he ages can be better determined, making a more aggressive approach acceptable. He had a reasonably good, dense donor area and a well-established pattern of baldness. He underwent 2040 follicular unit grafts in one session (megasession).

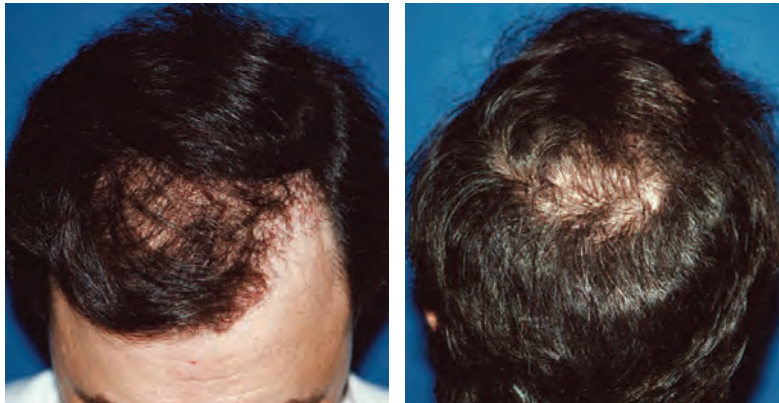




This 43-year-old man has male pattern baldness type III_{vertex} without frontotemporal recession. The density and thickness of his donor hair are excellent. The front part of his scalp is covered with healthy, full hair. His pattern of baldness is well established and limited to the crown. I recommended two sessions of micrografts and minigrafts a year apart to achieve an optimal result. The crown typically will take at least two sessions to obtain reasonable coverage. Although the whirl can be reconstructed by orienting the grafts in a circular orientation, it probably does not warrant the additional time and effort.



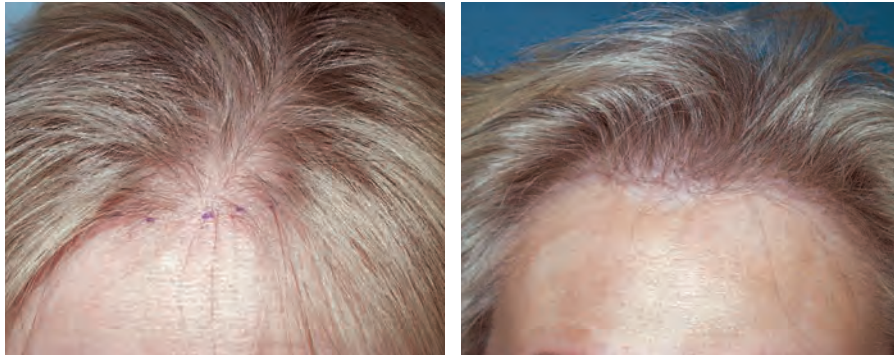
This 42-year-old man presented with male pattern baldness type VII, the most severe form of male pattern baldness. There was insufficient donor hair to transplant the entire area. Flaps, tissue expansion, and scalp reduction were treatment options because of the sparse donor hair and extensive area of baldness. I advised a session of 1300 follicular unit micrografts and minigrafts only to the median forelock area, the rhomboid-shaped area on the front part of the scalp. Even though his crown will remain bare, strategic transplantation to this area will help frame his face. He is shown 1 year postoperatively. The hair on the top of his head blends naturally with the temporal fringes.



This 37-year-old man has male pattern baldness type IV. His coarse, wavy donor hair will provide good coverage. Because his hair loss is not very severe, approximately 700 to 800 follicular unit micrografts and minigrafts should be sufficient to strengthen both the front scalp and crown. He must be forewarned that there will be further temporary thinning. The hair must be continuously parted as the grafts are inserted; however, it is not necessary to shave the residual hair in the recipient areas.



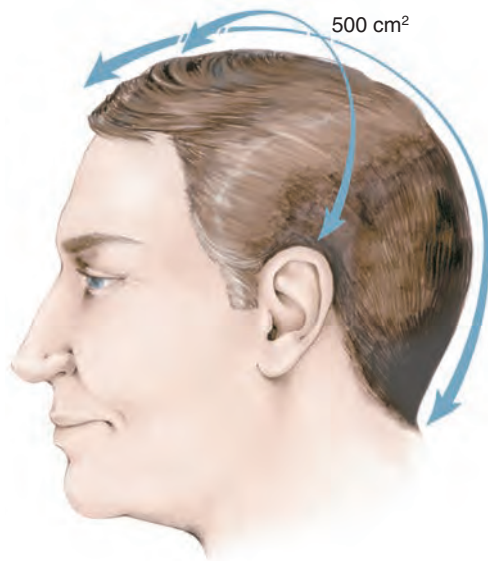
This 43-year-old woman had Ludwig grade II to III female androgenic alopecia. Patients such as this tend to exhibit uniform thinning over the entire scalp with preservation of the front hairline. Candidates for the procedure must have an area with good hair quality and density, which tends to be in the occipital region. I recommended that this patient undergo a megasession of 1000 follicular unit micrografts and minigrafts. The patient was forewarned that she could expect further temporary hair thinning for the first 3 to 4 months in the area grafted (telogen effluvium). I recommend that female patients use 2% minoxidil twice a day postoperatively to help preserve and thicken the existing hair as well as the grafted hair.



This 50-year-old woman was concerned about her hair thinning on the front of her scalp. Because she had good density on her remaining scalp, I recommended a session of 400 micrografts and minigrafts. This treatment added hair precisely where needed and was easily performed with the patient under local anesthesia with mild intravenous sedation. I would not advise scalp flaps, strip grafts, or tissue expansion in such a case. These treatments would have been excessive, causing a scar at the front hairline, and she would have had to endure an unpleasant expansion phase. Her postoperative results are very natural, without any detectable scarring.

Preoperative Planning

Aesthetic Considerations



An average scalp is approximately 500 cm² (50,000 mm²). The normal nonbalding scalp has one follicular unit/mm², and each unit contains an average of two hairs (that is, a density of 2 hairs/mm²), so there are approximately 100,000 hairs on the head. Of course, this varies from patient to patient.

The appearance of fullness has to do with hair mass, which is related to the number of hairs, the thickness of the individual hair shafts, texture and color, and curliness. Furthermore, the contrast of colors between the scalp and the hair has a significant influence on the optical illusion of fullness. Most experts today agree that the average healthy, nonbalding patient has a density of about 200 hairs/cm² (range 130 to 280 hairs/cm²) and that only 100 hairs/cm² (range 65 to 140 hairs/cm²) are needed to give an appearance of normal density.



19-1 Hair
transplantation with
micrografts and
minigrafts

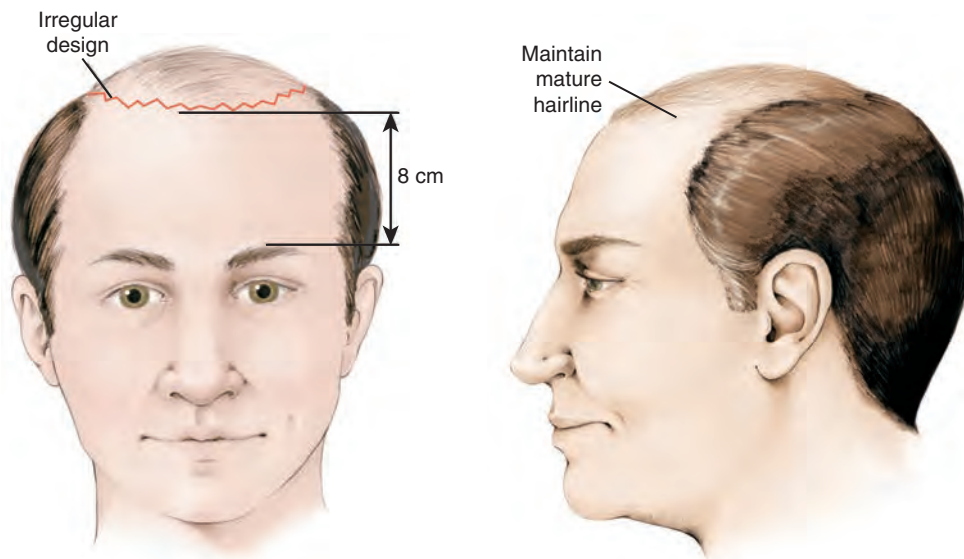
Realistically, this number of micrografts and minigrafts can be transplanted in two sessions. To obtain a surgical result that mimics nature, a large number of randomly transplanted small grafts (follicular unit-sized grafts) is essential, providing a result unmatched by any other method of hair restoration. Patients should be advised that two sessions and occasionally three sessions may be necessary to obtain the desired density. Often, however, significant improvement is seen after just one session, and results will persist for years without a repeat procedure.

If the ratio of donor site to recipient area is favorable, I transplant the entire area of baldness. If the ratio of donor site to recipient area is not favorable, I may only transplant the front hairline or a median forelock. If it is clear that there is insufficient donor hair, it is better not to proceed with transplantation. It is a judgment call.



When feasible, I prefer to transplant the entire bald area, with a focus on providing the greatest density possible at the front hairline. Patients can style their hair so that it layers farther back to give the visual appearance of density in the back.

Design of the Hairline

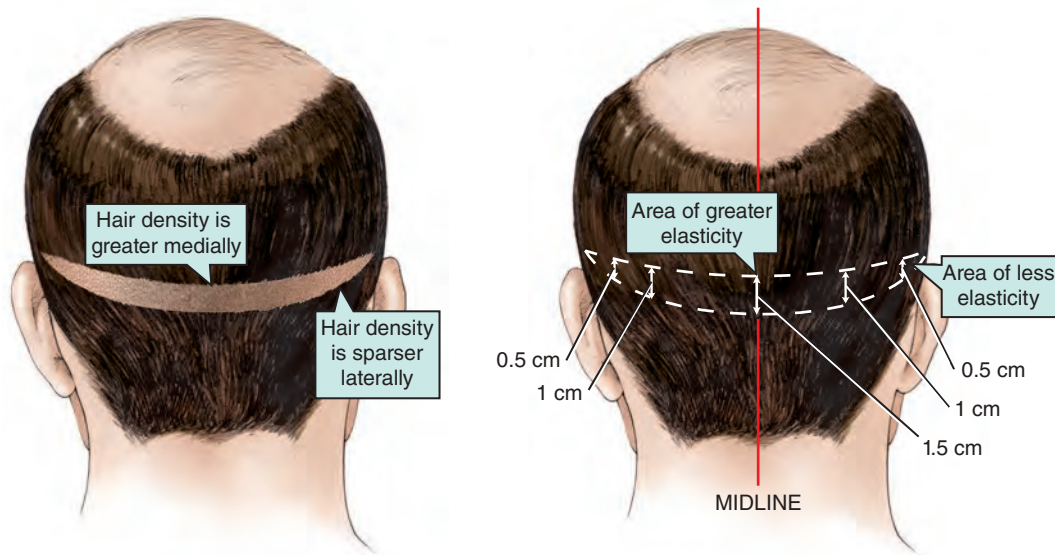


The design of the hairline or the area to be transplanted is crucial, the idea being to mimic nature as much as possible. The position of the front hairline is critical for a natural result; conservatism is in order. The goal is to achieve a mature hairline. The size and shape of the head vary among individuals, as does the position of a mature hairline. Generally, the midline of the new hairline is approximately 8 cm from a horizontal line immediately above the eyebrows. In some patients a slightly longer or shorter distance is appropriate, depending on the facial features, shape, and size of the head as well as the interrelationship and proportions of the face and skull.

Donor Site Harvesting

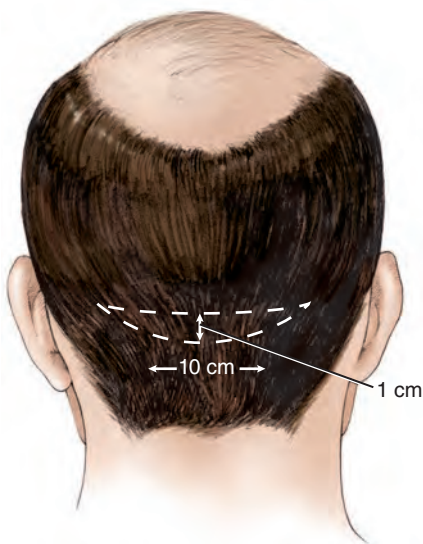
The many variables encountered during donor site harvesting test the surgeon's clinical judgment. The size of the donor ellipse varies, depending on the number of grafts planned or the size of the area to be grafted, as well as the density of the donor site and the pliability and elasticity of the donor scalp. Only the amount of scalp needed should be harvested, yet the surgeon must ensure that enough donor scalp is obtained for the number of grafts planned and that the donor defect can be closed under minimal tension.

The laxity of the scalp varies from person to person. The surgeon must be alert to the presence of scar tissue from previous procedures since this will result in reduced elasticity and pliability of the donor scalp. Most patients' scalps permit ellipses 1 to 1.5 cm wide to be harvested with minimal tension on closure. The surgeon must feel the donor scalp to assess the laxity, elasticity, and pliability.

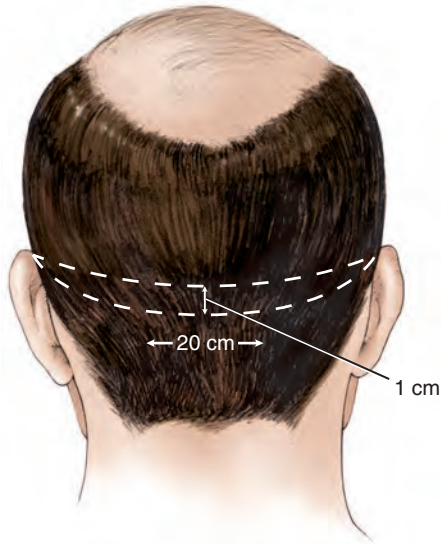


A long, narrow, horizontal donor ellipse is preferable to a short, wide ellipse. Hair density as well as the elasticity of the donor occipital site is usually greater toward the midline. The hair becomes sparser and the scalp less elastic more laterally. The scalp above the ears is usually quite inelastic. These factors must be taken into consideration so that the ellipse can be designed to allow closure with minimal tension.

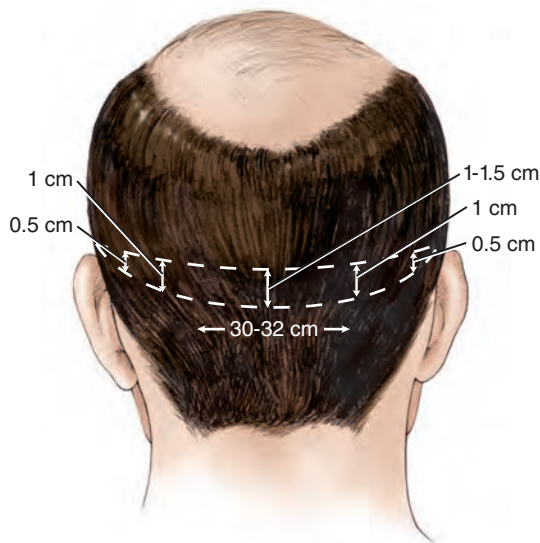
Normally the hair density in the donor area is approximately 200 hairs/cm² (range 130 to 280 hairs/cm²). The diameter of the individual hair shafts varies from 0.06 to 0.14 mm.



Assuming a density of 150 hairs/cm², an ellipse 10 by 1 cm will yield approximately 1500 hairs. Naturally occurring follicular units have 1 to 4 hairs per unit. These units must be kept intact as much as possible. The exact number of grafts can only be determined after dissecting the donor ellipse into grafts, but an ellipse of this size will yield approximately 500 to 600 grafts.



If hair density is approximately 150 hairs/cm², a horizontal, occipital donor ellipse of 20 by 1 cm with 3375 hairs will be needed to produce 1000 to 1200 micrografts and minigrafts (1 to 4 hairs per unit).



A maximal density procedure (2000 to 2500 grafts) in patients with types VI or VII male pattern baldness makes harvesting enough donor tissue a greater challenge. In these cases I harvest a horizontal ellipse approximately 30 to 32 cm long and 1 to 1.5 cm wide at the midline (scalp elasticity permitting), gradually tapering the width laterally to 1 to 0.5 cm at the ends. In most patients this yields approximately 2000 to 2500 follicular unit micrografts and minigrafts and between 5000 and 6000 hairs.

Donor Site Dimension Guidelines

Micrograft and Minigraft Follicular Units (number of hairs)	Hair Density (hairs/cm ²)		
	150 (low)	200 (average)	201-250 (high)
500-600 (±1500 hairs)	10 × 1 cm ellipse	6-7 × 1 cm ellipse	5 × 1 cm ellipse
1000-1200 (±3000 hairs)	20 × 1 cm ellipse	15 × 1 cm ellipse	10 × 1 cm ellipse
1500-1800 (±4500 hairs)	25 × 1 cm ellipse	20 × 1 cm ellipse	15 × 1 cm ellipse
2000-2500 (±6000 hairs)	30 × 1.5 cm ellipse	30 × 1 cm ellipse	25 × 1 cm ellipse

NOTE: All ellipses 1.0-1.5 cm in width, tapering only at the 1.0-0.5 cm ends.

Camouflaging Scalp Scars

Patients are often seen with scars on the scalp or the front hairline as a result of accidents, surgical interventions, and poor healing after an aesthetic surgical procedure. Micrografts and minigrafts alone can frequently benefit such patients.

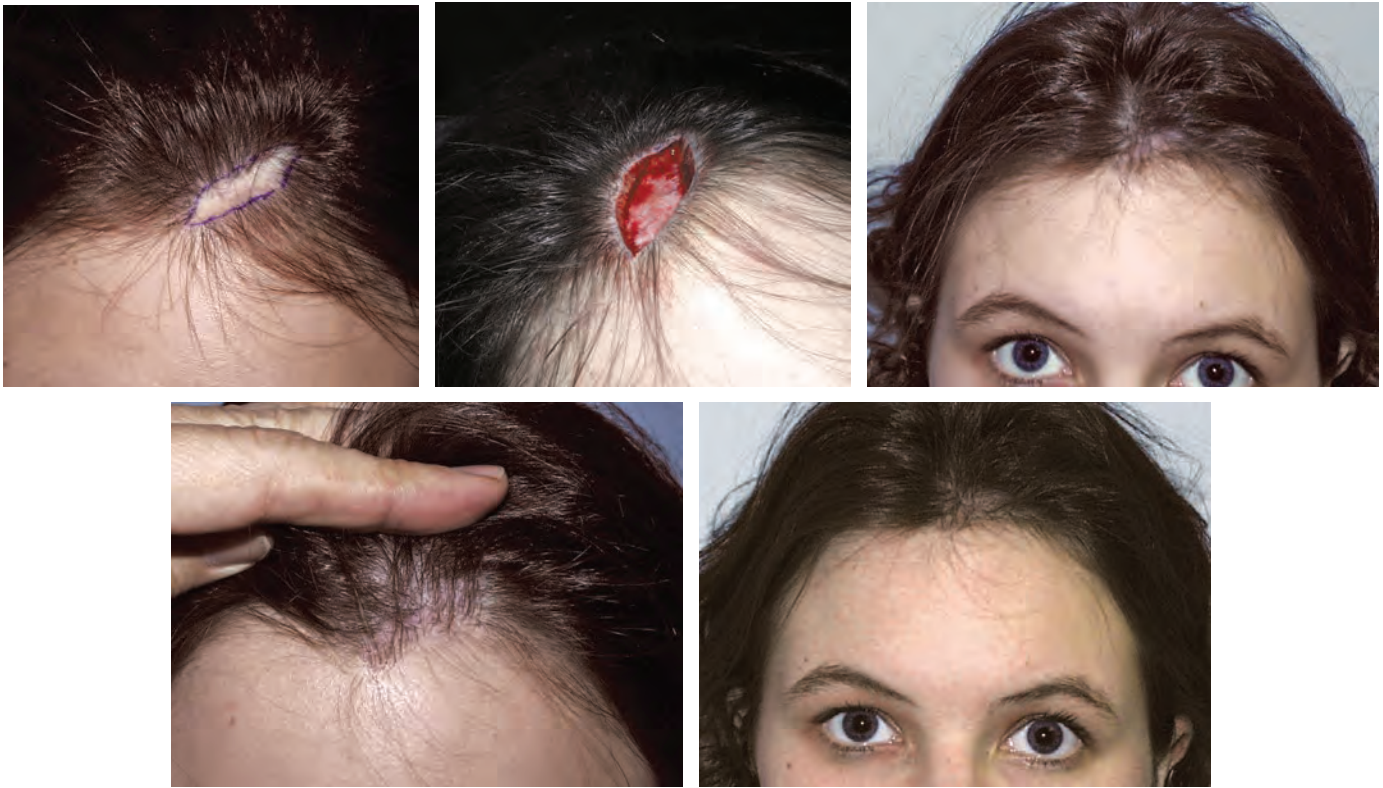
Even when incisions are made parallel to the hair shafts on the scalp or on the hair-bearing skin (eyebrows, beard, or mustache) and closed without significant tension, a fine hairline scar is often inevitable. These scars are sometimes detectable because of the absence of hair at the scar line. Micrografting and minigrafting offer an excellent solution for these deformities. The technique is basically the same as that described earlier except that the direction of the graft insertion may be more critical for controlling the direction of hair growth.

When working on the temporal hairline, eyebrows, or mustache, for example, the direction of the natural hair growth at the respective sites must be followed. Micrografts and/or minigrafts can be added at the newly closed wound suture line in hair-bearing incisions. These small grafts thrive well even if the blood supply is precarious and will help minimize hair loss at the incision site. The use of atraumatically dissected micrografts and minigrafts and closure under minimal or no tension are key to the success of this approach.

When feasible, it is best to make the micrografts and minigrafts from hair-bearing areas surrounding the wound (local hair), especially for the eyebrows (the contralateral eyebrow or residual hair from the same eyebrow), because they normally exhibit a very different growth pattern than that seen in scalp hair.



This 15-year-old girl had an otoplastic procedure performed. A tight dressing placed around the head and knotted at the front hairline level resulted in a pressure sore and loss of hair in an area about the size of a half dollar.



The area of alopecia was excised, but an area of hair loss remained. Scar revision by a plastic surgeon left a widened scar. The patient was referred to me for further revision and/or micrografting. I reexcised the scar and placed micrografts along the suture line closure and a few micrografts at the scar's perimeter. About 25 micrografts and minigrafts were placed at the closure line and 25 around the closure.

Correction of Sideburns After Face-Lift Procedures

Surgeons who perform face-lift procedures acknowledge that upward displacement of the sideburn, temporal hairline, and retroauricular hairline is not uncommon, especially in patients undergoing secondary face lifts. The sideburn is an important aesthetic unit of the face.

Sideburn loss is a telltale deformity unique to face-lift procedures. Patients attempt to style their hair to camouflage the area, but this may be futile if they live active outdoor lives. Such upward displacement can often be prevented if prehairline incisions are used. If sideburn loss does occur, it can be corrected with various scalp flaps, but I prefer the use of micrografts and minigrafts for several reasons:

1. A natural result can be achieved in just one session.
2. The direction of the hair can be controlled by angling the surgical blade.
3. The desired hairline design can be followed with precision.
4. A transition zone can be readily created that avoids a scar in front, a common sequela of flap techniques.



This 52-year-old woman came for a consultation 3 years after a face lift. In a single session, 850 follicular unit micrografts and minigrafts per side were transplanted to restore the lost sideburns, temporal hairline, and some at the front hairline. Postoperatively, blending of the grafts with the natural direction of hair growth is evident.

Restoration of the Eyebrows, Mustache, and Beard

Fujita first described the use of single hair grafts to reconstruct the eyebrows in 1953. This was the first mention of the use of micrografts since Tamura reported transplanting single hair grafts from the pubic area in 1943. It would be another four decades before there was further experimentation with small grafts. More recently, Gandelman published his superb results using micrografts and minigrafts to restore the eyebrows.

Fortunately, micrografts and minigrafts grow anywhere on the face and thus are useful for restoring the eyebrows, mustache, and beard. However, because the consistency of facial skin is softer and more elastic than that of the scalp, the surgeon will encounter more problems with grafts popping out when transplanting facial areas.



This 54-year-old man desired thicker eyebrows and more density in his frontotemporal region.



He underwent scar revision for a previous direct approach brow lift (done elsewhere) plus a slight brow lift. I advised a session of 250 grafts to the frontotemporal recession areas and about 150 grafts to each eyebrow. Because of his thin eyebrows, donor hair was taken from the lateral occipital area. He is shown 1 year postoperatively. The density and natural direction of the hair and absence of scars are evident.

This case presented the challenge of choosing the optimal donor site for eyebrow hair. If a patient has unilateral eyebrows with high contralateral density, donor hair can be taken from the existing eyebrow. However, when the patient has thin eyebrows bilaterally, other options such as axillary, pubic, and scalp hair must be explored. The caliber of individual axillary or pubic hair is generally too thick, and both have textures different from eyebrow hair. Although it seems ideal to obtain donor hair from the nape of the neck, the caudalmost part of the occipital area,

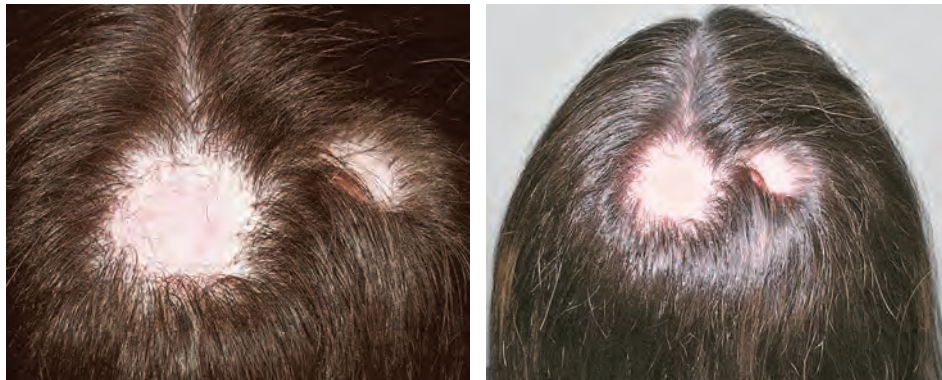
I prefer not to harvest from this region because of the increased risk of hypertrophic scarring. In addition, as we age, hair recedes from a caudal to a cephalic direction. Therefore I look primarily at the lateral occipital area, not the retroauricular, as the ideal potential donor site.

Treatment of Burn Alopecia

Various methods have been used for the treatment of burn alopecia, including punch grafts, local scalp flaps, free scalp flaps, and tissue expansion. The fibrotic scar tissue that normally forms after burn injuries has a precarious blood supply and is not an optimal site for any type of graft. Single- and double-hair grafts (micrografts) and grafts with three to four hairs (small minigrafts) have fewer metabolic requirements because of their small size, which probably permits them to survive in this hostile environment.

Having seen these small grafts survive in patients with male pattern baldness who had scarred scalps from previous surgical procedures, I decided to try them in patients with burn alopecia. The success of this approach has been reported in the literature.

I think that it is important to allow sufficient time for the scalp to heal, soften, and fully recover from the insult of surgery or trauma before proceeding with hair transplantation, especially in the case of burn alopecia.



This 18-year-old woman developed chemical-burn alopecia after applying highlights to her hair. She had very high density in the surrounding areas and requested quick results, because she was leaving for college in a few months. Follicular unit micrografts and minigrafts would have provided a nice result but would have taken at least two sessions and perhaps three to blend reasonably well with the surrounding hair density. Furthermore, the sessions would have to be performed at least 6 to

8 months apart and would take 1½ to 2 years to complete. Scalp reduction was not an option, because her scalp was a bit tight. Even though serial excisions might have improved the tightness, it would have been repetitive and would have resulted in a hairless scar line at best. Therefore I recommended tissue expansion with micrografts inserted between the sutures during closure.



Tissue expansion was performed using a 350 cc crescent-shaped expander inflated to 210 cc. The expander was removed after 3 months.



With the patient under conscious sedation and local anesthesia, the areas of alopecia were excised by tailoring the expanded scalp. The wound was closed with a simple running 3-0 Prolene suture. Approximately 50 grafts were placed between sutures to further camouflage the closure. She is shown 3 months postoperatively with excellent hair density.

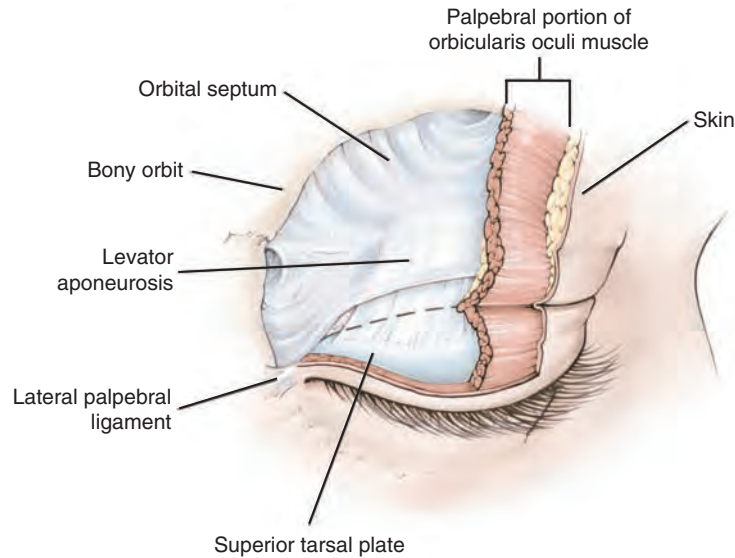


This 43-year-old man sustained severe third-degree burns to his upper body, chest, neck, face, and scalp. He underwent multiple surgical procedures, including rib-graft ear reconstruction. He was referred to me for restoration of frontotemporal, left frontotemporal-parietal, sideburn, and eyebrow hair. He requested postponing eyelash reconstruction. I recommended a single session of 1525 follicular unit micrografts and minigrafts to both temples and the frontal hairline and 125 grafts to each eyebrow. He is shown 8 months postoperatively. He returned for a second session to further increase his hair density.

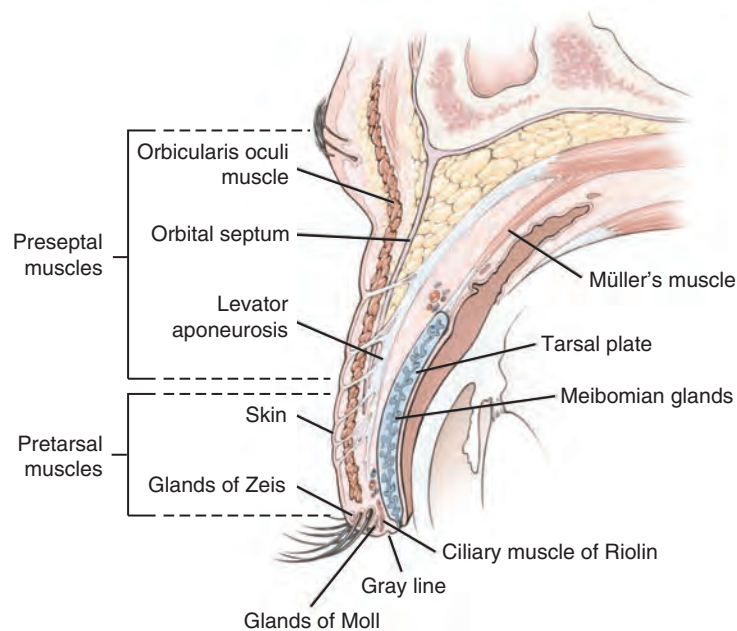
Eyelash Reconstruction and Augmentation

The eyelash of the upper eyelid is an important structure both functionally and aesthetically. The upper eyelashes resemble a cantilever, preventing the entrance of small foreign bodies that may cause microtrauma to the conjunctiva and cornea. Eyelashes contribute to the aesthetic appearance of the eyes and face. Lack of eyelashes can result in a strange, owl-eyed appearance that is both embarrassing and damaging to the self-esteem. Eyelash reconstruction is suggested for the following conditions:

1. Congenital absence of eyelashes
2. Eyelash loss from traumatic injury, burns, or dermatologic disease
3. Eyelash loss caused by oncologic surgery or radiotherapy
4. Iatrogenic loss resulting from the use of silver nitrate to prevent trachoma

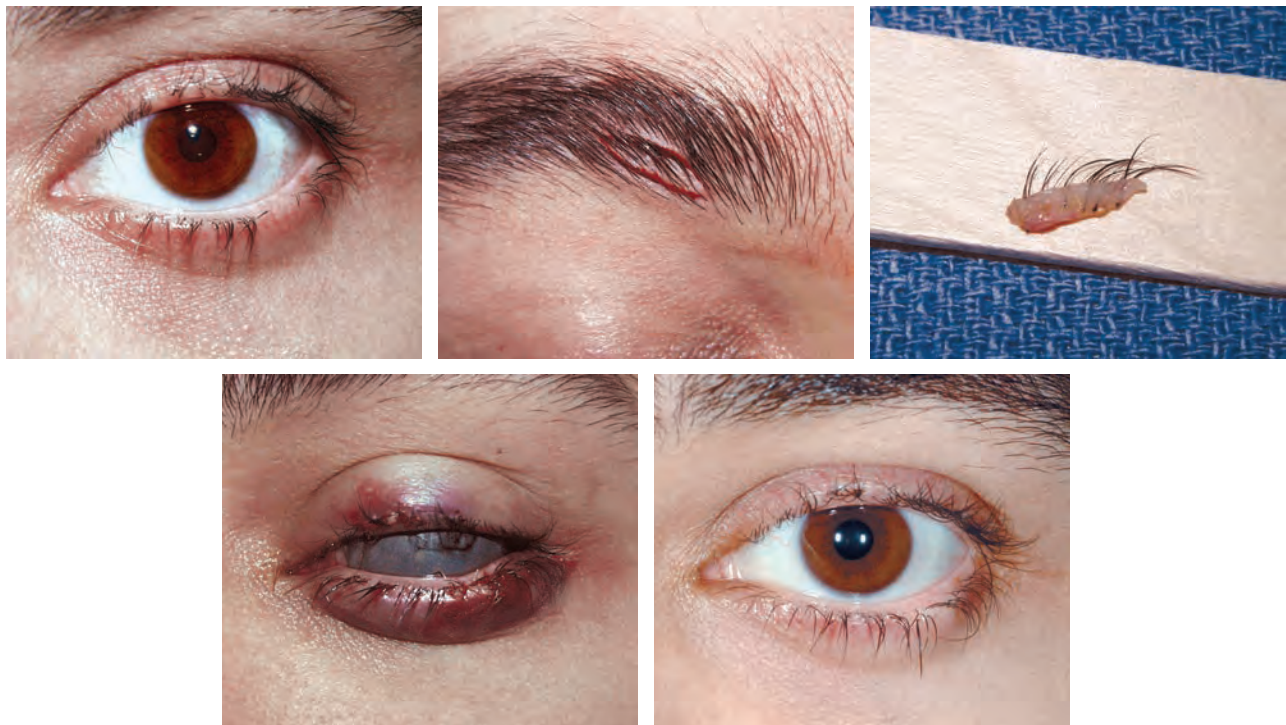


Some anatomic features are especially noteworthy for successful eyelash reconstruction. The central portion of the orbicularis oculi muscle covering the eyelid is referred to as the palpebral portion. This is further divided into the *preseptal* and *pretarsal* muscles based on their relationship to the underlying orbital septum and the tarsal plate, respectively.



This illustration of a sagittal section through the upper eyelid shows the superficial and middle structures of the upper eyelid, including the levator aponeurosis, preseptal and pretarsal portions of the orbicularis oculi muscle, and the eyelid skin. The drawing also demonstrates the relationship of the pretarsal portion of the orbicularis oculi muscle, eyelash hair follicle, and eyelid skin.

The pretarsal muscle is firmly attached to the underlying tarsal plate. However, the upper part of the upper pretarsal muscle is attached to the levator aponeurosis and thus is separated from the tarsus at that point. There are approximately 100 to 150 lashes on the upper eyelid. The eyelashes emerge in two to three irregular rows from the eyelid margin anterior to the *gray line* (mucocutaneous junction). Sweat glands (Moll) and sebaceous glands (Zeis) enter the follicular structure of the cilia. The skin of the eyelids is the thinnest of the entire body. There is a thin fascial layer between the skin and the orbicularis oculi muscle. There is virtually no subcutaneous fat in this area, and the skin is tightly applied over the pretarsal muscle and loosely adherent to the preseptal muscle.



This 23-year-old man requested restoration of a small segment of eyelashes in his left lower eyelid. I recommended one strip graft and a total of five micrografts to both the upper and lower eyelids. He had dense eyebrows, and since the area of demand is small, I elected to harvest a small donor strip from the contralateral eyebrow. I selected a spot that had good density with desirable hair direction. The strip was turned and positioned in the most desirable orientation to mimic the missing eyelashes as best as possible. He is shown immediately after surgery with the scleral shield still in place and 1 year postoperatively.

I decided to choose eyebrow hair for the donor strip, because its features are similar to those of eyelashes. Although it is a challenge to encourage transplanted eyebrow hair to grow in the same direction as natural eyelashes, a strip graft, rather than follicular unit grafts, provides additional control.

Choosing the Best Option

	Scalp		Strip Grafts	Eyebrow Donor	Tissue Expansion
	1-2 Hair Follicular Unit Micrografts	3-4 Hair Follicular Unit Micrografts			
Male pattern baldness					
Female pattern baldness					
Lost sideburn and retro-auricular area hair					
Scalp burn alopecia and scalp-scarring alopecia					*
Eyebrow restoration*			*		
Eyelash restoration			*	*	
Moustache and beard restoration					
Pubic hair restoration					
Body and lower leg					

*In selected cases.

Clinical Caveats

The follicular units should be maintained as intact as feasible.

For patients with dark hair, 3.5 loupe magnification and background lighting are sufficient to dissect most grafts as follicular units.

For patients with light hair or gray hair, surgical microscopes and background lighting may be needed for more accurate dissection.

Always consider which donor area is most desirable. In most cases, it is the occipital area; for eyelashes and eyebrows I usually use scalp hair, but pubic hair may be considered for eyebrow reconstruction.

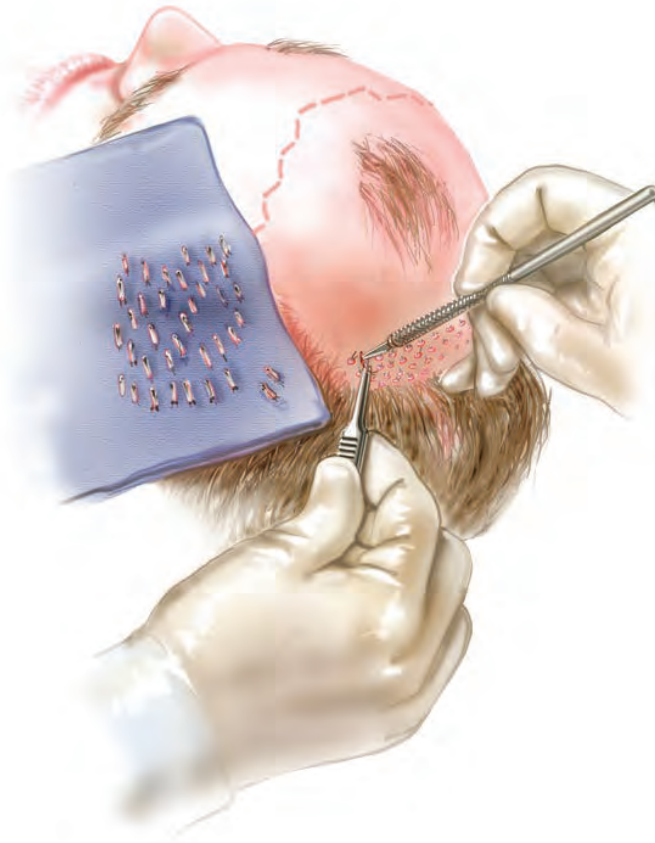
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CHAPTER 20



Micrograft and Minigraft Megasections in Hair Transplantation: *Current Techniques and Future Directions*

CARLOS OSCAR UEBEL

Hair loss, whether partial or complete, is the cause of significant concern to both men and women, who view it as unaesthetic and a visible sign of aging. Consequently, as our population ages and techniques for hair transplantation improve, the demand for hair restoration has grown significantly. Today surgical replacement of the hair has become an increasingly common and popular procedure in the field of male plastic surgery; it has been embraced by politicians, movie stars, and businessmen alike as they seek to reverse the progressive hair loss associated with the aging process. Women are also requesting this procedure to address alopecia and to correct deformities secondary to face-lift procedures. In the first part of this chapter I describe the basic techniques currently performed; the second part focuses on new developments and the potential role for platelet-rich plasma growth factors.

Evolution of Technique

The beginnings of modern hair transplantation procedures can be traced back as early as 1943, when Tamura of Japan successfully transplanted pubic hair; this was followed by Fujita in 1953, who transplanted hair for eyebrow reconstruction. However, it was not until 1959 that hair transplantation became popular when Orentreich introduced the use of punch grafts. He also introduced the concept of *donor dominance*, which is central to hair transplantation. This concept asserted that individual hair follicles had their own hereditary characteristics that are preserved after transplantation, enabling the hair to grow at the recipient site with its inherent characteristics preserved. Although the punch procedure provided a mechanism for hair transplantation to address male pattern baldness, the results were often unnatural and obvious.

In an effort to improve the aesthetic appearance of transplanted hair, temporoparietooccipital (TPO) flaps were introduced by Juri, with subsequent improvements by Chajchir et al and Uebel. Although scalp pedicle flaps from the parietal and occipital areas produced acceptable aesthetic results in patients with male pattern baldness, there were two distinct disadvantages. Even though it was well integrated, the flap was visible as a camouflaging patch, and the residual scar at the border of the hairline was conspicuous. It was not until the 1980s, with the introduction of the micrograft concept by Nordström and Marrit, that these problems were solved and surgeons were able to create a more natural-appearing hairline. This served as the basis for further advances and refinements, culminating in the introduction of micrograft and minigraft megasessions in 1986. I published reports on this technique in 1989 and 1991, which I called the *micropunctiform technique*; I have been perfecting this procedure since its introduction. Today this technique has become widely ac-

cepted by surgeons and patients as a simple and safe procedure that recreates predictably natural and aesthetic hairlines for most patients with various degrees of hair loss. The unnatural clumps, rows, strips, or flaps so typical of early procedures have now been replaced with random-pattern hairlines with feathered, natural borders. We have truly entered a new age of hair transplantation that offers the surgeon a valuable tool for addressing male and female pattern baldness, as well as other hair loss problems associated with disease or aesthetic surgery.

Indications and Contraindications

Although male pattern baldness is often associated with the aging process, it can also occur in younger patients, beginning as early as 16 years of age. It results from three main factors: heredity, androgenic hormones, and age. It is progressive in nature, and its growth cycle becomes more evident after age 30. In women, hair loss seems to occur more frequently during menopause, but androgenic female alopecia can occur at an earlier age.

Hair restoration procedures are appropriate for men and women of all ages and in patients with partial or moderate balding. Careful patient selection and good communication are crucial. Patients must have realistic expectations of what can be achieved. Because there is no means of creating new hair, they must understand that hair transplantation is ultimately a method for redistributing their available hair, and the success of the procedure depends on the condition of the donor area as well as on the density and quality of the hair to be transplanted.

The micrograft/minigraft technique is very effective in older patients in helping them to achieve a younger look. The new hairline reframes the patient's face with a natural, elegant profile. In women, this technique is indicated for androgenic baldness; it is also very effective in patients undergoing secondary face and forehead lifts for reconstructing sideburns and improving the temporal recesses.

I prefer to operate on patients who are at least 24 years old, because by that age they are more aware of the progressive nature of their hair loss, are truly certain of what they want, and are usually mature enough to understand that they may need to undergo one or more additional procedures in the future. Patients should always be honestly informed of the necessity for any reoperative procedures to maintain hair density. Surgery is not recommended for patients with diabetes or coagulation disorders as evidenced by a prothrombin level of less than 75%.

Preoperative Assessment

History and Testing

As is standard with all operative procedures, a complete history is obtained, including previous illnesses and surgeries. After the patient has been assessed and a surgical plan defined, the following laboratory tests are performed:

- Complete blood cell count
- Glucose test
- Coagulation test
- Electrocardiogram for patients over 50 years of age

We do not require any complementary examinations, because hair transplantation procedures are performed on an outpatient basis with the use of local anesthetic and sedation.

Evaluation of Hair Characteristics

Hair can be divided into different categories to help the surgeon assess each patient's requirements and develop a realistic plan for hair restoration. Griffin established the following four important characteristics for evaluating the hair in patients undergoing hair transplantation:

1. Color: black, brown, red, blond, or gray
2. Texture: coarse, medium, or fine
3. Skin-to-scalp contrast:
 - High contrast: black hair on fair skin
 - Low contrast: red hair on ruddy skin
 - Medium contrast: brown hair on olive skin
4. Degree of curl: kinky, curly, or straight

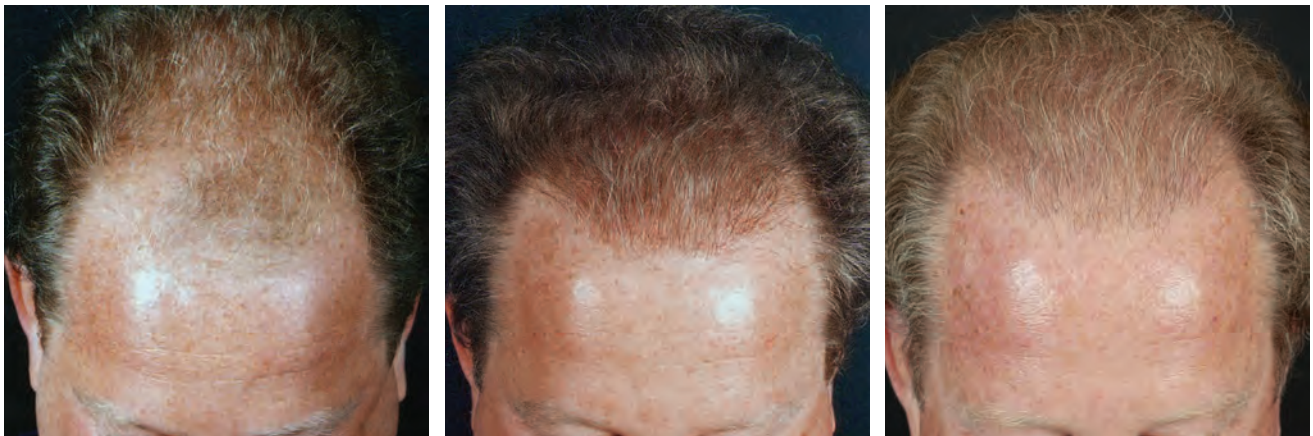
Norwood added two more factors for proper patient assessment:

5. Density
6. Size of donor area

To these classifications, I have added two other hair types that are very common in patients of European descent and in the patients I see from southern Brazil:

7. White hair
8. Wavy hair

Hair Density



Hair density is an important factor in hair restoration. As can be seen in these three individuals, density varies from one patient to another; the younger the patient, the denser the hair. One of the best techniques for improving hair density is to place additional grafts in between the remaining hair. Patients are satisfied with the results and are able to change hairstyles and color. In the third patient, the natural aging progression of follicular units is demonstrated. He is seen preoperatively at age 42, 3 years after transplantation at age 45, and 13 years after the procedure at age 57.

Hair Thickness

Hair thickness must also be considered. Coarse hair usually covers baldness more effectively than fine hair does; however, the shafts of thick hair tend to be more visible and detectable. With fine shafts we can achieve a better hairline, although it is less dense, often making repeat procedures necessary. Wavy and kinky hair works well in hair restoration and provides better coverage of the bald area.

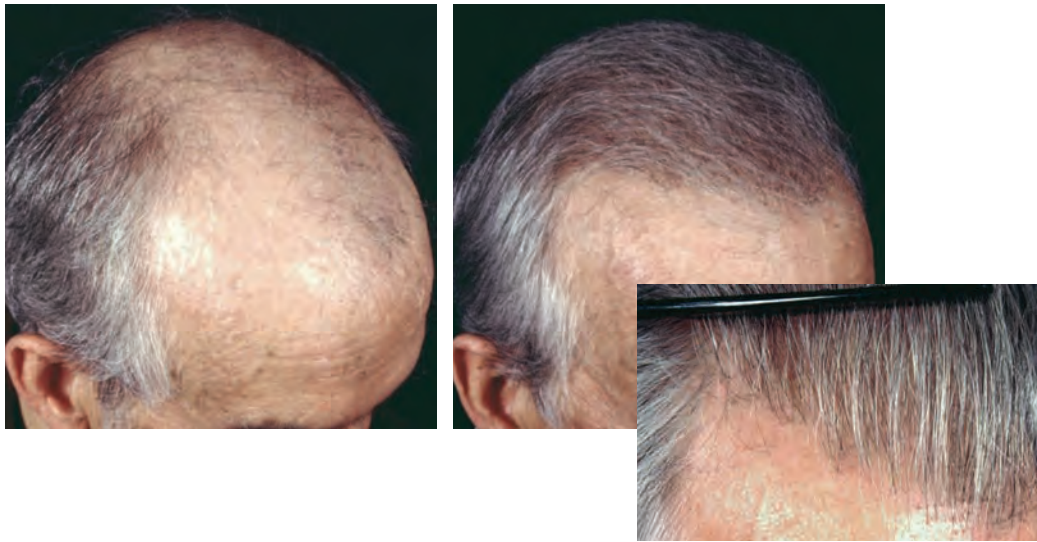
Hair Color



Special care is needed when transplanting black hair, especially if it is coarse and implanted on a bright, oily surface. In these cases the contrast is high, which results in an artificial appearance. A random distribution of implants is recommended, and the temple recessions should be maintained to create a natural appearance. Patients who have thick, dark hair are encouraged to modify their hairstyles by combing the hair to the front or to the side.



Brown hair is usually found on young patients with incipient baldness. It is easier to work with than black hair. Its contrast against the scalp is lower, and the result is aesthetically more natural. This type of hair will gray with age, improving the surgical result.



Gray hair is typically found on patients over 60 years of age. In older patients the hair becomes fine, and its contrast with the scalp is minimal. Hair transplanted from the neck is usually darker, and this mixture of gray and dark hair produces a more youthful appearance.



Red hair is rare; it maintains its color or lightens with age, giving patients a youthful appearance. In most cases, red hair is accompanied by ruddy skin and scalp. These patients are often freckled.



Blond hair offers the best results in hair restoration. It is usually fine, and its contrast to the scalp is minimal. In most cases, to achieve good density, two or three transplant procedures must be performed.



The root of white hair is very difficult to work on, because the absence of melanin in the hair bulb and shaft make the root almost imperceptible when the follicular units are being prepared. However, the aesthetic result is very pleasing.

Texture

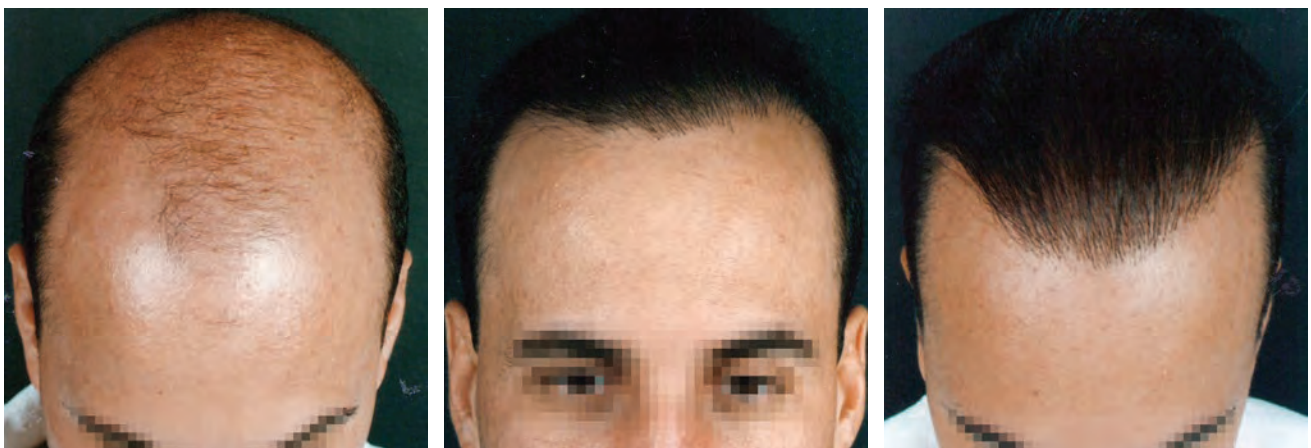


Coarse hair is very good for transplantation. The preparation of follicular units is easy, and the desired density often can be achieved in the first procedure. A natural hairline is often difficult to obtain. Therefore the texture of the donor area needs to be assessed, and the patient must be aware of this tendency. Care should be taken to implant the hairs *one at a time* and in an irregular dispersal pattern to achieve a natural result.



Fine hair is sometimes found on young patients but is more frequently found on individuals 40 years of age and older. The aesthetic result is better than with coarse hair, although the hair density is lower. A second replacement procedure after 1 year is essential.

Skin-to-Scalp Contrast



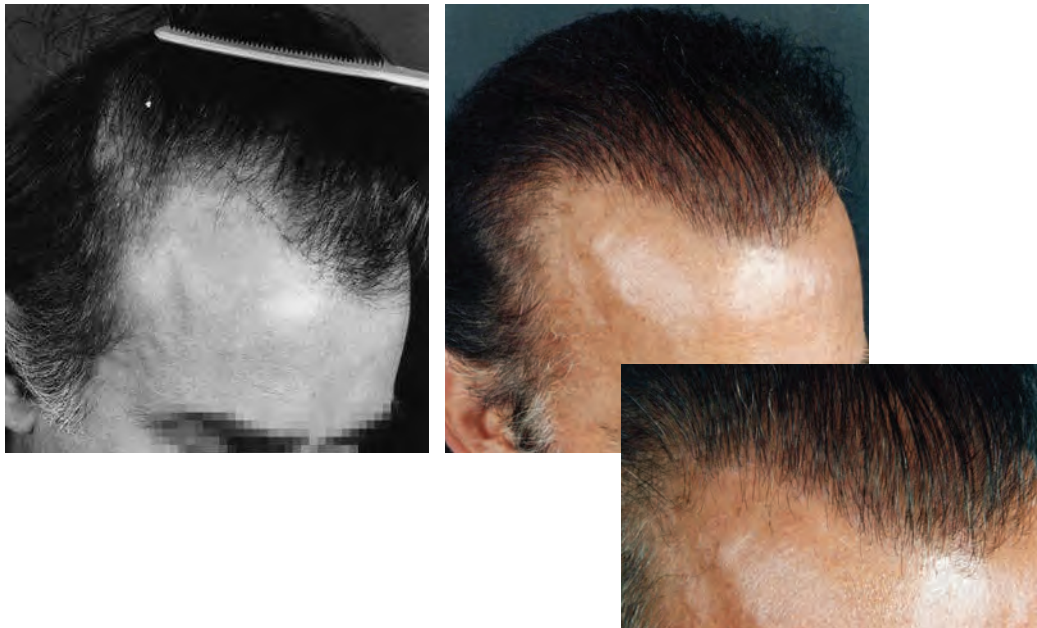
Black hair on fair skin has a high contrast. This is usually seen in patients with oily skin. The surgeon should be honest and explain that even after two or three replacements are performed, the results will be detectable. Patients in this category are instructed to wash their hair with a shampoo for oily hair to keep the hair as oil free as possible. Some patients use skin blush to diminish the high contrast.

Degree of Curl

Kinky and curly hair is typically found on individuals of African descent, Arabs, and people of Middle Eastern origin. It is more difficult to separate the follicular units because of their curly form; however, this hair type covers and protects the scalp better than other kinds of hair. The density and aesthetic result are superior to what is achieved with other hair types.



Wavy hair provides the patient with different hairstyle options and good natural density.



The aesthetic result from straight hair is good, but maintaining a hairstyle often proves difficult. Usually two replacement procedures are required to achieve natural density. We recommend that patients use gel to hold the hairstyle in place.

Photographic Documentation



Pictures are very important at all stages of hair restoration surgery. We take color photographs (ISO 100/21 degrees) and digital photographs with a 5.0-megapixel camera. Preoperative images are taken with the patient sitting and the head positioned at a 45-degree angle. The front and right and left sides are photographed, and when the crown area is included, a picture is taken from behind. These images help the surgeon evaluate the new hairline, assess the area of baldness, and estimate the quantity of hair to be replaced.



Postoperative pictures are usually taken 8 months after the transplantation procedure for men and 12 to 15 months after transplantation for women. It is important to allow enough time to pass so that the final result can be adequately estimated. Postoperative photographs must be of the same quality as those taken preoperatively. It is very important for the photographer to maintain the same distance from the patient and to duplicate the views and angles of the preoperative images so the post-procedure images are comparable. When in doubt, the preoperative photos should be reviewed.

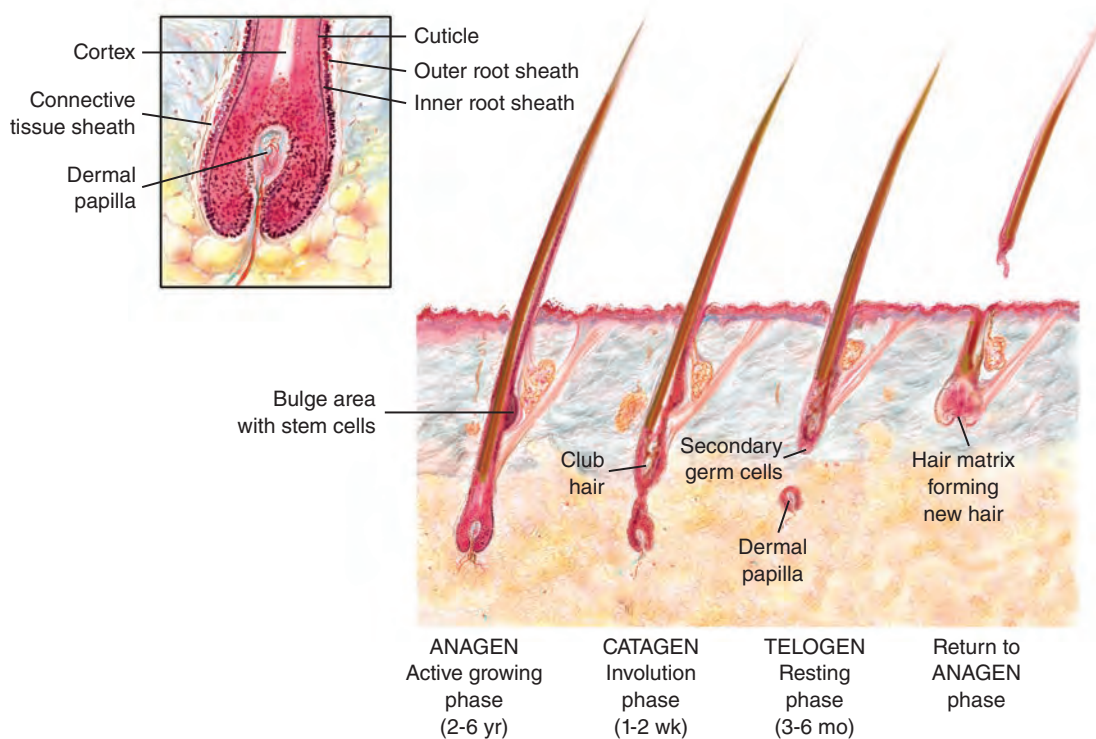


The proper preoperative and postoperative views and positions are demonstrated. A close-up view of the hairline using a macro lens is helpful to detail the new hairline (see p. 648). A complementary photograph taken from behind showing the horizontal scar and donor area can be included if necessary for planning a second replacement procedure.

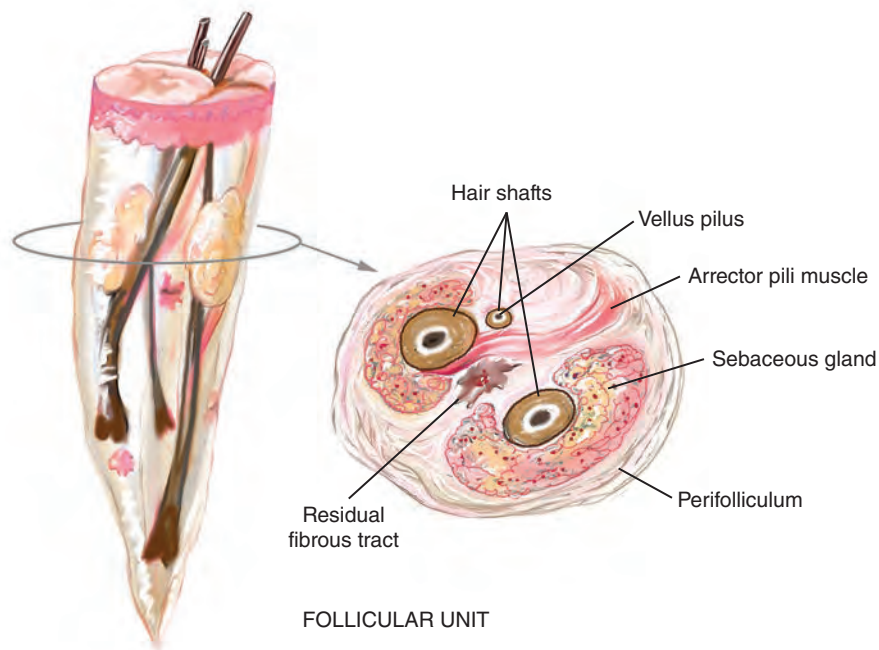
Patient Education

Each step of the procedure is explained to the patient. Surgeons should always be honest when discussing the positive and negative aspects of hair replacement. Baldness is progressive in nature, and the transplanted hair will undergo the same aging process as the hair of the donor area, becoming finer and changing color. It is especially important to make the patient aware that a second procedure may be necessary to maintain the new hairline. Honesty will increase the patient's confidence, and he or she will become an ally and collaborator in establishing the surgical plan.

Pertinent Anatomy



The growth cycle of hair is divided into three distinct phases: anagen, catagen, and telogen. Anagen, the adult phase, lasts approximately 6 years. In this phase, hair grows exuberantly and naturally. Catagen, the involution and loss of hair, lasts 2 to 3 weeks. In this stage, hair is lost on pillows, on combs, and in the shower. Average hair loss during this phase is approximately 100 hairs per day. After the involution of the follicle, the telogen phase begins and lasts from 3 to 6 months. This is the preparation phase for new hair. During this phase, fine hair begins to grow and lasts for 6 years. Implanted hair, with its preserved genetic characteristics, maintains this cycle.



An anatomic/histologic structure of the scalp was described by Headington. It usually consists of two to four terminal follicles, one to two vellus follicles, sebaceous glands, and insertions of the arrector pili muscles. Surrounding this structure is the perifolliculum, which is formed by reticular dermis collagen fibers.

The key to successful graft survival and ultimate hair growth is knowledge of this anatomy and an understanding that chubby grafts and intact follicular unit grafts have far greater potential for survival than bare hair shafts.

Preoperative Planning

When a new hairline is being designed, the donor area, its density and hair type, and the bald area are evaluated to ensure that there are no dermatologic lesions. The progression of the patient's baldness is also assessed.

Hairline Design



The new hairline is discussed with the patient in front of a mirror, and the new hairline is drawn on the scalp. An irregular frontal hairline will create a more natural and aesthetic result. Temple recessions are maintained to create a more natural appearance. Normally we begin with a perpendicular line from the tail of the eyebrow to the upper scalp, reaching the temple recession area. From this point we mark the frontal hairline.



In young patients it is important to project the definitive frontal hairline. I normally draw a line 2 or 3 cm beyond the original hairline, estimating the future frontal and temporal recesses. In older patients (more than 60 years of age), a more posterior hairline is suggested, sometimes with a design such as a frontal forelock.

Over the years I have established some important parameters for the frontal hairline. The midpoint of the forehead is normally 8 cm from the glabella, varying from 7 to 9 cm, depending on the individual patient's facial contours. I draw a perpendicular line from the brow–lateral canthus up to the temporal recesses. This lateral point will connect with the middle point in a VW irregular line. If necessary, the thin hair and effluvium are raised to make the surgery more effective.

Operative Technique

Donor Area Preparation



The donor area is shaved and the ellipse is marked. The hair follicles are harvested from the posterior cervical area where the hair density is greatest and the quality is best; this is normally 6 to 8 cm from the nape of the neck. I plan to remove a hair-bearing ellipse that correlates to the size of the area of baldness; this area may be small, medium, or large and can vary from 10 by 2 cm to 20 by 3 cm, where 500 to 1500 follicular units can be obtained.



I never count the exact number of hairs to be replaced. Some patients have less density per square centimeter than others, so it is useful to harvest a larger hair-bearing ellipse.

Anesthesia

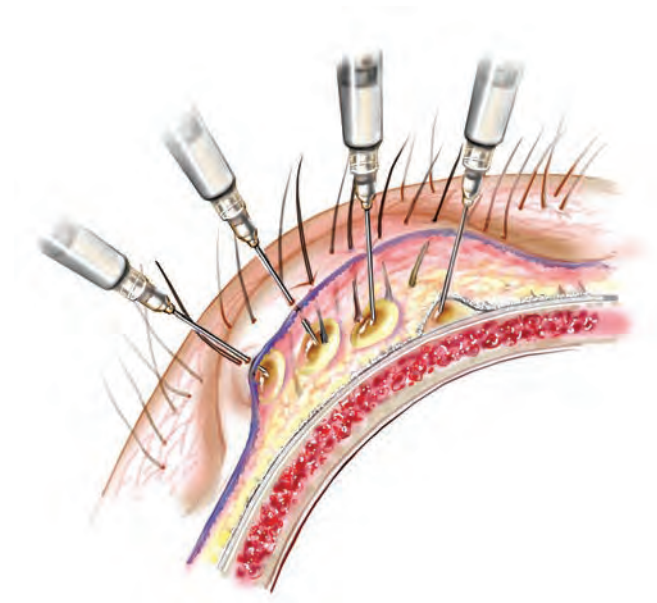
During the procedure the patient must be kept calm and quiet and in a reclining position. The operation takes approximately 2 to 3 hours, so the patient should be positioned comfortably. Both the surgeon and the patient should be relaxed. A well-trained team is requisite for a good result. Anesthesia is divided into three stages: sedation, nerve blockage, and scalp ballooning.



I normally use midazolam 5 to 10 mg and fentanyl citrate 1 to 2 ml to sedate the patient, and 20 ml levobupivacaine chloride 0.5% with epinephrine 1:200,000 to block the supraorbital nerves and the coronal area 1 cm in front of the hairline.



Scalp ballooning is a procedure that I described in 1991. It is designed to increase the edema of the scalp and to achieve ischemia, which aids in the implantation of the follicular units. The scalp is infiltrated with 160 ml of saline solution containing epinephrine 1:160,000.

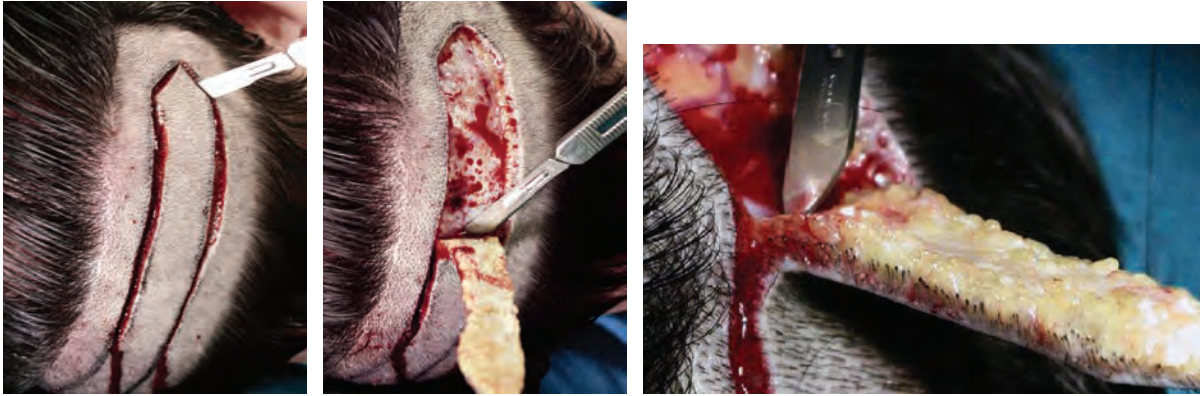


All layers of the scalp are infiltrated, from the subgalea to the dermis. This maneuver is important to prevent bleeding during surgery and to maintain the grafts inside the punctiform incision. We wait 5 to 10 minutes before we begin and repeat the infiltration every 30 minutes as necessary.



We also use levobupivacaine 0.5% at the donor site to block the occipital nerve branches and the entire ellipse. The scalp-ballooning technique is also performed at the donor site. The objective of this infiltration is to make the scalp tumescent, thus easing the separation of the follicular units. It also reduces bleeding in this area.

Harvesting the Donor Ellipse



The hair-bearing ellipse is cut with a single No. 10 blade at an oblique angle to avoid damaging the hair follicles. This incision is quite superficial; the flap is raised from the subcutaneous fat layer, with care to avoid dividing the sensitive branches of this region. It is important to avoid causing posterior paresthesia or painful processes such as sensitive neuroma, which may last for months. The galea aponeurotica must remain intact.

In the past we attempted to use multiblades and punches in the donor area, but we found that we damaged many of the hair follicles. This in turn made it more difficult to harvest the area during a second replacement procedure.

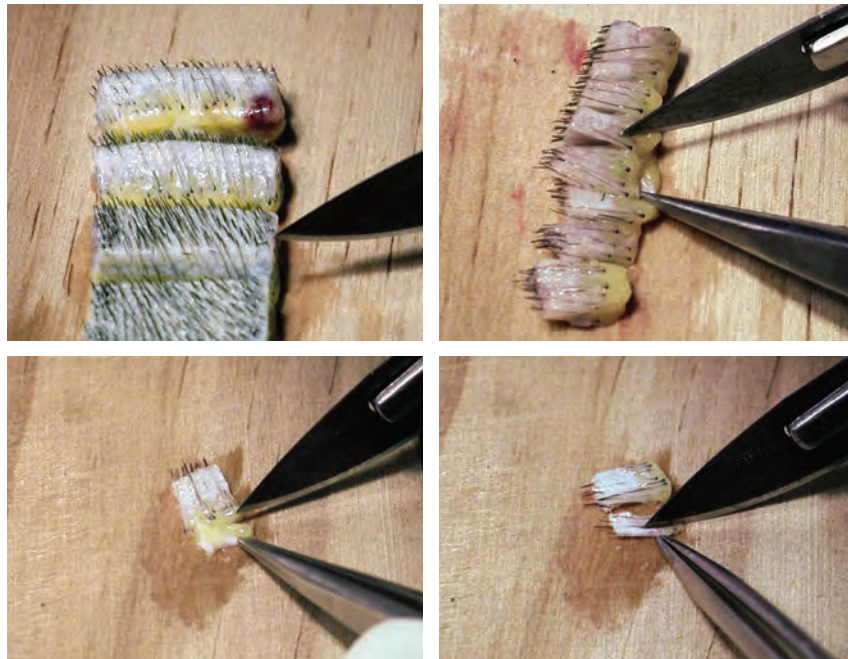


To achieve a natural closure, it is very important to undermine the superior and inferior edges of the ellipse, taking care not to damage the occipital vessels and nerves located at the ends of the ellipse. The scalp does not tolerate stretching, so closure must be done gently.



Subcutaneous sutures are placed, and a running superficial cutaneous suture is used to close the defect.

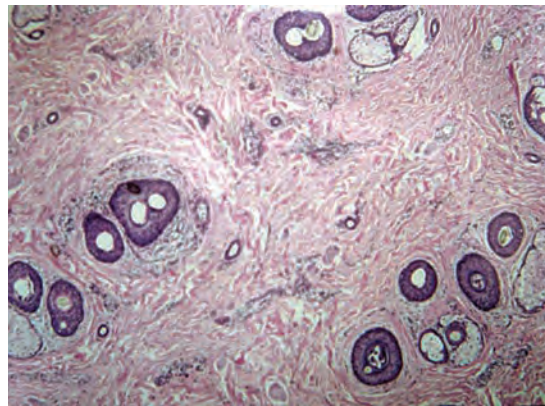
Preparing the Follicular Units



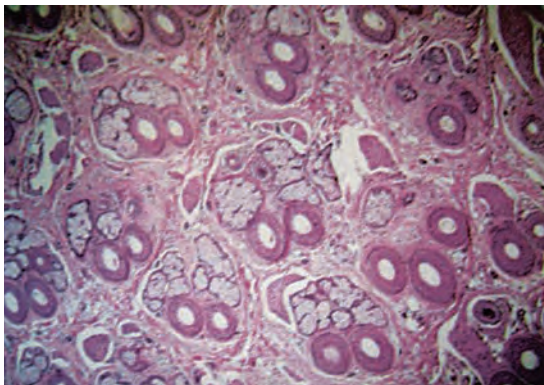
The hair-bearing ellipse is placed on a hard wooden or acrylic surface and cut into several slices, 3 to 4 mm wide, with a No. 22 or No. 10 blade. The movement for cutting the grafts must be fast and precise, maintaining a direction parallel to the shafts and follicles. The subcutaneous fat is removed from the follicles, but care is taken to maintain a small amount around the bulbs. This remaining fat will provide nourishment and protect the bulbs during the grasping maneuver.



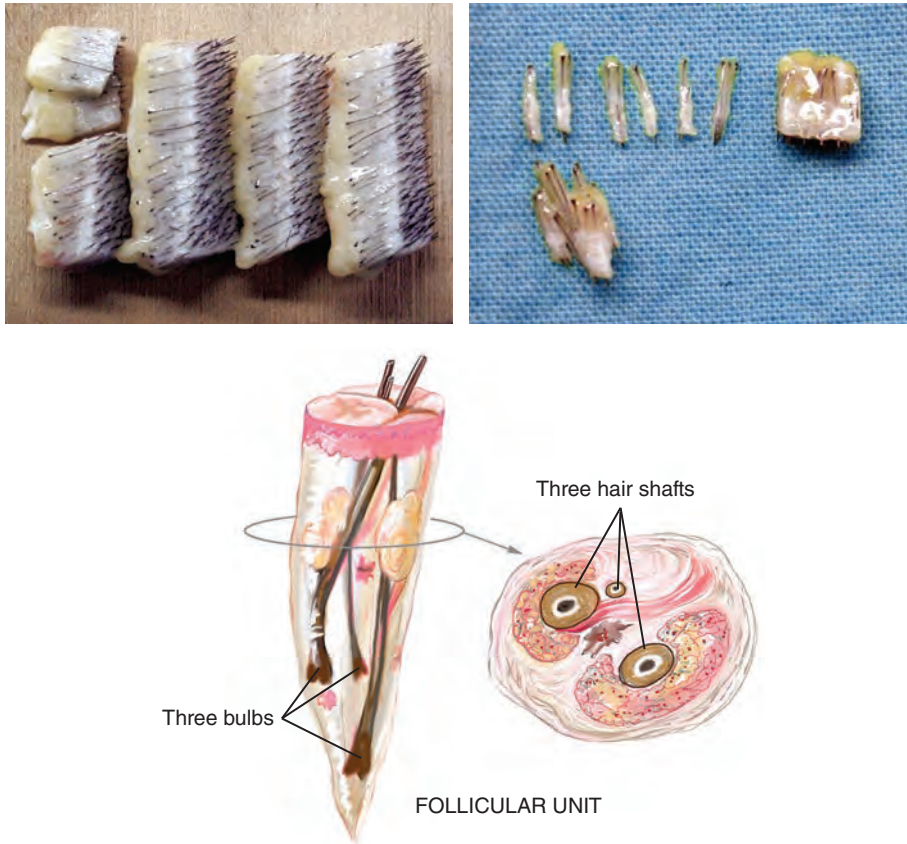
Patients with less hair density will present with larger interstices of reticular dermis and connective fibers surrounding the grafts. This tissue is trimmed away during graft preparation so the follicular units may be placed closer together in the recipient area to create density with a significant amount of connective tissue surrounding the grafts that needs to be trimmed away.



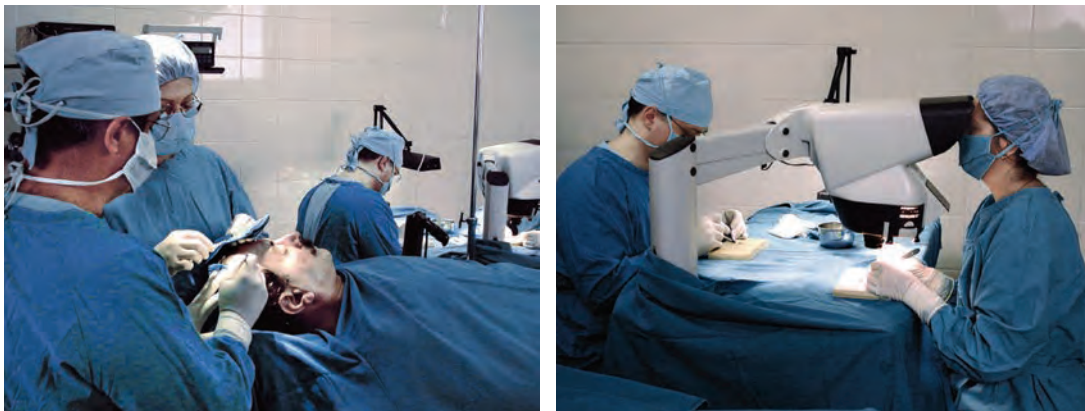
In this transverse section of the scalp, at the level of the sebaceous glands in the low reticular dermis, follicles are seen separated by a large fibroconnective tissue (hematoxylin-eosin stain; original magnification 50 $\times$). This tissue is trimmed away, “cleaning” the units for transplantation. Other areas have a density greater than 1 follicular unit/mm².



In this histologic specimen, we see a normal density of follicular units (hematoxylin-eosin stain; original magnification 50 $\times$).



The grafts are divided into two groups: micrografts consisting of one or two bulbs, and minigrafts consisting of three or four bulbs. Both are called *follicular units*.



Grafts can be separated without magnification or with three-dimensional stereoscopic viewing. The use of magnification in the preparation of follicular units has contributed to improved graft quality. Highly skilled and experienced assistants are essential in the preparation of the follicular units. With good lighting and sharp blades, they can accurately prepare 100 to 1000 grafts within an hour.

In preparing the grafts, it is important not to cut the epidermis. We have found that buried grafts produce more cysts and granulomas after the third month, when the hair starts to grow. For the past 12 years we have preferred to maintain the epidermis.

After the grafts are prepared, they are placed on gauze moistened with saline solution and brought to the recipient site immediately; there is no need to place them in solution or wet dishes. To maintain good histologic condition, grafts should be transplanted within 20 minutes of being divided. Through studies described by Limmer, we know that the grafts can be kept out for a period of up to 2 hours without waste. After that, they lose their quality and the yield will be jeopardized. This is an important part of our technique, which allows the grafts to be implanted immediately. As the follicular units are being prepared by two assistants, the surgeon and another assistant are immediately implanting them.

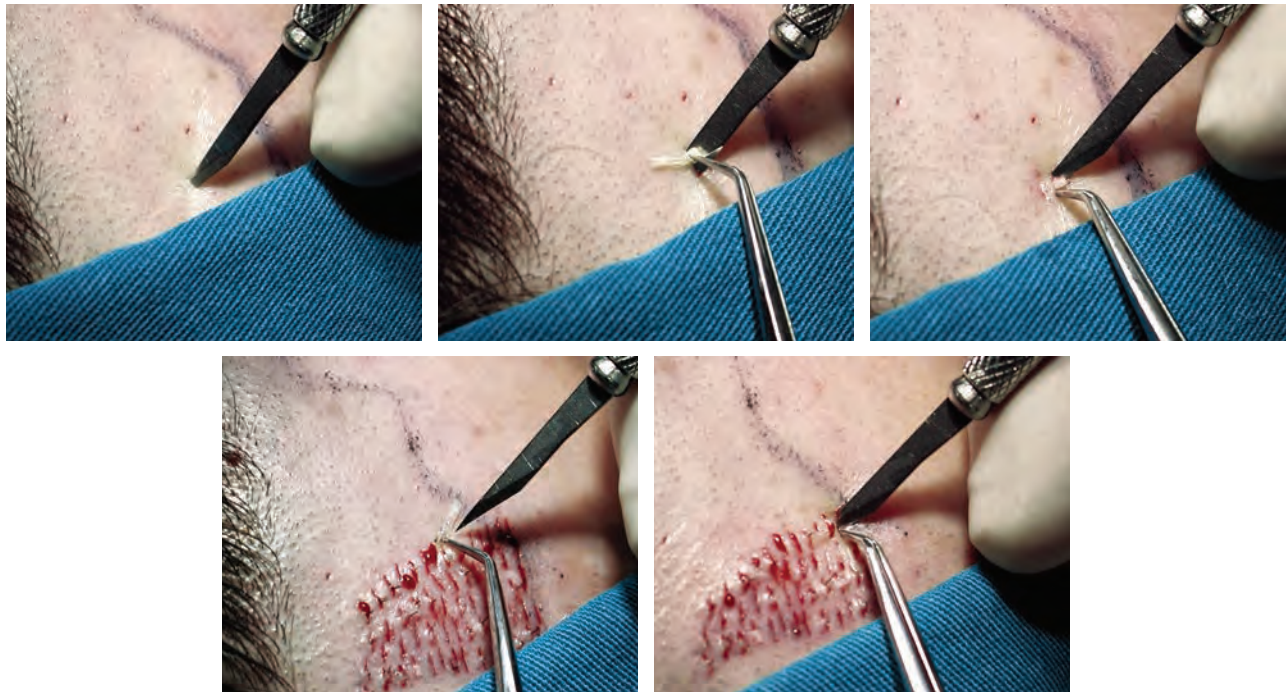
Implantation of the Follicles



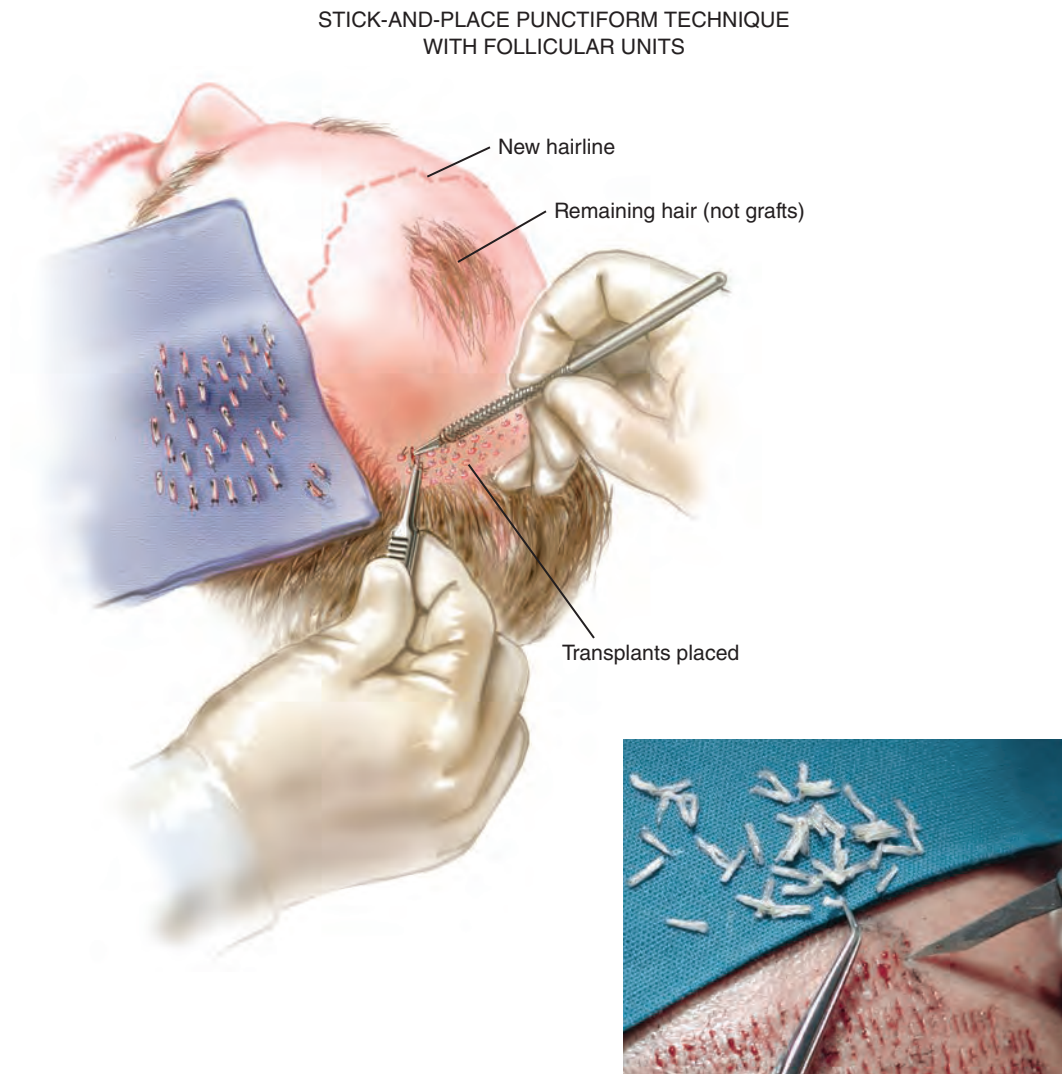
The bald recipient area should be swollen and ischemic; it is important to work without bleeding and to maintain the grafts inside the orifices. To achieve this scalp ballooning, I perform tumescent infiltration of all layers of the scalp. As mentioned previously, this can be repeated every 30 minutes, whenever the tumescence and ischemia diminish. It is important to inject the dermal surface immediately before transplantation to achieve a sympathetic and microvascular plexus of the area, which is demonstrated by “white marbling.” The area is then ready to receive the micrografts without bleeding.



To perform the punctiform incision, we use a No. 11 sharp blade, or a microsurgical blade (Beaver 6500-BD). An angular microsurgical forceps is useful to grasp the follicular units and bring them to the slit.



I normally prefer to begin the punctiform incision from the middle and work toward the front. To create a natural hairline, the incision is made vertically in the middle and then a little obliquely as it approaches the forehead. The incision is 3 to 4 mm deep, which is a sufficient depth to gently place the graft. Care must be taken not to cut the galea aponeurotica, because doing so would cause more bleeding and the graft could be totally buried.



When I have made the incision with a No. 11 blade or microsurgical blade, the assistant picks up the graft from the moist towel with an angled microsurgical forceps and gently inserts it into the slit. The blade is then removed to help with insertion. This maneuver, which we call *stick-and-place*, is performed simultaneously.



The stick-and-place procedure is repeated, maintaining a space of 4 to 5 mm between each unit so the implanted grafts are not dislodged. If greater density is desired, I wait 15 to 20 minutes before introducing another graft between the newly implanted units. During this time the fibrinogen inside the skin becomes fibrin and surrounds the grafts like glue, causing them to adhere in place. When the anterior region of the forehead is reached, I implant single hairs in an irregular pattern for an effect that is vital to achieving a natural-looking final result. It usually takes 2 hours to place 1500 follicular units; we do not recommend exceeding this amount. It is preferable to perform a second replacement procedure after 8 months, if necessary, at which time another quantity of grafts can be successfully implanted. *Transplanted units are like plants in that we need to keep a distance of 2 to 3 mm between them so that they will grow with greater vitality.*



When transplantation is complete, a simple dressing of gauze moistened in saline solution is applied over the implanted area, and a bandage is kept in place for 24 hours to protect the area.

Postoperative Care

After the surgery, someone should accompany the patient home. Patients may return to their professional activities the day after surgery. I recommend the use of an analgesic to relieve discomfort in the donor area, which is common 6 to 8 hours after surgery. I do not recommend the routine use of antiinflammatory medication or antibiotics.

During the first 24 to 48 hours, it is important for the patient to sleep with the head elevated at no more than a 30-degree angle to avoid swelling in the forehead, which may occur as a result of the scalp ballooning. Swelling of the forehead occurs in 25% of patients and may, after the second day, move down to the eyelids and even the cheeks. Cool compresses are helpful for reducing the swelling, but steroids do not bring significant improvement.

The tumescent technique produces swelling in the scalp that lasts for approximately 2 days and can affect the face and upper eyelids for up to 3 days. I recommend that the patient not drive during the first 24 hours and sleep in a dorsal or lateral decubitus position at a 30-degree angle for the first 48 hours.

The patient removes the dressing at home on the second postoperative day and showers, gently cleansing the scalp with an antiseptic shampoo. Patients should try to remove only the dry blood but not the crusts, which will slough off within 8 to 15 days. If the patient dislodges any of the implants, there will be some bleeding, which can be stopped by pressing the location for 3 to 5 minutes.

There is a transition phase, catagen, 1 to 3 weeks after surgery, in which the implanted hair grows to 3 or 4 mm. During this stage, the patient can touch the implanted area and feel hair beginning to grow. After this period, the telogen phase begins, during which almost every implanted hair falls out. This phase lasts approximately 6 to 9 weeks, and the patient may worry whether the surgery was a success. After the telogen phase, the anagen phase begins, and new hair will be generated from the remaining matrix. The new hair growth initially comes in very thin and delicate. The final result will be visible after 6 to 8 months in men and 10 to 12 months in women.



Preoperative



3 months



4 months



5 months



6 months



7 months



8 months

This 42-year-old patient shows the progression of hair growth in the first 8 months after hair transplantation.



The same patient is shown preoperatively and 1 year postoperatively.

Patient Instructions Following Hair Transplantation

Plan on relative rest for the first 72 hours. During this period always lie with your head elevated at a 30-degree angle.

After the second day, swelling may occur in the eyelids and the forehead region. If this occurs, apply cold compresses soaked in saline solution or boric acid dissolved in water. The swelling will decrease within 48 hours.

The dressing should be removed on the second postoperative day, and your head must be washed with antiseptic shampoo, taking care to remove only the dried blood, not the crusts. The antiseptic shampoo must be used for a week.

After the dressing has been removed, we recommend covering the implanted area for protection with sterile gauze and a hat or cap.

We advise against any of the following:

- The use of hair dye
- Driving while the eyelids are swollen
- Smoking or drinking alcoholic beverages during the first postoperative week
- Playing sports or exerting yourself during the first 2 postoperative weeks
- Exposure to the sun or intense heat for at least 3 weeks

The stitches in your head must be evaluated on the third postoperative day and removed on the seventh postoperative day. The small crusts from the follicular units will fall off by themselves approximately 10 days after surgery, along with some implanted hair. Do not worry about the hair loss; the implants are still intact.

It is common for cysts to appear after the third month; these should be ruptured with a sterilized needle or forceps, and the scalp should be cleansed with antiseptic solution.

Hair growth will begin 90 to 120 days after surgery, and the final result will be visible within 6 to 8 months in men and within 10 to 12 months in women.

If a second implant procedure is necessary, this can be performed 1 year after the initial transplantation.

Surgical scars remain for an indefinite period and their quality is unpredictable, depending on characteristics of your skin.

Female Pattern Baldness

Although male pattern baldness is more prevalent, millions of women also experience hair loss. The most common cause of hair loss in women is androgenic alopecia, which usually occurs when an individual enters menopause. The operative technique for treating female pattern baldness is similar to that described for men, with a few modifications. Because women's hair is finer than that of men, we prefer to implant more minifollicular units containing three to four shafts rather than microunits with one or two shafts. We begin the replacement procedure in the posterior region and work forward toward the anterior region. When we need to implant grafts into the anterior hairline, we transplant microunits containing one or two hair shafts. Final results can be expected approximately 15 months after the procedure. Patients are advised not to color their hair until 1 month after surgery, because hair-coloring products can be abrasive to the newly implanted bulbs. If additional hair density is desired, a second replacement procedure can be performed 15 months later.



This 58-year-old woman presented with androgenic female baldness and was treated with one follicular unit replacement session. She is shown 14 months postoperatively.



This 62-year-old patient has typical temporal hair loss (*telogen effluvium*) as a result of an endoscopic brow lift. She is shown 11 months after transplantation of follicular unit micrografts.

Complications

The complications associated with hair transplantation are rare and minor compared with those of other techniques. The most common complication is forehead and eyelid edema, which appears 2 to 4 days postoperatively. Application of a 10% solution of boric acid dissolved in water or cool chamomile compresses can help reduce the swelling.

For patients at high risk for keloid scars, a trial procedure is recommended, during which approximately 10 follicular units are implanted. The donor and recipient sites are observed for 6 to 12 months to ascertain that the healing process is complete before proceeding with the full hair transplantation.

Temporary alopecia around a tight donor site closure (the telogen phase induced by ischemia) has been observed, but the hair usually regrows within 3 to 4 months. This is more likely to occur in patients who have scars from prior procedures.

Results



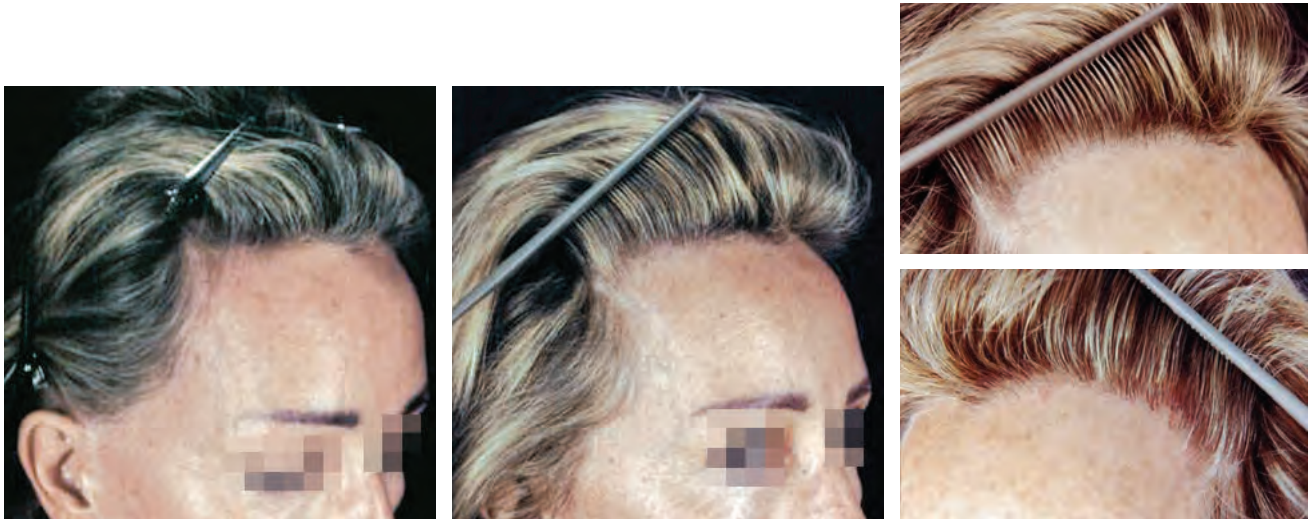
This young patient had incipient baldness; we increased his hair density. After 2 years, he enhanced his hairstyle with some blond highlights.



This 41-year-old patient with androgenic female baldness was treated with a single session of follicular unit implantation. She is shown 2 years postoperatively.



This 48-year-old man had hair loss and gray hair; he is shown initially at 15 months after transplantation. He is then seen 4 years postoperatively; he had changed his hair color to a slightly bluish cast.



This 48-year-old patient with a secondary frontal-glabellar lift was treated with follicular unit implantation. She is shown 3 years postoperatively with blond hair.



This 78-year-old man with white hair presented with hair loss. The newly implanted hair reframes his face, and he looks younger. He is shown 8 months postoperatively.

FUTURE DIRECTIONS

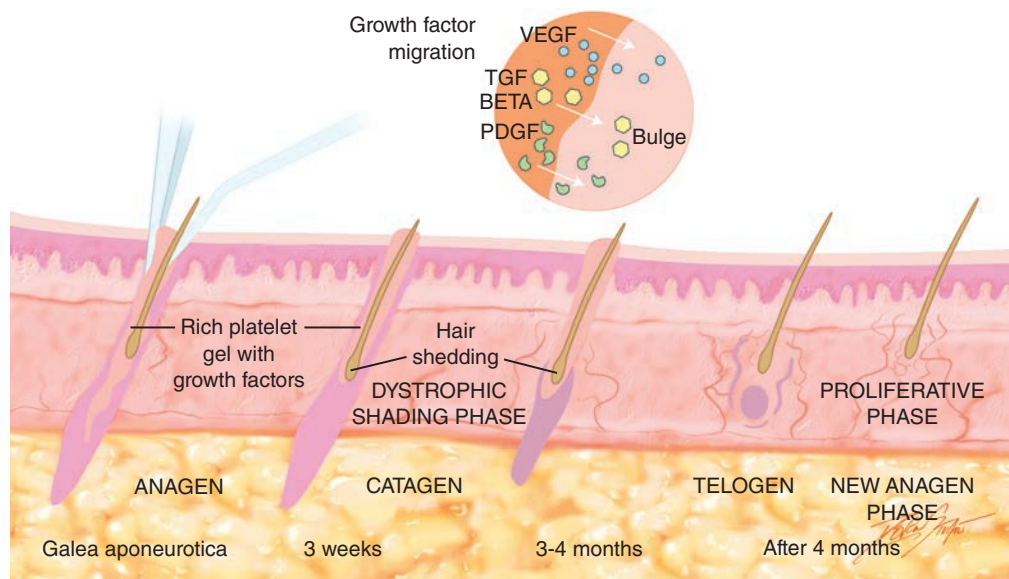
The Role of Platelet-Rich Plasma Growth Factors in Surgery for Male and Female Pattern Baldness

Baldness surgery with micrografts and minigrafts performed in megasessions was described in 1989 and 1991, and today it is a widely used technique for treating both male and female pattern baldness. The procedure transplants great quantities of follicular units harvested from the posterior occipital area of the scalp and places them in bald regions. These transplanted units carry a good genetic histologic structure, providing the future hair with the same quality of growth, durability, and characteristics as the donor area. Implanted hair growth has an individual cycle. During the first 2 weeks of implantation, the catagen phase occurs, marked by an inflammatory process in which redness in the scalp and shedding of the hair shaft is common. The patient then enters the telogen phase, which lasts between 3 and 4 months. This is followed by the latency period, which precedes the third phase, anagen. In this phase, the future hair begins to grow. During the resting period, substantial follicular unit loss can occur because of apoptosis. Between 15% and 30% of the implanted grafts will either be eliminated or absorbed by the scalp. Therefore only 70% to 85% of the implanted hair will sprout. Considering this important hair loss fact, we developed a clinical trial using platelet-rich plasma growth factors obtained from the patient's own plasma. This experimental research was submitted to and approved by the Ethics Committee of the Pontificia Universidade Católica do Rio Grande do Sul in Brazil, Division of Plastic Surgery.

Platelet Growth Factors and Hair Stem Cells

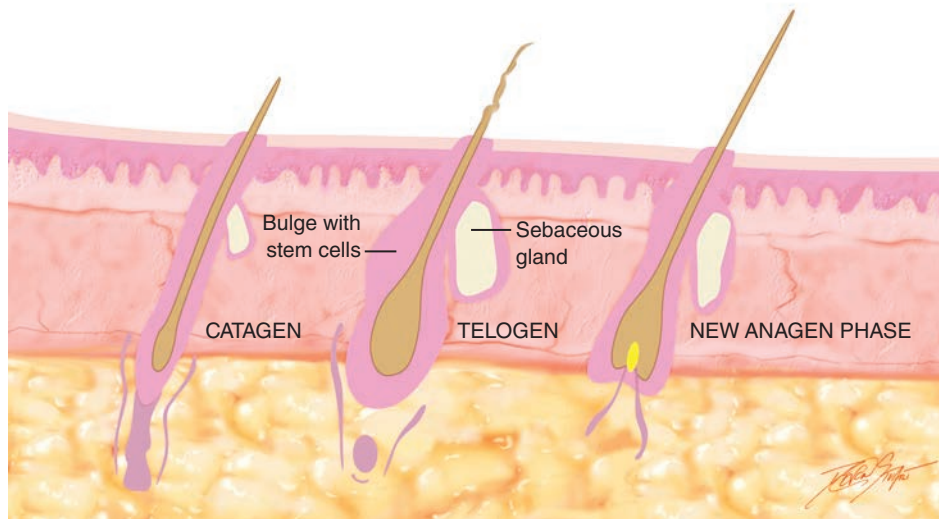
The first articles on growth factors derived from plasma were published during the 1970s and 1980s describing their application for tissue repair and hemostasis during the healing process of ulcers and undermined wound surfaces. More recent works in orthopedics and odontology demonstrated the role of such factors in bone graft recomposition and in the osteosynthesis of teeth. Man et al in 2001 and Bhanot and Alex in 2002 reported new applications of platelet-rich plasma in the wound sites of cosmetic procedures. The growth factors contained in platelets of blood plasma are basically three: platelet-derived growth factor (PDGF), transforming growth fac-

tor (TGF), and vascular endothelial growth factor (VEGF). These are protein molecules that, in contact with their respective receptors, act in tissue angiogenesis, stimulating the healing and growth of new organic structures. The action of growth factors on the germinative hair cycle has already been studied in both its embryologic and adult phases; however, it has not yet been studied in hair micrograft implantation surgery. No clinical trial or experimental protocol had previously been performed to verify the efficacy of those factors in the growth and density of implanted follicular units.



This illustration depicts follicular units being implanted and the associated platelet plasma growth factors, showing the dystrophic shading phase and the new proliferative phase with an intense vascular endoneogenesis supporting the new hair development to the anagen phase. There is an intense growth factor migration into the stem cells in the bulge area.

These growth factors interact in the bulge area with cells of the matrix, thus activating the proliferative phase of the hair. Stem cells are more primitive and of ectodermal origin. They give rise to epidermal cells and sebaceous glands. Germinative cells of the matrix, which are found at the dermal papilla, are of mesenchymal origin.



The hair follicle cycle shows the meeting between matricial cells from the papilla and the stem cells in the bulge area, starting the growing phase of the new hair follicle.

Both cells need each other, and when they meet through the action of various growth factors (PDGF, TGF, and VEGF), they give rise to the future follicular unit, which consists of the hair shaft, sebaceous glands, erector pilus muscle, and the perifolliculum. Headington described this histologic unit in 1984. It is the complete and developed follicular structure in the anagen hair cycle phase that lasts from 3 to 6 years in the scalp.

Experimental Model

Twenty male patients aged 22 to 54 years with male pattern baldness in the frontal, parietal, or occipital area were selected for this experiment.



Two symmetrical 2.5 cm² bald areas were delineated. On the right side of the patient's head, follicular units imbued with platelet plasma growth factors were implanted; on the left side, standard follicular units were implanted as a control. In all

patients, both areas were implanted with an equal number of micrografts. All patients were duly informed about the clinical trial and signed informed consent documents. This patient is shown 7 months after implantation, with improved hair growth on the right side.

Surgical Technique

Harvesting of Follicular Units



In all cases, a hair-bearing ellipse flap was taken from the occipital area of the scalp above the neck, where the best histologic and genetic quality of hair is present. The flap size varied according to the amount of follicular units needed. For medium-type baldness, an ellipse was obtained, usually 15 cm long by 2 cm wide, from which 1200 follicular units could be obtained.

The donor area was closed without tension, using an intradermal or continuous suture, to enable a secondary harvesting of grafts 3 to 4 years later if needed. Two groups of 180 follicular units were harvested and prepared—one group was imbibed with platelet plasma growth factors and the other was kept wet with saline solution on an acrylic surface.

Obtaining the Platelet Plasma Growth Factors

Before surgery, 80 ml of blood was withdrawn from the patient in eight vacuum flasks, with each one containing 1 ml of anticoagulant, 3.2% trisodium citrate (Vacurette; Greiner Bio-One, Kremsmuenster, Austria).



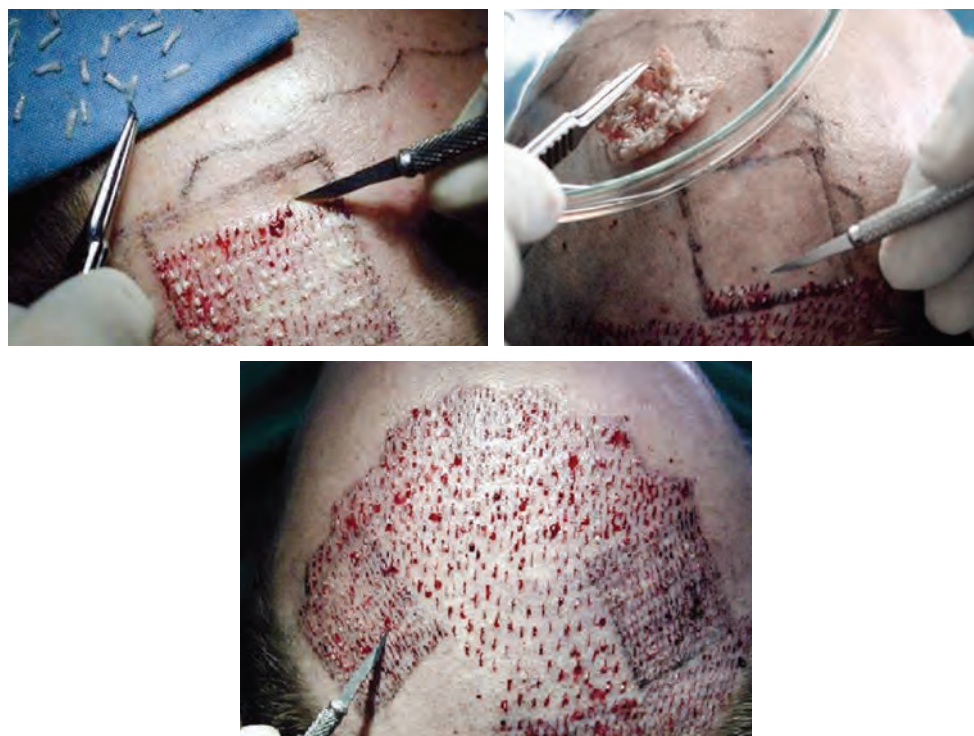
The eight flasks were centrifuged at 1000 rpm for 10 minutes. This slow speed is important so that platelets are not displaced to the bottom of the flasks. The plasma was then dispensed into four new flasks for a second centrifugation at 5000 rpm for 10 minutes. The floating platelet-poor plasma was discharged, leaving only 2 ml of concentrate—the platelet-rich plasma with four to six times more platelets than normal plasma, and therefore containing a high concentration of growth factors. This concentrate was then added to the follicular units before implantation. The follicular units were kept in the platelet growth factor solution for 15 minutes to allow the growth factors to attach to the stem cells located in the bulge area of each follicular unit.



Next, 10 drops of 10% calcium chloride was added to the mixture to convert fibrinogen into fibrin, thereby producing the plasmatic gel that would seal the growth factors around the micrografts. The follicular units were then ready to be implanted.

Implanting the Follicular Units

The entire bald area on the scalp was massively infiltrated with saline solution containing epinephrine 1:160,000. This tumescent technique, or “scalp ballooning,” with the vasoconstriction obtained with the epinephrine injection, helps to limit bleeding and facilitates implantation of the micrografts.



The units were implanted by the stick-and-place punctiform technique. In the outlined area to the right, the units imbued in platelet-rich plasma growth factors were implanted; to the left, the units considered controls were placed. The same number of grafts was implanted on both sides, thus allowing greater control for the clinical trial.

For this procedure, microblades (BD Beaver) and lance tip 15DEG (Ellis Instruments) and jeweler-type microforceps were used. After the two demarcated areas were implanted, the remaining bald area was implanted using standard follicular units. Moist gauze was applied to the implanted area and secured by an elastic bandage that was kept in place for 24 hours. After that time, the patient removed the bandage and washed the entire implanted area with an antiseptic, neutral shampoo.

Endpoint Evaluation

All patients were evaluated monthly for 7 months, and the yield of follicular units was counted in the outlined areas. An accurate inspection, counting the number of follicular units within the two areas, was performed by staining four india ink spots. The final count was performed at the end of 7 months with a magnifying glass by the surgeon; the hairs were recounted by two assistants for confirmation.



This 38-year-old patient had 150 implanted follicular units. After 7 months, 114 were counted on the right and 95 on the left—an improvement of 20% for the platelet plasma growth factor-imbibed side.

Statistical Analysis

The data were summarized using mean standard deviation. To compare the platelet-rich plasma growth factor protocol and the control group, the paired *t* test was used, because data showed a gaussian distribution. Analyses were performed using SPSS version 12.0 (SPSS, Chicago). The significance level was set at 0.05.

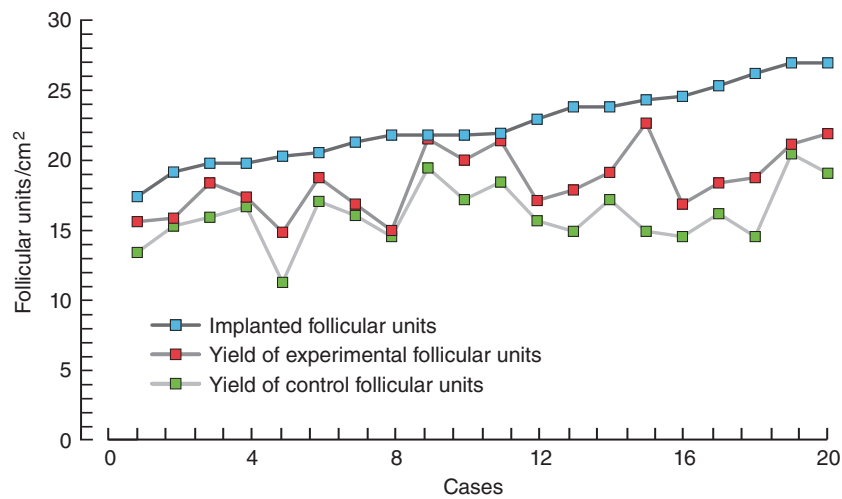
Patient Characteristics, Implanted and Yield of Follicular Units per 2.5 cm² Areas, and Normal and Rich Plasma Platelets (N = 20)

Age (yr)	Region of Baldness	Implanted Follicular Units	Yield of Follicular Units		Platelets	
			Control	Experimental	Normal Plasma	Rich Plasma
35	F	138	117	135	224.000	460.000
45	F	170	129	134	185.000	417.000
49	F	155	92	107	234.000	614.000
39	F	164	92	119	268.000	658.000
31	F	128	72	94	227.000	640.000
50	F	170	121	139	187.000	390.000
29	F	160	102	117	183.000	380.000
36	F	150	95	114	180.000	420.000
32	F	145	99	108	217.000	390.000
48	F	153	94	143	144.000	536.000
36	O	110	86	99	224.000	460.000
32	F	137	92	95	184.000	391.000
48	F, P, O	150	108	121	195.000	600.000
54	F, P, O	137	123	135	150.000	420.000
23	F	121	97	101	311.000	343.000
22	F	125	101	116	270.000	1,202.000
42	O	135	103	107	165.000	656.000
29	F	137	108	127	248.000	1,076.000
38	F	130	108	119	140.000	321.000
39	F, P	125	105	110	200.000	191.000
38 ± 9	—	142 ± 17	102 ± 14	117 ± 15	206.800 ± 44.942	528.250 ± 243.586

Data are summarized as mean ± standard deviation. F, Frontal; O, occipital; P, parietal.

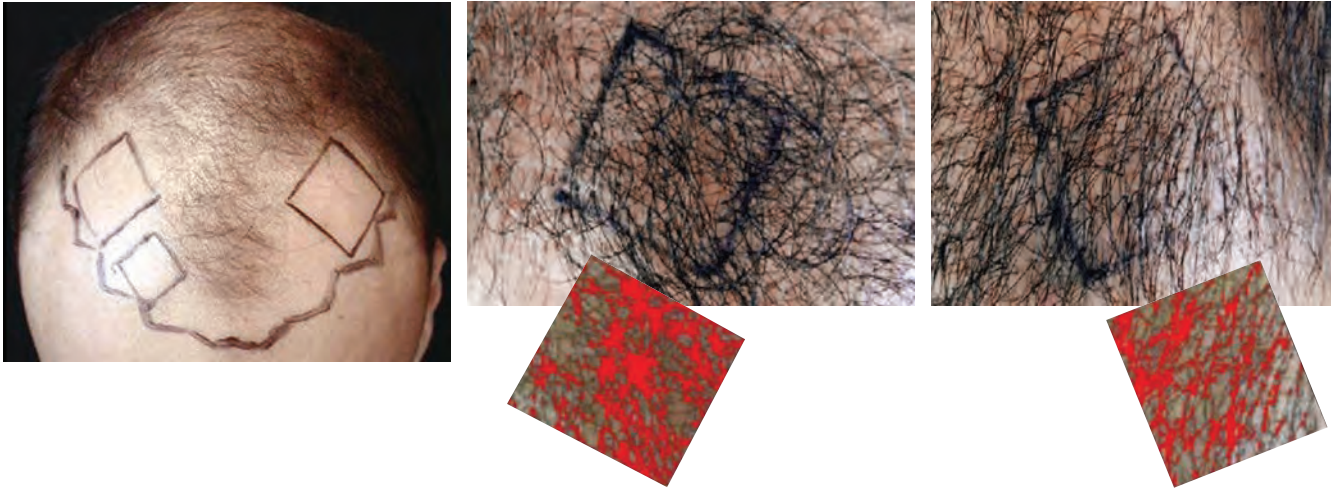
Experimental Results

There was a statistically significant difference observed in the yield of follicular units when the two groups were compared ($p < 0.001$). The experimental group with the platelet-rich plasma growth factor showed a density of 18.7 follicular units per cm^2 , whereas the control group showed 16.4 follicular units per cm^2 . The difference of 2.3 follicular units per cm^2 (95% confidence interval, 1.6 to 3.2 follicular units per cm^2) represented a 15.1% increase in the yield of follicular unit density between the two groups.



Group	Yield of Follicular Units	Effect/ cm^2	95% CI	p (Student t)
Implanted	22.7	—	—	—
Experimental	18.7 ± 2.4	2.4	1.6 to 3.1	<0.001
Control	16.4 ± 2.2	—	—	—

This graph shows the total implanted follicular units and the yield of follicular units for both experimental and control groups. This means that if there is a 100 cm^2 (10 by 10 cm) bald area to be implanted, one can obtain 240 follicular units more, or approximately 480 hair shafts, assuming two shafts per follicular unit. It is important to note that some patients had only a 3% increase using the platelet-rich plasma growth factor protocol, whereas others had a 52% increase in follicular unit density.



This 32-year-old patient had 125 follicular units implanted on each side; 117 follicular units were counted on the right and 93 on the left; thus 26% more hair was noted in the area implanted with platelet-rich plasma growth factors. Software image analysis demonstrated a similar density of 28% on the right side.



This 78-year-old woman had female pattern baldness and was treated with follicular unit grafts and platelet growth factors. She is shown 14 months postoperatively.



This 62-year-old man had very thin hair. He was treated with platelet-rich growth factor follicular unit grafts and is shown 1 year postoperatively.



This 54-year-old patient had very thin hair and was treated with platelet-rich growth factor follicular unit grafts. He is shown 14 months postoperatively.



This 36-year-old patient had poor hair growth after one replacement procedure. The results are shown after a second micrografting procedure with platelet-rich growth factor follicular unit grafts. At 1 year postoperatively, there is approximately a 55% increase in hair follicles.

Imaging

The use of digital imaging is an important comparative tool for assessing density. For one patient, a digital camera (5.0-megapixel, 24-bit color) was used at a fixed distance from the scalp. Photographs in this study were recorded in raw format. Image-Pro Plus 4.5 image analysis software (Media Cybernetics) was used to perform morphometric analysis and to derive objective measures of the hair color density from the marked areas on the right and left sides. A color threshold level was selected interactively by an experienced observer and applied on both images from each patient. The scale used was 40 pixels/cm. The area covered by hair was divided by the total area measured on every image. The patient shown on p. 683 demonstrates 28% more density on the right side. By counting the follicular units with a magnifying glass, an increase of 26% was observed in that area. This indicates that both systems are practically the same and that the digital program could perhaps be improved in future studies.

Concluding Thoughts

In this clinical trial of 20 patients with male pattern baldness, there was 15.1% more hair yield in follicular units and density in the areas treated by platelet-rich plasma growth factors. This new development for hair transplant surgery demonstrates that the use of autologous platelet growth factors can improve capillary density with low cost and low morbidity, using a simple technique—a significant improvement over conventional techniques. Especially for patients with less density and very thin hair in the donor area, this technique should be a great contribution. Although these results are significant, further research, such as a double-blind test, should be performed to evaluate the final results with outside assistance, in asymmetrical areas. This offers a new perspective on hair transplantation and is an important contribution to implantation surgery with follicular unit megasessions.

Clinical Caveats

Careful patient selection and good patient communication are crucial to achieving optimal results.

Surgeons should always be honest when discussing the positive and negative aspects of hair replacement with patients. It is especially important to make the patient aware that a second procedure may be necessary to maintain the new hairline.

Hair follicles are harvested from the posterior cervical area where the hair density is greatest and the quality is best. This is normally 6 to 8 cm from the nape of the neck.

A well-trained team is a requisite for a good result.

Scalp ballooning tumescent technique is important to prevent bleeding during surgery and to maintain the grafts inside the punctiform incision.

Scalp ballooning at the donor site makes the separation of the follicular units easier and reduces bleeding in this area.

The surgeon should avoid division of the sensitive branches in the donor region to prevent posterior paresthesias or painful processes that can last for months.

The scalp does not tolerate stretching, so closure of the donor site must be done gently.

When preparing the grafts, it is important not to cut the epidermis.

We recommend implanting a maximum of 1500 follicular units per procedure.

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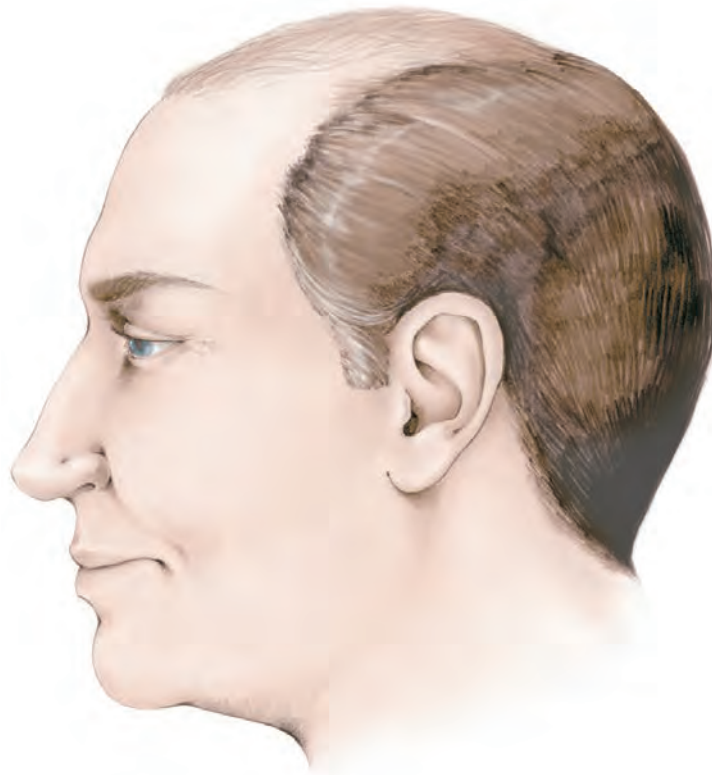
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CHAPTER 21



Reoperation, Refinement, and Treatment of Complications After Hair Transplantation

JACK FISHER

Hair transplantation is one of the most frequently performed aesthetic surgery procedures in men today. The goal is hair restoration that is natural and virtually imperceptible. A poorly designed or executed procedure will result in a highly visible and unnatural hairline. Despite its popularity, this procedure often results in unsatisfactory aesthetic outcomes. The causes of these problems and solutions for addressing them are the focus of this chapter.

Before defining the problems that create bad results in hair transplantation, one must identify the components of a natural hairline. Without knowledge of what defines the normal, it is difficult to discuss the abnormal. A successful hair transplant should look totally natural, with a hairline that is irregular, feathered, and age appropriate.

When considering a patient for hair transplantation, the surgeon must realize that hair loss is progressive. Probably no single factor is as important or has led to so many poor results as when the progressive nature of hair loss is ignored. The location of the frontal hairline is another key factor. What looks good in an 18-year-old male will usually not be appealing in a 45-year-old. Therefore it is important to design a frontal hairline that will be aesthetically acceptable over a long period as the patient's face matures and hair loss continues. High hairlines rarely look bad, but extremely low hairlines can be a disaster. One of the most critical anatomic components of a natural hairline is the frontotemporal angle. Rounding off this angle with hair transplants usually leads to a bizarre appearance, especially as the patient ages.



Aesthetic surgeons frequently place a high premium on obtaining symmetrical results in most procedures. However, in hair transplantation, a perfectly straight, symmetrical hairline, even with the use of micrografts, is destined to look artificial, as can be seen in this patient, who had a large number of transplants placed in an extremely straight line. Irregularity and asymmetry are the hallmarks of a natural-appearing hairline.

Common Problems Requiring Reoperation

Unsuccessful hair transplants generally share similar characteristics:

- The hairline is too even and straight.
- The frontotemporal angle has been blunted.
- Large plug grafts have been used.
- The transplanted hair fails to grow.
- The hairline is too low.
- The hair has been transplanted at an incorrect angle.

Transplants done with large plug grafts represent a major problem. Unfortunately, many individuals have undergone these procedures over the past three decades. Careful analysis is required to correct or improve these difficult cases. Often there is significant scarring in the donor site, because a coring device was used to remove grafts containing 10 to 40 hairs at a time. Frequently the donor site was allowed to heal by secondary intention, resulting in significant scarring. Many of these patients have little if any available donor hair remaining for further grafting.

In individuals with adequate donor hair, a significant improvement can be achieved by excising the old plugs, recutting and recycling this hair, and using small one- to three-hair grafts for further transplantation. This improvement can only be accomplished, however, if sufficient residual donor hair is available. Scalp excisions and forehead advancement procedures are important adjuncts in these difficult secondary cases.

Another problem is the failure of transplanted grafts to take. In healthy patients, the graft-take rate should exceed 90%. Small one- to three-hair grafts, properly created, will rapidly undergo neovascularization, and in a healthy patient most of this hair should grow. However, if the grafts are poorly prepared, the success rate falls off drastically. It takes a considerable amount of time and experience for a surgeon to be able to create these small grafts, and a well-trained team is critical for a successful outcome.



One of the most difficult problems to correct successfully is a hairline that has been placed too low. As the patient ages, the hair recedes, leaving a bizarre, isolated frontal hairline. Often the only solution is an aggressive procedure that involves resection of these grafts combined with a forehead lift with regrafting.

Finally, there is the group of patients who have had cosmetic surgery and experienced secondary hair loss, such as after a face lift or a coronal brow lift. In a patient who has undergone a face lift, temporal hair loss is the most common; it is caused either by excess skin tension or superficial undermining with direct damage to the hair bulbs. Hair loss is usually related to tissue ischemia. In many of these patients, the hair will regrow after 6 to 9 months, and a conservative approach is best. In some individuals the hair fails to regrow, and transplantation is an ideal solution. Traumatic alopecia, which usually occurs from hair bulb ischemia, may be caused by factors other than cosmetic surgery. Prolonged pressure on the scalp, such as in a comatose patient, can also lead to hair loss without ischemia of the scalp. The skin is more tolerant of ischemia than the hair bulbs are.

Evolution of Technique

In 1959 Orentreich published a landmark report on the use of punch grafts to treat male pattern baldness, thereby establishing punch grafts as the standard treatment for almost three decades. Although results achieved with this technique may have been reasonable at that time, the abnormal cornrow appearance they produced was far from aesthetic. These grafts were harvested with a 3.5 to 5.0 mm punch, producing plugs containing a large number of hairs. This technique created two major problems: (1) a severely scarred donor site in the posterior scalp because the donor holes were allowed to heal by secondary intention, and (2) an unnatural recipient site with the classic cornrow appearance.

Eventually, smaller plugs containing six to eight hairs were used, but this still resulted in an unnatural appearance. It was not until the early 1990s that physicians began to recognize that donor grafts containing the follicular units (naturally occurring clusters in which hair grows) of one to three hairs were the key to producing

natural results. By transplanting the hair in these smaller units, the cornrow appearance is avoided.

The other great advance in the evolution of hair transplantation occurred with the development of the technique for transplanting large numbers of hairs in one session. Pioneers such as Carlos Uebel and others developed techniques whereby 1000 to 2000 follicular units could be transferred at one time. Thus the combination of small grafts composed of anatomically correct one- to three-hair units and the ability to rapidly transfer a large number of grafts in a single “megasession” produced a revolution in hair transplantation.

Indications and Contraindications

The patient’s age, family history of hair loss, current hair pattern, amount of hair remaining, and expectations are all important factors in selecting potential candidates for reoperative hair transplantation. Patients with minimal hair loss are the best candidates for primary—and in particular secondary—hair transplantation procedures and are much more likely to be satisfied after hair transplantation.

Patients in their late or early twenties and those in their teens are rarely appropriate candidates. These young patients often develop a receding hairline later in life and may wish to fill in the anterior hairline they previously had. Such a procedure is usually a major mistake, because with progressive hair loss the patient will be left with an isolated frontal fringe with balding areas behind the transplanted rows. An attempt to create a juvenile hairline by rounding off the temporal recession is also a mistake in a young patient. Patients who demand an inappropriate hairline should be excluded from surgery; otherwise, both the patient and the doctor at some time in the future will regret the procedure.



This patient had plug grafts to thicken his frontal hairline in his early twenties. As the hair surrounding the unsightly plugs fell out with aging, the large plug grafts became exposed, creating this noticeable deformity.



Another common problem when a young patient undergoes a hair transplantation procedure at too early an age is the creation of a permanent frontal fringe with extensive baldness behind it. The use of large plug grafts makes the deformity even more noticeable. However, in this patient, even if small natural grafts had been inserted originally, the effect would still look unnatural because of the extensive baldness that evolved over the years behind the grafts. The major point demonstrated by this case is not to perform transplantations too early.

A patient with extensive hair loss with only a thin posterior and lateral remaining fringe is also a poor candidate for reoperative hair transplantation. Such a patient can be given a frontal hairline, but if complete coverage of the area of alopecia is the goal, the patient will likely be disappointed after the procedure. Caution should also be exercised when attempting hair transplantation in the occipital area. In young patients or those with extensive hair loss, overly aggressive transplantation in this region can lead to a strange “halo” pattern, with a permanent tuft of central occipital hair surrounded by a bald ring or halo that progresses as the patient ages and hair recedes. It is important to explain to the patient the possible ramifications of overly aggressive hair transplantation in this area. Thus in younger patients it is prudent to graft the frontal and superior regions of hair loss initially and to observe over time the evolution of the patient’s hair loss. If a young patient with fairly extensive hair loss rejects a high hairline with temporal recession, this patient is not a good candidate for transplantation.

As in all aesthetic surgery procedures, it is essential that the patient be fully informed to ensure ultimate patient satisfaction. This is even more important in an unhappy patient who has had a poor result and wants revision. Realistic expectations must be established before the surgeon considers reoperating on such patients, based on the results of previous surgery and what available donor hair tissue remains. The patient with a poor result from 20 years ago who expects a miracle should be excluded from surgery. Some of these patients must resign themselves to wearing a hairpiece

to cover up either a poor result in the recipient area or to cover excessive scarring in the donor site from previous punch grafting. In other areas of cosmetic surgery, such as a face lift, the procedure can be repeated over time. However, a patient with male pattern baldness has limited donor hair; therefore it is critical to set appropriate goals with the patient based on this simple anatomic fact.

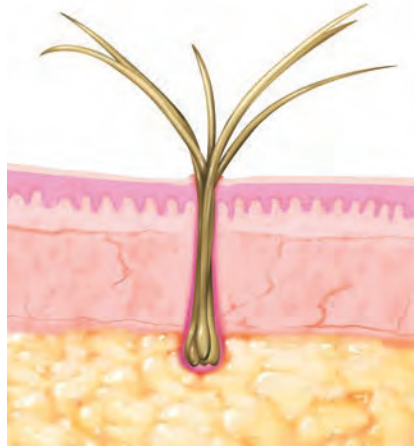
Preoperative Assessment

Preoperative assessment focuses on the recipient site to evaluate the results of the transplantation, as well as the donor site to assess residual scarring and the amount of available donor hair. The recipient site should be examined to determine whether the hairline was placed in the correct location—not too high or too low—and whether it was properly created. That means it has an irregular line with a natural temporal recession. A common problem after hair transplantation, especially in the past, was creation of a straight hairline. Hairlines need to be irregular; even a properly located hairline with small grafts in the correct location will look unnatural if it is perfectly straight.

After assessing the recipient area, the physician must critically evaluate the potential donor site if further grafting is to be considered. Initially, donor grafts were harvested with punches, and the residual donor area was allowed to heal by secondary intention, creating a significant amount of scar tissue. Eventually, physicians began to use linear excision of the donor site with primary closure. This became the standard, which significantly reduced scarring in the donor area. Unfortunately, in the past and even today, some surgeons make multiple parallel incisions each time they harvest donor hair, which results in multiple transverse scars in the posterior recipient area. This technique is rarely necessary. Most patients can undergo at least two or three repeat procedures over time using a single donor site and creating a single scar. If multiple transverse parallel donor scars are too close together, further excisions run the risk of tissue devascularization and scalp necrosis.

The course of hair loss should also be considered. Hair loss is both progressive and unpredictable. It is this unpredictability that is the single most important issue in evaluating patients as candidates for these procedures. In designing the hair pattern to be transplanted, the surgeon must take into consideration the patient's progressive postoperative hair loss over the ensuing decades.

The individual characteristics of the patient's hair and skin color must also be examined. The less the contrast between skin and hair color, the more natural the final result will appear after transplantation. Thus light hair with fair skin or dark hair with dark skin will have a low contrast. Dark hair on light skin, however, has a high contrast, and grafts with several hairs will look more unnatural in these high-contrast patients.



The phenomenon called *compression* is particularly noticeable in patients with a high-contrast situation. Compression is a condition in which there are too many hairs exiting a single hole, thereby creating a “bouquet” appearance, with the hair spreading out distally from a central site. To avoid compression of individual grafts, it is particularly important to use small micrografts or follicular units in dark-haired patients. The texture, density, and straightness versus curliness of the hair should also be assessed. Curly hair provides better coverage of the scalp than straight hair after transplantation. Fine hair gives less coverage than thick hair.

Preoperative Planning

In secondary hair transplantation, as in other types of revision surgery, planning is as important as the execution of the surgery itself. In patients with adequate donor hair who had previous unnatural-looking plug grafts, a two-step procedure is suggested. First, the plug grafts are excised, recut, and replanted as small, natural-looking grafts; then donor hair is harvested from the posterior scalp and implanted as small follicular units in between the previous plug grafts to fill in the spaces.

There is no consistent pattern to follow when planning incisions in this group of patients. When large, unsightly grafts are visible, they need to be excised, and wherever there is residual donor hair, it needs to be harvested. For more extensive cases, a more aggressive approach may be necessary, with radical excision of the previous recipient plugs, followed by secondary grafting. Badly scarred donor areas can be improved in selected patients as long as there is adequate hair in the area to cover up scarring from further excisions. Wide donor scars can frequently be improved by simple reexcision with primary closure. In more extensive cases, tissue expansion or flap rotations can be used to improve unsightly donor scars.

The goal of reoperative hair transplantation is to produce an overall hairline that is both natural and undetectable. Therefore, when planning revision surgery, the surgeon should avoid placing the transplanted hair too low and rounding off the temporal recession. The emphasis should be on creating a high hairline at least 8 to 10 cm above the glabella with a natural-appearing frontotemporal angle.

Proper angulation or direction of the transplanted hair is another key anatomic factor in producing a natural result. Hair grows at different angles at different locations on the scalp. Along the frontal hairline, the hair should be angled in a slightly anterior direction. Too much anterior angulation appears abnormal, as does posterior angulation. Hair in the temporal area needs to be angled downward, whereas hair on top is directed straight upward and hair in the posterior scalp is directed downward. Incorrectly angled hair requires revision surgery.



In this case, hair was transplanted along the patient's right frontal hairline at the wrong angle. Even though the grafts were small and natural appearing, because of their incorrect angulation, they created a strange appearance. This patient requested correction, which required excision of the scalp in the area marked by the ellipse. After this area healed, grafts were inserted at the correct angle, solving the problem.



This patient's hair grafts were inserted at too acute an angle. The hairs are growing straight forward from the scalp, yielding a very unnatural appearance. To correct this problem, excision, recycling, and new grafting were all required.

Options for Reoperative Hair Transplantation

There is no single operation for management of poor results or complications from previous hair transplantation. Management of these complex cases requires a combination of techniques. In some cases, simple excision of unsightly plugs alone can yield a reasonable improvement, especially in a patient who wishes no further grafting procedures or one who no longer has any usable donor hairs.

However, in most patients with unsightly plugs, it is necessary to excise the plugs and recut and recycle them as small follicular units or micrografts. Excision of old plugs is performed under loupe magnification ($2.5\times$ or $3.5\times$) using a No. 11 blade or a 1 or 2 mm biopsy punch. It is important to keep the tip of the blade parallel with the hair shaft and follicle to avoid injury to the entire hair unit. Improper angulation of the knife blade will damage the follicle or may leave it in its original location, only to regrow another unsightly plug. Once the entire plug is removed, it is carefully recut into small individual units for regrafting. Typically, only 50% to 75% of the hairs removed in the old plugs can be made into new, acceptable small grafts because of scarring. However, in patients with limited donor hair, every hair counts. The best solution is to combine this technique with further harvesting of posterior scalp donor hair to create more small grafts for filling in between previous grafts.



Partial plug removal



Plugs removed to be recycled into minigrafts

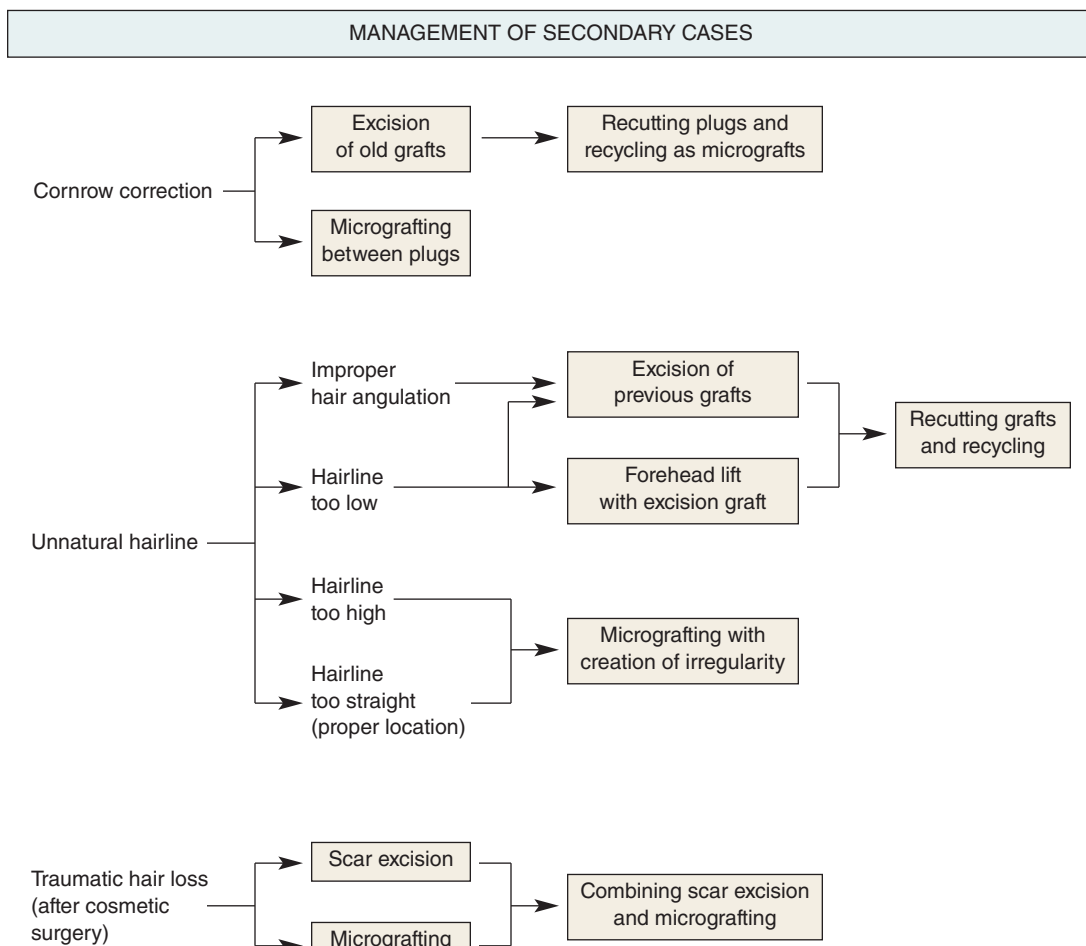


Additional micrografts and minigrafts



Immediate postoperative result

Patients with unnatural hairlines may present special problems, such as improper angulation of the original grafts, or hairlines placed too low, too high, or too straight. Again, a proper preoperative evaluation is critical, depending on which of these four problems is present. In a patient with improper angulation of previous grafts, simply filling in between with new grafts will not solve the problem. These grafts must be excised carefully, as previously discussed; regrafting of the entire area is the best solution using both the old recut grafts along with new ones. In patients whose hairlines are too low, more aggressive treatment may require scalp excision and a forehead lift in addition to plug excision and graft recycling. In patients whose hairlines are too high, more aggressive treatment may require scalp excision and a forehead lift in addition to plug excision and graft recycling. In patients whose hairlines are too straight, more aggressive treatment may require scalp excision and a forehead lift in addition to plug excision and graft recycling.



Avoiding Donor Site Problems in Patients With Previous Transplant Procedures

The tension in the donor site closure should be minimized.

Scalp elasticity should be evaluated in patients with multiple donor site scars.

The closer the previous scars are to the lower neck hairline, the better the elasticity, because it is possible to recruit neck skin.

The higher the previous donor site scars and the closer to the fixed occipital scalp, the less elasticity will be available. This makes further donor site excisions more difficult to close.

Patients who had previous plug grafts harvested from the donor area have stiffer donor tissue, making closure of strip excisions more difficult.

Multiple previous transverse strip excision donor sites should be noted because of the risk of tissue devascularization associated with further harvesting of donor tissue.

Patient Examples

Cornrow Plugs



This patient presented with noticeable plug grafts along the hairline. Because the patient had a high-contrast component with dark hair and light skin, the plugs seemed even more obvious. Correction of this common problem was accomplished using three different techniques. First, the old plugs along the outer edge were excised as previously described; next these plugs were cut into small follicular units to be re-inserted. At the same time, an ellipse of posterior scalp measuring 1.8 cm wide and

16 cm long was excised and cut into 1200 follicular units. These small grafts plus those that were recycled were then placed between and in front of the remaining plugs. The excised plug sites, which usually measure 5 to 6 mm in diameter, are closed with a single 5-0 nylon suture that is left in for approximately 1 week. At 1 year postoperatively, the patient is healed and has had complete correction of the artificial plug look. The results here demonstrate that hair transplants should not be recognizable but should resemble natural hair.

Isolated Frontal Forelock

Some patients develop an isolated frontal forelock as they age. When connecting this forelock with the hair posteriorly, it is important not to drop the hairline too low. It may be necessary to begin transplanting behind the frontal forelock.



This patient demonstrates the appearance of an isolated frontal forelock. He has two isolated tufts of hair on his head, creating a bizarre, unnatural appearance. To correct this problem, a single session of 1500 follicular grafts was used to connect the two isolated forelocks with the hair posteriorly. This approach produced improved framing of the face and a much more normal appearance to the hairline. Also, the hair was placed in an irregular pattern, which produced a more natural appearance.

Temporal Alley Defect

In patients who have had previous transplants along the superior scalp and occipital area, a gap or “alley” may develop as the hair recedes inferiorly along the sides of the head. In this situation, a combination of procedures is required, including excision of the scalp as well as further grafting.



A common problem after scalp excision, however, is the phenomenon of “stretch back.” This refers to the progressive widening over time of the excised area as a result of tissue relaxation.



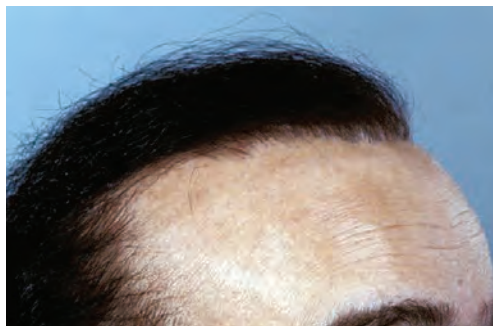
This patient presented with a temporal alley defect after an unsuccessful attempt at hair transplantation.



The defect was excised and a hole was created for the Mitek suture fixation device, which was placed on either side of the defect.



The sutures were then crisscrossed to pull the edges of the defect together, thereby reducing the amount of stretch.



At a separate session 4 months later, approximately 1200 follicular grafts were placed in the area, completing the restoration and significantly improving the appearance in the temporal area.

Abnormally Low Hairline

One of the most difficult problems to correct is a hairline that has been placed too low, especially if unsightly plugs were used. In this situation, the old plugs must be carefully excised and recut into small grafts. Scalp excision and forehead lift may also be required. In these complex cases, multiple stages are frequently required.

Correction of a Low Hairline: Operative Overview

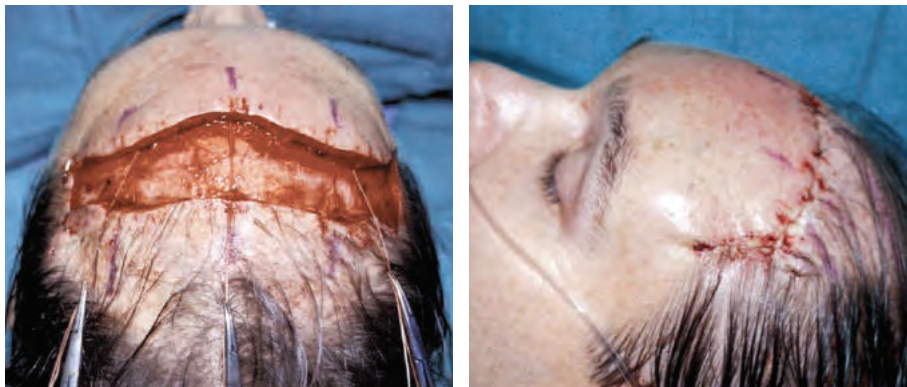
1. The frontal hairline scalp, including the old unsightly plugs, is excised as a circum-linear ellipse.
2. The galea is left intact and the ellipse of skin with its old plug grafts is recycled, as described earlier, creating new, small, one- to two-hair grafts for replanting.
3. Next, a forehead lift is performed while the excised hair is being recut.
4. Unlike a traditional forehead lift, in which the goal is elevation of the eyebrows and upper lids, this forehead lift advances the forehead skin superiorly to raise the new future hairline, leaving the eyebrows alone. This is accomplished by not dissecting below the superior orbital ridges and releasing these tissues.
5. The frontal forehead is stretched superiorly by making numerous parallel, horizontal releases in the periosteum in a subperiosteal dissection or in the galea in a subcutaneous dissection.
6. Next, deep sutures of 3-0 Ethibond are used with the Mitek fixation device, outer table drill holes, or the Endotine device (Coapt Systems, Inc.) to fix the forehead in an elevated position. (I have used all three techniques with excellent results.)
7. The suture fixation device is placed several centimeters above the new future hairline to allow maximal elevation while it is being tied.
8. Once the forehead has been adequately elevated along its superior aspect, the skin is closed with 3-0 Vicryl sutures and a running 3-0 or 4-0 Monocryl suture.
9. The old plugs, which have been recut into small grafts, are now reinserted behind the suture line.
10. After the skin is adequately healed in 3 to 4 months, large-volume grafting is begun to create a new, natural hairline.



This patient presented with an abnormally transplanted hairline, with the grafts placed too low in the temporal region. Besides the original transplanted hairline being too low, the grafts had also been placed incorrectly in a curved line so that the temporal area was rounded off, thus losing a normal frontotemporal angle.



A more aggressive approach was required for this revision. A radical excision of the previous plug grafts was done, along with excision of a segment of scalp along the frontal and temporal areas. Holes were then made at multiple sites for insertion of Mitek devices.



The Mitek device with 2-0 Ethibond sutures attached was inserted. The sutures were tied with significant elevation of the forehead in both the midline and the temporal area. The incision was allowed to heal for several months, and then the patient underwent micrografting to the area.



Postoperatively a significant elevation of the forehead is evident, with creation of a normal frontotemporal angle. The patient has a visible scar in the temporal area from the forehead lift. However, this scar could not be avoided, because further grafting in this area would have recreated the abnormal appearance.

High Hairline

In males, hairlines that are too high are rarely a problem, and as long as donor hair is available, further sessions of grafting, using small grafts with an appropriate irregular hairline, solve these patients' problems. However, in females who had an overly aggressive forehead lift, a high hairline can create an abnormal appearance, especially if it also creates a masculinizing acute temporal recession.

Straight Hairline

Another problem that presents a reoperative challenge is a transplanted hairline that is extremely straight. Hairlines need to be irregular; even in patients with small grafts, straight hairlines are noticeable. Obviously, if the straight hairline includes unsightly plugs, these must be excised and recycled, as previously described. In many of these patients, as long as the hairline is not too low, it can be improved by placing small one- to two-hair grafts in an irregular pattern in front of the previously grafted areas. It is easier to improve the hairline in patients with light skin and light-colored hair, because the color contrast is less obvious than in patients with dark hair and light skin. In high-contrast patients with dark hair and light skin or light hair and dark skin, a greater number of grafts will be required to mask the previous procedure and create irregularity. This is true for all corrective procedures. Color contrast is a subtle but important issue when performing secondary hair restorations.

Traumatic Hair Loss

One of the most common causes of traumatic hair loss is aesthetic facial surgery. This can be caused either by direct damage of the follicles from superficial elevation of the skin flaps or by excessive tension leading to ischemia. The skin may not visibly show signs of ischemia after aesthetic surgery, but there may be enough relative decrease in tissue perfusion to damage the follicles. In most patients, the hair regrows after 4 to 6 months, but in some cases the hair loss is permanent.

In some patients, simple excision of the non-hair-bearing scar can be successful. However, this maneuver often fails, because the new scar may also lose its hair, and reexcision, because of the risk of undue tension, will lead to ischemia and further hair loss. For these reasons, many patients with traumatic hair loss require hair transplantation to fill in the defect. Remarkably, small hair transplants placed directly into scar tissue consistently grow. The problem with placing small grafts into scar tissue is mechanical. Unlike normal scalp, which is relatively thick, areas of hair loss with or without scar tissue are frequently thin, and it can be difficult to insert the grafts in these areas. Using a tumescent technique in the recipient areas is particularly helpful in this situation. The tumescent fluid creates the depth necessary for graft insertion. In some of these patients the grafts cannot be placed as close together, because the scar is thin and relatively ischemic. In these patients several sessions performed over a period of time may be more useful.

Most patients with traumatic hair loss have their hair restored in two sessions of grafting. Combining excision with grafting may be the ideal situation, because excising a portion of the non-hair-bearing area produces a smaller area requiring grafting. When combining these two procedures, the surgeon should excise the skin conservatively, because further tension and ischemia will lead to more hair loss and may create a relatively hypoxic environment in which few of the transplanted grafts survive.

One of the benefits of today's micrografts or follicular grafts is their high success rate. These small grafts have fewer metabolic demands than the larger grafts previously used and usually do well in areas of scar tissue and even in skin grafts. The older-style plugs, especially those with 10 to 20 hairs in each plug site, had less tolerance for ischemia. Frequently, patients with old plugs have sites or areas within the plugs with poor hair growth. One also sees scars from the old plugs creating a "cobblestone" appearance, with little or no hair growth. This occurs because the skin of the plug graft was neovascularized and survived, but the follicles within never successfully grew hair. This cobblestone look is unsightly, and excision of the non-hair-bearing skin plugs is frequently the best solution, followed by further grafting when possible.



This woman had posttraumatic hair loss in both the preauricular temporal area and the posterior neck–postauricular area after a face lift. In one session, 350 grafts were placed in the temporal area and 400 in the posterior neck–postauricular area. Care was taken to properly angulate the hair grafts; this maneuver is essential to achieving a natural result. In the temporal area, hair naturally grows in a downward and slightly posterior direction. In the posterior neck, the hair needs to grow downward and slightly backward. Following these guidelines, significant improvement can be achieved in a patient with traumatic hair loss after aesthetic surgery.

Postoperative Care

Of all the areas of aesthetic surgery, hair transplantation, whether primary or secondary, is one of the easiest procedures to deal with in the postoperative period. Every physician has his or her own protocols. I put patients in a protective head dressing, similar to a face-lift dressing, for 24 hours and then remove it. Where there is a donor site closure with sutures, the patient washes this area in a normal manner. Where the grafts have been inserted, I instruct patients that after the first 24 hours, they should blot a mild shampoo on the recipient site once a day and rinse the area using a cup, avoiding a direct shower stream hitting the recipient grafts. After 6 days patients can wash the recipient areas without any restrictions, since the small grafts are well fixed at this time. I usually leave sutures in for 10 to 12 days in the linear donor site area and where the forehead lift has been performed because of significant tension. Otherwise, nothing unique is required in the immediate postoperative period for management of these patients.

Concluding Thoughts

Many factors go into creating a successful hair transplant. Avoiding complications before they occur is obviously the optimal situation. Many of the problems associated with less than satisfactory results after hair transplantation are more often associated with mistakes in judgment and less likely the result of errors in surgical technique. To avoid an unnatural result, the surgeon must realize that hair loss is progressive in nature. It is important to design a hairline that will be aesthetically acceptable over time as the patient matures and hair loss continues.

Clinical Caveats

The following four characteristics are associated with unsuccessful hair transplantation: (1) large, unnatural plug grafts, (2) an extremely straight hairline, (3) a blunted frontotemporal angle, and (4) a hairline that is too low.

Surgical correction of large, unnatural plug grafts requires graft excision, recutting into individual one- and two-hair grafts, reimplantation of new small grafts, and closure of individual donor sites with single small sutures.

Surgical correction of a hairline that is too straight involves removal of periodic grafts along the hairline if plugs are present, with recycling farther back, and use of small single-hair grafts to create a feathered, irregular hairline.

Surgical correction of a blunted frontotemporal angle includes removal of hair grafts and elevation of the temporal skin, with advancement superiorly and posteriorly.

Surgical correction of an abnormally low transplanted hairline requires excision of frontal grafts, with reimplantation farther back, excision of skin along the transplanted hairline, and a forehead lift and closure of the defect.

Color contrast is a subtle but important consideration when performing secondary hair restorations.

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Bernstein RM, Rassman WR. Follicular transplantation. Patient evaluation and surgical planning. *Dermatol Surg* 23:771-784; discussion 801-805, 1997.

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Vogel JE. Correction of the cornrow hair transplant and other common problems in surgical hair restoration. *Plast Reconstr Surg* 105:1528-1536; discussion 1537-1541, 2000.

A thorough description of the various techniques used to correct unsuccessful hair transplants is presented. The technique of plug graft excision with recutting into smaller grafts for recycling is discussed in detail, as well as scalp excision techniques.

Suggested Readings

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PART V

BROW LIFT



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CHAPTER 22



Clinical Decision-Making in Brow Lift

FOAD NAHAI

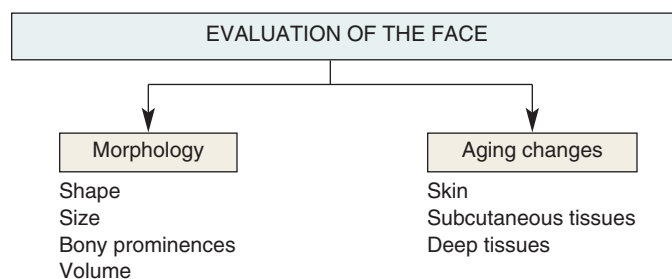
Evaluation

We evaluate the entire face rather than isolated zones. The hallmark of a youthful face is the smooth transition from zone to zone; for example, brow to eyelid, eyelid to cheek, cheek to perioral area, perioral area to jawline, jawline to neck. For best results, procedures are planned to rejuvenate all of these areas and to restore a harmonious transition from zone to zone.

It comes as a surprise for a patient seeking an “eyelid lift” to be advised that in addition to blepharoplasty, a brow lift is also recommended. Most patients will accept the surgeon’s recommendation, yet others resist, saying they only want to remove the excess skin or bags from their eyelids. For some it becomes a financial consideration, with concerns that each added procedure will increase the cost. Regardless, we explain to the patient that regional or full facial rejuvenation would be the best option rather than localized, isolated procedures. We leave the final decision to the patient.

In my practice, an isolated brow lift is a rarity. I consider a brow lift to be one component of periorbital rejuvenation, encompassing the brow, upper and lower eyelids, lid-cheek junction, and midface. No brow or forehead rejuvenation is complete without considering rejuvenation of at least the upper eyelids, if not the entire periorbital area. When evaluating a patient’s face, I make note of the morphologic structure and anatomic features, then I evaluate the changes resulting from the aging process. *Morphology* refers to the study of the shape or form of an anatomic structure; thus it is the morphologic structure of the face, breast, and body that we change through aesthetic surgery rather than the anatomy. Yet a detailed knowledge of the anatomy of the structures themselves is essential in aesthetic surgery. This includes bony prominences, eye prominence, nasal prominence, and hairline shape, whereas aging changes include changes in the skin, subcutaneous tissues, deeper soft tissues, and even the bones.

Anatomic Features



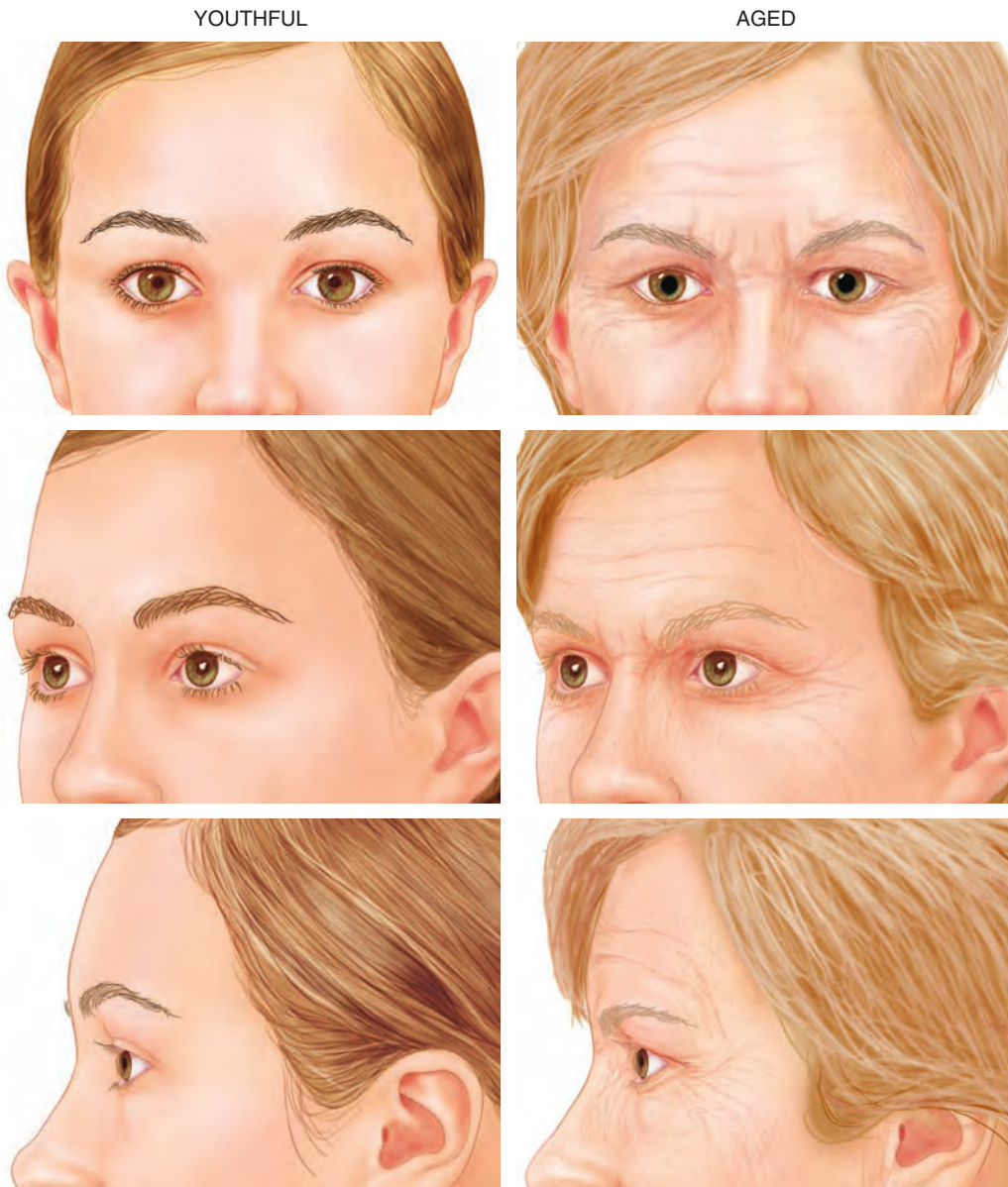
The convexity of the forehead and any supraorbital bony prominence is noted. The thickness of the retroorbicularis oculi fat (ROOF) is assessed. The hairline and height of the forehead are noted. We also note how thick the hair is and areas where the hairline is receding.

Evaluation of the Aging Forehead and Brow

Features to Assess

Brow position—lateral and medial
Rhytids—horizontal and vertical,
at rest and on animation

Crow's-feet
Lateral orbital crowding
Skin



Evaluation should include an assessment of the position of the brow laterally and medially, the relationship of the brow to the upper eyelid, and the distance from the upper lid sulcus to the hair-bearing brow. Horizontal and vertical forehead and glabellar rhytids are assessed at rest and on animation, as are the crow's-feet. (Horizontal forehead rhytids are more common in men.) The quality, elasticity, and thickness of the forehead skin are also evaluated. Lateral orbital bunching or crowding is noted with the eyebrow at rest and when elevated.

Evaluation of Brow Position

The medial brow is usually lower than the lateral brow, with a variable arch in between. The position of the brow is judged based on the relationship of the hair-bearing brow to the supraorbital rim. A lower brow position is typically seen in men; in fact, brow position varies with sex, age, and ethnic background. The ideal brow position also varies according to fashion and culture. High-arched brows are more common and more desirable among those of Hispanic, Latin, and Mediterranean origins. Low brow position is associated with a tired, unhappy appearance, whereas excessive brow elevation is associated with a frightened or surprised look.



Low brow



Medium brow



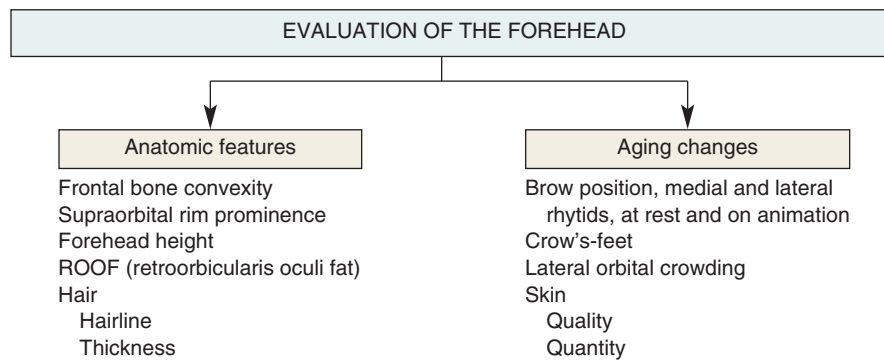
High brow

Brow height does not necessarily signal youth. Brow fullness and shape are far more important than height, as indicated by the three images of young women shown here.

Evaluation of Rhytids, Crow's-Feet, and the Lateral Orbital Area

The patient is asked to frown, elevate the brow, and tightly close his or her eyes so that the glabella, forehead, and crow's-feet rhytids can be assessed. Brow position and the lateral orbital area are also evaluated during each of these facial movements. By observing these muscle contractions in relation to brow, eyelid, and lateral orbital movement, the surgeon can assess muscular interactions. Success in relocating the brow to the desired position will largely depend on modification of this muscle balance.

Evaluation of Skin



The quality and quantity of the skin on the forehead, upper eyelid, and lateral orbital area are evaluated for thickness, elasticity, and the presence of rhytids. The depth of the rhytids and the skin texture are noted. Any excess skin is also noted, including determining whether the skin excess is real or apparent, with particular attention to whether there is excess skin in the glabella over the nasal radix.

Treatment Options

There are a variety of surgical and nonsurgical options as primary procedures. Adjunctive treatments such as resurfacing may be performed at the same time to enhance the results. Treatment options range from toxin injections to the traditional open coronal forehead lift.

Options for Forehead Rejuvenation

The goals of forehead rejuvenation are to reposition or reshape the brow into a more youthful position or desired shape. Brow shape is far more important than brow elevation. Injection of toxins is effective not only in elevation of the brow, but also in reshaping (see Chapter 13 on toxin injections). Surgical rejuvenation of the brow leads to brow repositioning or shaping through a combination of steps, including mobilization of the brow and modification of muscles to assist in maintaining brow position and ameliorating rhytids. The open coronal lift was for years considered the standard procedure and now, with several options available, it is considered the benchmark procedure to which all others are compared. In the table below, I have compared the various procedures, including injectables, in terms of ease of exposure of the anatomic structures, muscle excision, and forehead mobilization. Scalp excision is included, because at one time it was the only option for fixation. I have found the endoscopic approach to be as effective as the coronal, and in selected patients the combination of a lateral approach with transpalpebral muscle excision has also proved satisfactory.

Options for Forehead Rejuvenation					
	Exposure	Release of Adhesions	Muscle Excision	Forehead Mobilization	Scalp Excision
Open coronal	++++	++++	+++	++++	++++
Endoscopic	++	++++	++++	++++	+
Direct approach	+++	+++	+	+++	++++
Transpalpebral	++	+	+++	+++	—
Lateral approach	+++	+++	—	+++	+++
Toxins	NA	NA	Temporary paralysis	+++	NA

Degree of effectiveness indicated by the number of pluses.
NA, Not applicable; *dash*, not possible.

Selection of a technique is based on aging changes and the patient’s anatomy. As important in this selection process is the surgeon’s familiarity and experience with each procedure, and in the final analysis, we will each select a procedure that in our hands will produce the best result with minimal morbidity.



Open coronal forehead lift



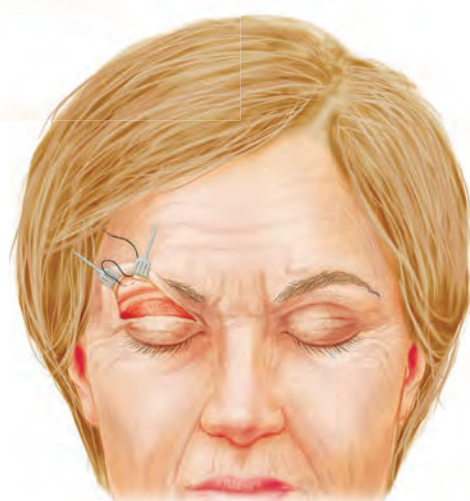
Endoscopic forehead lift



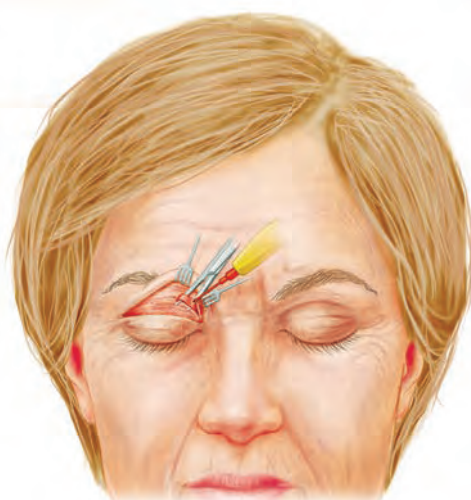
Lateral-temporal brow lift



Direct approach



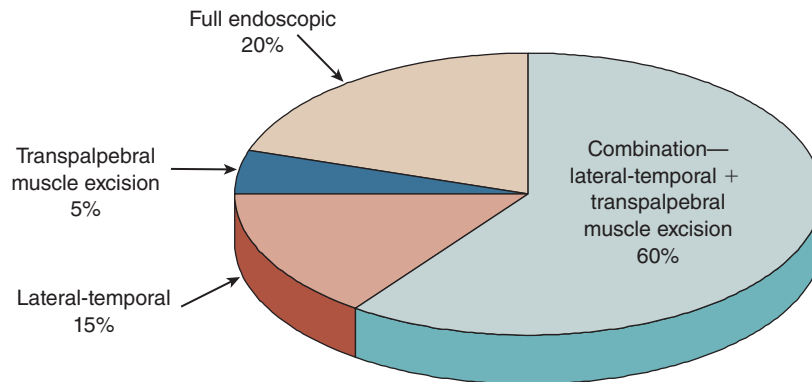
Transpalpebral browpexy



Transpalpebral excision of corrugator
and procerus muscles



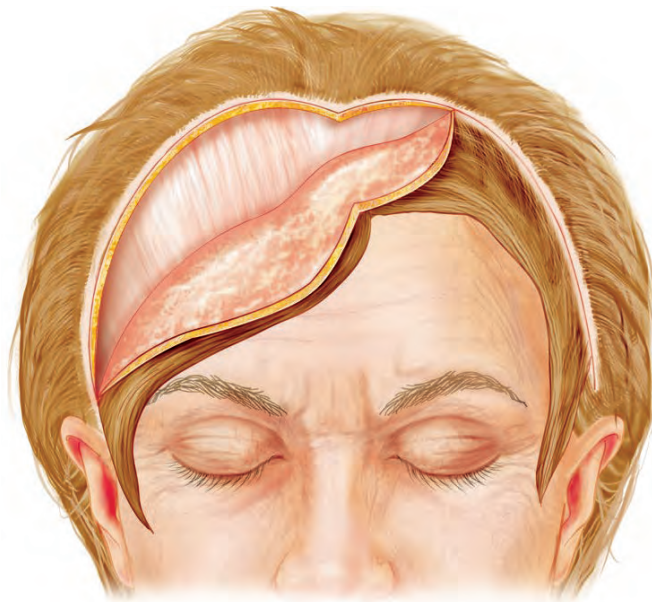
Toxin injection



My preferred surgical options and the frequency with which each is performed are as follows:

- Full endoscopic (20%)
- Lateral-temporal (15%)
- Transpalpebral muscle excision (5%)
- Combination—lateral-temporal plus transpalpebral muscle excision (60%)

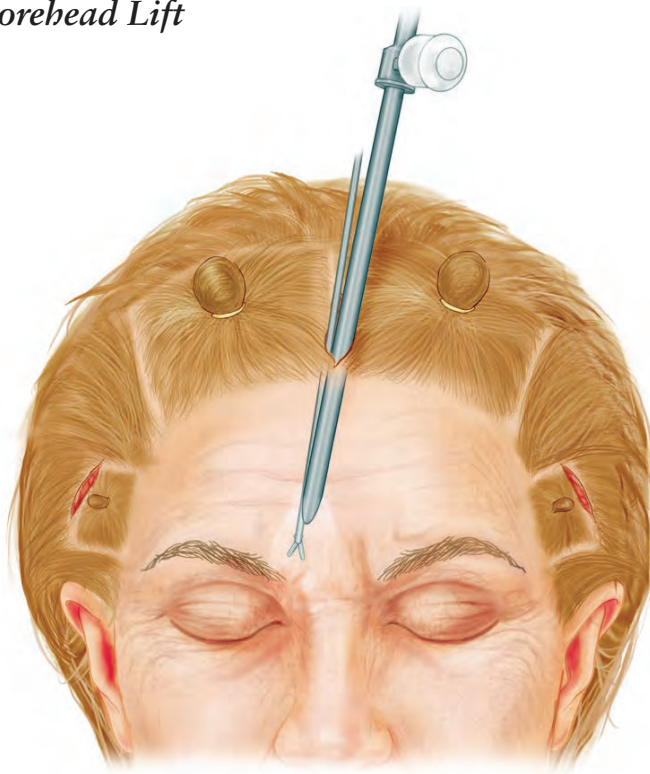
Open Coronal Forehead Lift



The open coronal approach affords excellent exposure and facilitates release of adhesions, muscle excision, and brow mobilization. The scalp excision is tailored to elevate the brow as desired and enhance its shape. The extensive incision involved, together with the risk of sensory changes, including dysesthesias, numbness, and alopecia, are perceived as deterrents by patients who decline this approach. Since the introduction of the endoscopic approach in 1993, I have not performed an open coronal brow lift. Before 1993, only 10% to 15% of the patients undergoing facial rejuvenation in my practice would accept the open coronal lift. Today almost all of my facial rejuvenation patients undergo brow rejuvenation through one of the four procedures listed above.

There is no question that the coronal approach is the best option for some patients. These are patients in whom a high hairline and a convex frontal bone would make the endoscopic approach rather challenging. In such individuals, I prefer a combination of the lateral approach with transpalpebral muscle excision. Those with a high forehead also present a challenge to the endoscopic approach, making it technically very difficult, if not impossible. An alternative would be an open coronal biplanar approach to forehead rejuvenation, allowing shortening of the forehead height.

Endoscopic Forehead Lift



The endoscopic forehead lift is not without its limitations. Although it can be uniformly applied in every patient, the results will vary according to the patient's anatomic features as well as the aging changes present. There are certain anatomic features that make the endoscopic approach rather challenging. These patients are best served by one of the alternative approaches.

The endoscopic approach affords excellent exposure for release of the periorbital adhesions and septa; the magnification offered through the endoscope facilitates muscle excision and nerve preservation. Scalp excision is rather limited with the endoscopic approach, so elevation and maintenance of brow position rely primarily on muscle balance and fixation techniques compared with the open coronal approach, in which scalp excision maintains brow position. Even 17 years after the endoscopic approach was introduced, there is still no consensus on endoscopic fixation. Opinions range from “muscle balance is all that counts; fixation is not necessary,” to the other extreme: some insist that fixation must be permanent. I individualize the need for fixation, whether permanent, temporary, or not at all.



Endoscopic Forehead Lift: Favorable and Unfavorable Candidates

Anatomic Features	Favorable	Unfavorable
Forehead		
Height	Short	High
Convexity	Flat	Convex
Hairline		
Height	Short	High
Receding	Nonreceding	Receding
Hair quality	Thick	Thin
Skin		
Thickness	Normal	Thick
Rhytids	Superficial	Deep

Lateral-Temporal Brow Lift

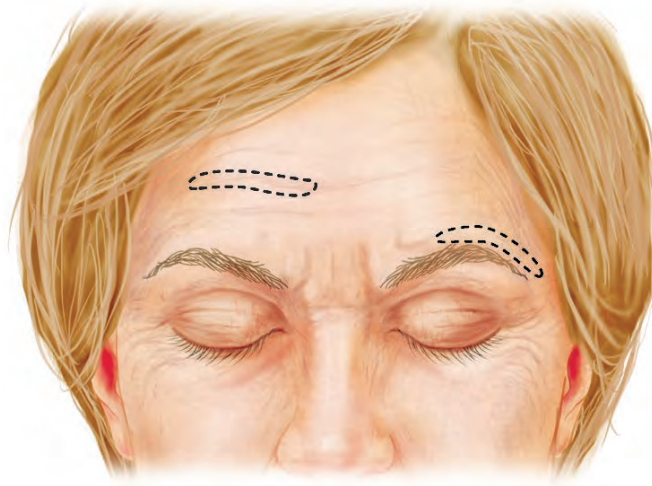


The lateral-temporal approach affords excellent repositioning and elevation of the lateral brow through a temporal incision. Suturing of the temporoparietal fascia to the deep temporal fascia provides permanent fixation.

Muscle modification, although theoretically possible, especially with an endoscope, is not usually performed with this approach. This approach is best combined with a transpalpebral excision of the corrugator supercilii and division of the procerus muscles for an effective brow lift.

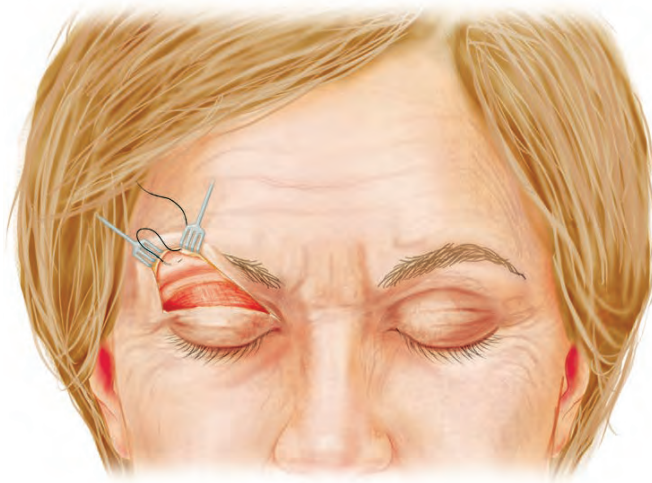
The best candidates for this combined approach are patients with little if any excess skin at the nasal radix, individuals requiring little if any medial brow repositioning, and those who are candidates for upper lid blepharoplasty. Advantages are the minimally invasive approach and the minimal risk of sensory changes.

Direct Approach



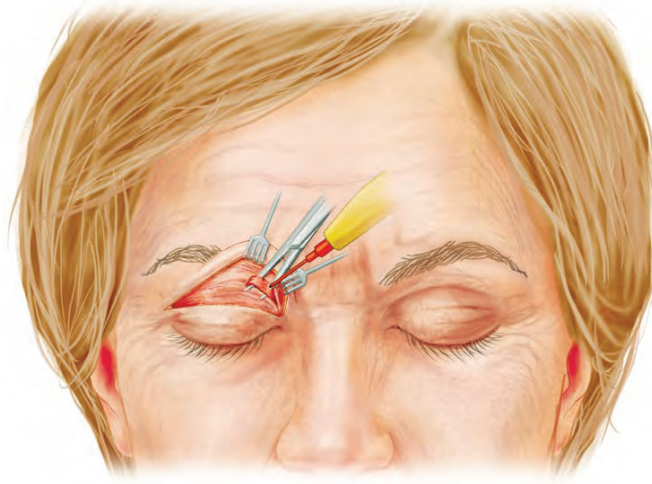
The direct approach is effective in elevating the lateral brow, but it is rarely performed, because it leaves a scar directly over the hair-bearing brow or in a transverse forehead line. The best candidates are elderly patients or those with pronounced lower forehead transverse creases where the scar can be concealed. This approach offers excellent brow elevation and access to the muscles. Traditionally, the excision has not been combined with muscle excision. The advantages of this method are that it is simple and quick, it can be performed with local anesthesia in many instances, and it carries minimal risk to the sensory nerves. The scar is the only potential disadvantage.

Transpalpebral Browpexy



Minimal lateral brow elevation is possible through this approach, in which the lateral brow is repositioned through the upper eyelid incision and sutured down to the periosteum. The limited elevation achieved with this approach restricts this procedure to patients with mild lateral brow ptosis without any medial brow ptosis or excess skin at the nasal radix.

Transpalpebral Excision of Corrugator and Procerus Muscles



Modification of the glabellar muscles through the upper eyelid results in improvement of glabellar lines with minimal medial elevation of the brow. Lateral brow elevation is performed through the lateral-temporal lift. The best candidates are individuals with glabellar frown lines with minimal if any medial or lateral brow ptosis. In combination with a lateral-temporal brow lift, this is my preferred choice for brow rejuvenation in patients requiring minimal or no medial brow elevation.



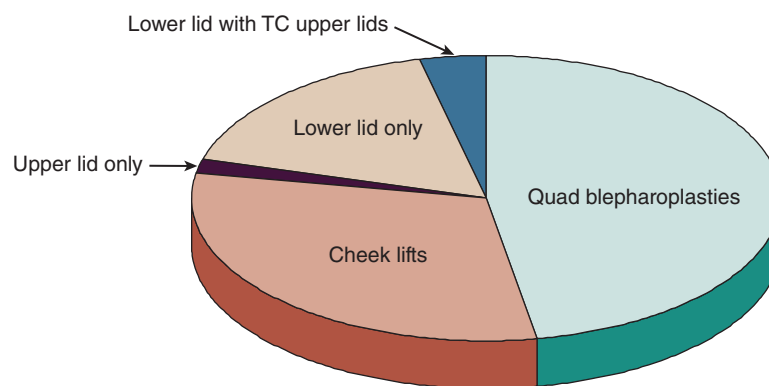
This patient with brow asymmetry, glabellar frown lines, and aging of the upper and lower lids underwent upper and lower lid blepharoplasty with transpalpebral excision of the corrugator and division of procerus muscles. Postoperative views and a split-face view at 18 months postoperatively show elimination of glabellar frown lines, improvement of asymmetry, and appropriate brow position.

Injection of Toxins



Toxin injections are the most popular procedure for brow rejuvenation, representing a safe and effective method for mild to moderate brow elevation through alterations to muscle balance. Advantages include the fact that it is nonsurgical and less expensive in the short run. Limitations include the temporary nature of the correction, the necessity for repeated injections, and the expense over time.

Regional Procedures



The brow lift is one component of periorbital rejuvenation. I rarely perform an isolated brow lift. In a personal series of 100 consecutive endoscopic brow lifts performed over 14 months, 79 patients underwent upper and lower lid blepharoplasty, 2 underwent upper lid blepharoplasty only, and 19 underwent lower lid blepharoplasty. Most of the patients undergoing a lower lid blepharoplasty also had a transpalpebral midface lift. There were no isolated endoscopic brow lifts during the period studied. These regional procedures reflect our approach to facial rejuvenation addressing facial zones or the entire face rather than individual components such as the brow or the eyelids.

Ancillary Procedures

The surgical procedures described reposition the brow and improve forehead and glabellar lines. Frequently, additional ancillary procedures are needed to further improve the result. These include peels and laser resurfacing, and the use of tissue fillers. We will often improve the vertical frown lines by threading a piece of autologous temporal fascia or orbicularis muscle just deep to the dermis. If the temporal fascia is exposed during the brow-lift procedure, my preference is to harvest the temporal fascia and use it as a filler. If an upper eyelid incision is made, the orbicularis oculi muscle would be an alternative source of autologous tissue. In my practice, laser resurfacing and autologous fillers for forehead and glabellar lines are the two most common ancillary procedures in forehead lifting.



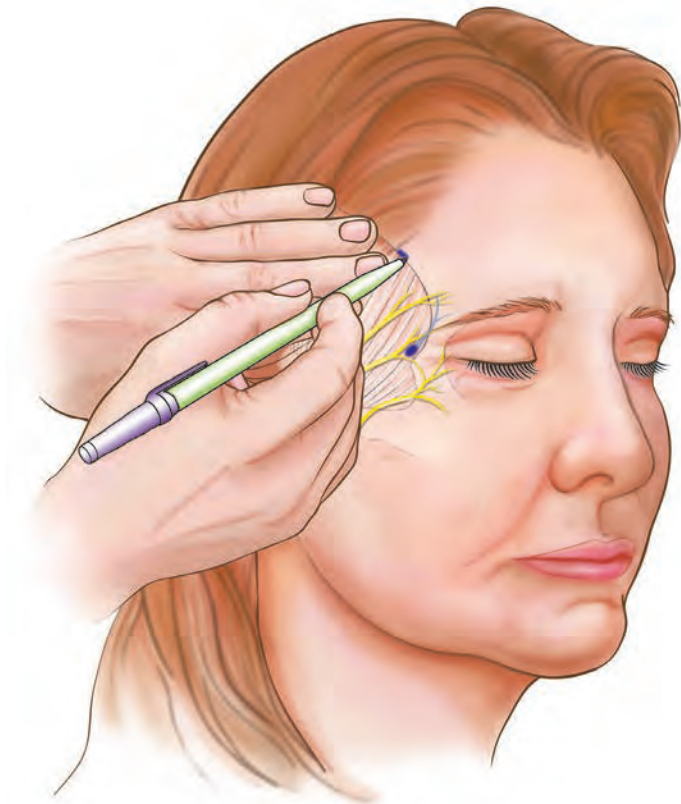
This split-face view demonstrates preoperative and 5-year postoperative results after an endoscopic brow lift with external screw fixation and laser resurfacing. Other procedures performed in this patient included upper and lower lid blepharoplasties, face lift, neck lift, and perioral laser resurfacing.

Suggested Readings

- Behmand RA, Guyuron B. Endoscopic forehead rejuvenation: II. Long-term results. *Plast Reconstr Surg* 117:1137-1143; discussion 1144, 2006.
- Byrd HS, Burt JD. Achieving aesthetic balance in the brow, eyelids and midface. *Plast Reconstr Surg* 110:926-933; discussion 934-939, 2002.
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- Farkas LG. Anthropometrics and art in the aesthetic of women's faces. *Clin Plast Surg* 14:599-616, 1987.
- Knize DM. Reassessment of the coronal incision and subgaleal dissection for foreheadplasty. *Plast Reconstr Surg* 102:478-489; discussion 490-492, 1998.
- Knize DM. Transpalpebral approach to the corrugator supercilii and procerus muscles. *Plast Reconstr Surg* 95:52-60; discussion 61-62, 1995.
- Tyers AG. Brow lift via the direct and trans-blepharoplasty approaches. *Orbit* 25:261-265, 2006.

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CHAPTER 23



Temporal Brow Lift

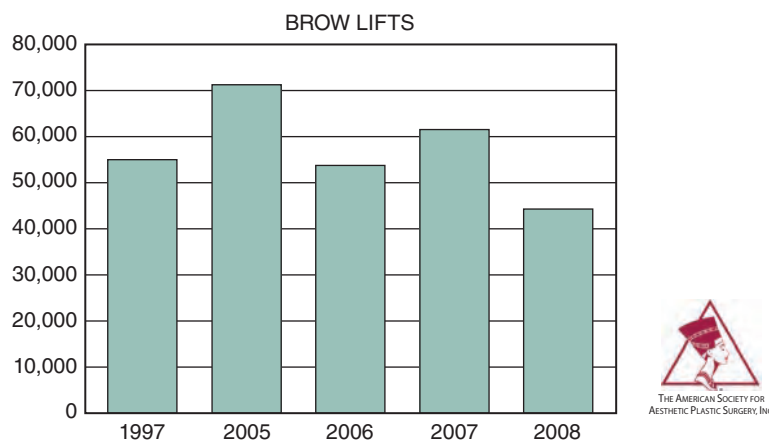
FOAD NAHAI

Our goals for brow rejuvenation include repositioning the eyebrows according to cultural norms and individual tastes, eliminating or at least improving lines at rest or on animation, reducing lateral orbital crowding, and correcting excess glabellar skin over the nasal radix. Very often brow rejuvenation is combined with an upper lid blepharoplasty. In these patients the upper eyelid will be the gateway to the brow, as the lower eyelid has become an important gateway for rejuvenating the lid-cheek junction and the midface. In this chapter I will discuss the role of the upper eyelid as a gateway to the brow and its role in periorbital rejuvenation.

With the many options for brow repositioning and rejuvenation (discussed in Chapters 22, 24, and 25), selection of a procedure based on the patient's individual needs is the key. Not every patient requires, nor should every patient undergo, an endoscopic or coronal brow lift to achieve an ideal result.

Through a limited temporal incision similar to that for the three-incision endoscopic brow lift, the periorbital septa and adhesions are easily divided, and subperiosteal dissection almost to the midline is also possible. Although challenging, even glabellar muscle modification is possible through this incision. However, my preference is to modify the glabellar muscles through the upper eyelid in this combination approach. Lateral brow elevation and fixation is easily achieved with this approach.

Injectable toxins and this combination approach have reduced the number of endoscopic brow lifts in my practice. A review of the procedural statistics published annually by the American Society for Aesthetic Plastic Surgery (ASAPS) reveals that the number of brow lifts performed in the United States peaked in 2005 and currently stands below 1997 levels, when ASAPS started collecting procedural statistics.



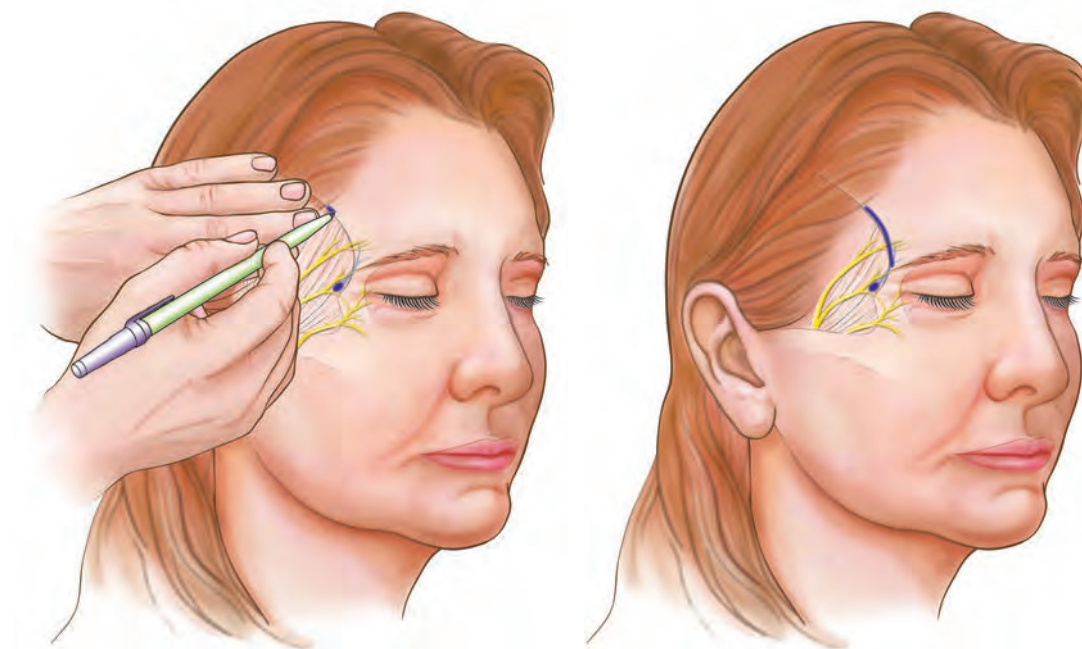
I believe this reflects the impact of toxin use and transpalpebral muscle modification on brow rejuvenation. The lateral temporal brow lift, with or without endoscopic assistance, accomplishes the mobilization and fixation of the middle to lateral brow, whereas muscle modification is undertaken through the upper eyelid with loupe magnification.

Indications and Contraindications

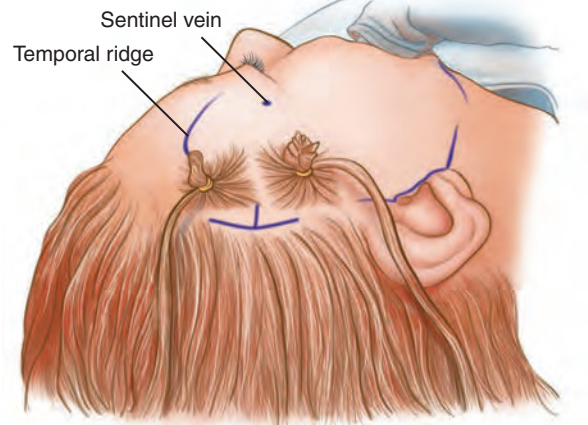
The lateral brow lift is best for patients with no medial brow ptosis, no glabellar skin excess above the nasal radix, and forehead aging limited to the lateral brow. For patients with glabellar lines, modest medial brow depression, and no excess skin above the nasal radix, the combination approach, including transpalpebral modification of the glabellar muscles, is an excellent option, with results matching those achieved with endoscopic and even open coronal techniques. I often combine this approach with an upper lid blepharoplasty and midface rejuvenation or a full face lift. This is not an effective procedure for patients with significant medial brow ptosis, excess glabellar skin over the nasal radix, and deep forehead lines at rest. These individuals are better suited for an endoscopic or coronal approach.

Preoperative Planning

Brow Markings

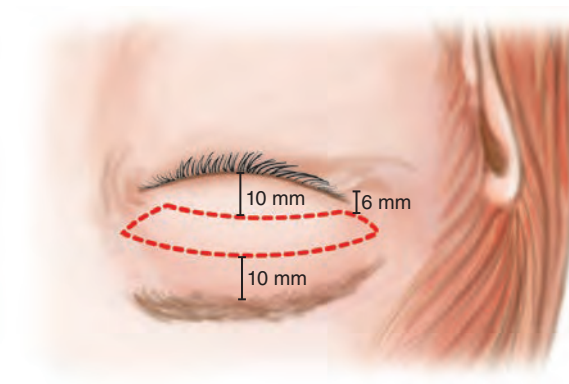


The patient is instructed to clench the teeth while contracting the temporalis muscle, so the surgeon can palpate this; the temporal crest–temporal line of fusion is marked along the anterior border of the contracted muscle. If the sentinel vein is readily visible with the patient in a sitting position, it is marked.



Otherwise, the patient is asked to lie supine, and the sentinel vein is marked. The temporal incision is marked 2 to 3 cm behind the temporal hairline, extending no higher than the temporal crest to avoid injury to the lateral branch of the supraorbital nerve. The incision is planned directly over the muscle to facilitate anchoring of the temporoparietal fascia to the deep temporal fascia. Incisions beyond the extent of the temporalis muscle should be avoided.

Eyelid Markings



The upper eyelid is marked for blepharoplasty with the upper eyelid crease at the level of the midpupillary line, usually 8 to 10 mm above the lashes in women and a little lower in men. The lateral marking should be at least 6 mm above the lateral canthus, with a lateral extension within one of the crow's-feet, if present. At least 10 mm of skin should be preserved between the upper marking and the hair-bearing brow. In addition, I ask the patient to frown so I can mark the extent and bulk of the corrugator muscle. If there are any horizontal glabellar lines, indicating procerus hyperactivity, those are marked as a reminder to section the procerus muscles.

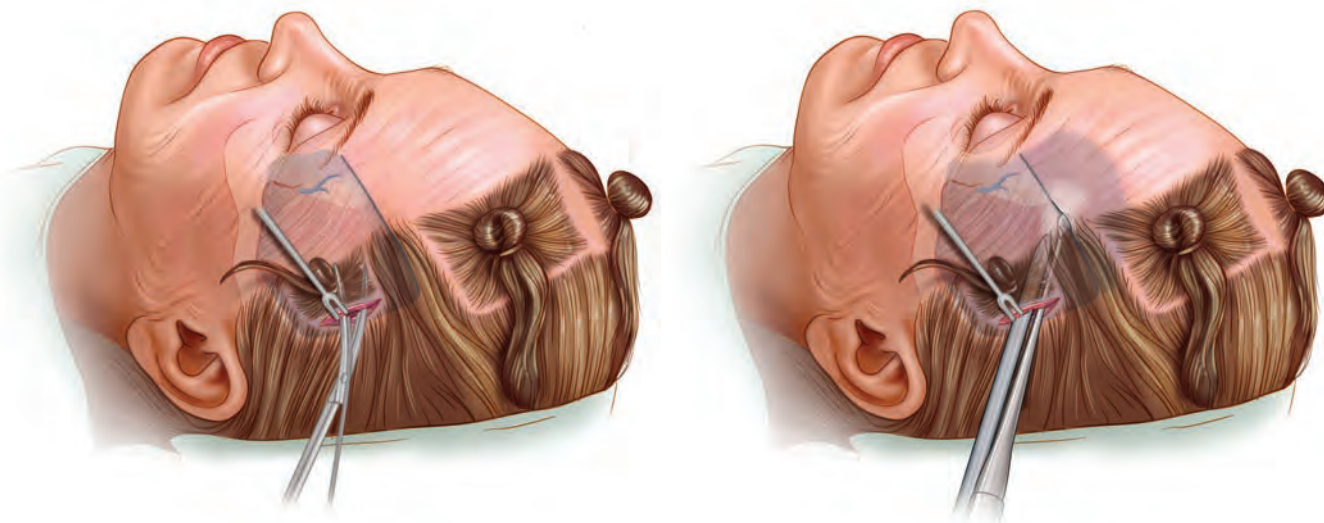
Operative Technique

Anesthesia

The procedure may be performed with the patient under local or general anesthesia. In my practice, because most of these procedures are combined with full facial rejuvenation, I prefer a general anesthetic. I always infiltrate the surgical field with a combination of lidocaine and epinephrine.

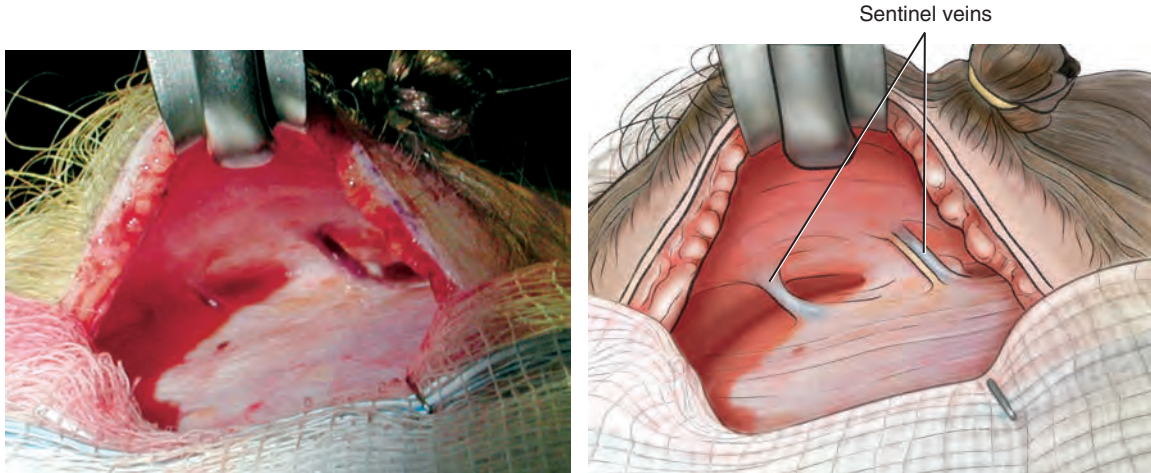
I prefer to do the lateral temporal brow lift first, simulate the new brow position to confirm the upper eyelid skin excision, and then proceed with the upper eyelid component of the operation.

Lateral Temporal Brow Lift

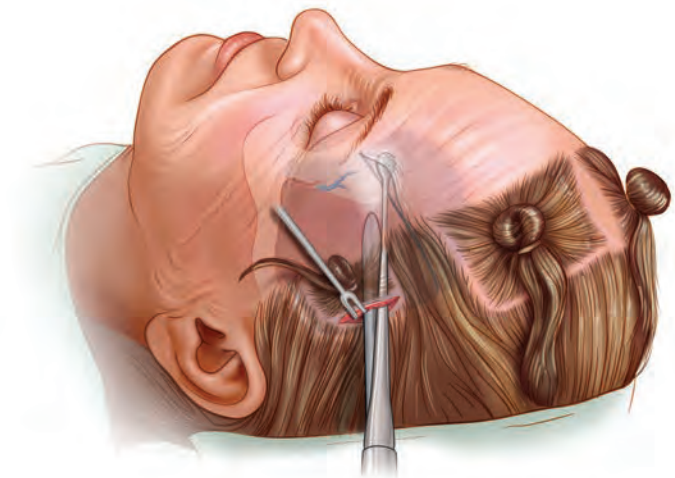


I perform this portion of the operation exactly as I do for an endoscopic brow lift. The incision is placed coronally or horizontally or anywhere in between, depending on the desired final brow position. The incision is made and continued through the temporoparietal fascia onto the deep temporal fascia. The initial dissection is made bluntly, with the scissors pushing along the deep temporal fascia toward the lateral orbital rim to establish an optical cavity. From this point on, the dissection can continue under endoscopic control or, my preference, direct vision with the aid of a lighted retractor or an Aufricht retractor and a headlight.

The endoscope is introduced, and dissection proceeds rapidly with an endoscopic dissector in this avascular plane toward the lateral orbital rim. The sentinel vein is easily identified, and I prefer to preserve it. The septa and adhesions are released, usually with the endoscopic dissector. To ensure complete release and thus mobilization of the lateral brow, I make a point of skeletonizing the sentinel vein.



Some of the septa and adhesions, especially beyond the vein, may require division with endoscopic scissors. Following the skeletonizing of the sentinel vein, dissection continues minimally beyond the orbital rim and then laterally through the temporal crest and into the subperiosteal space.

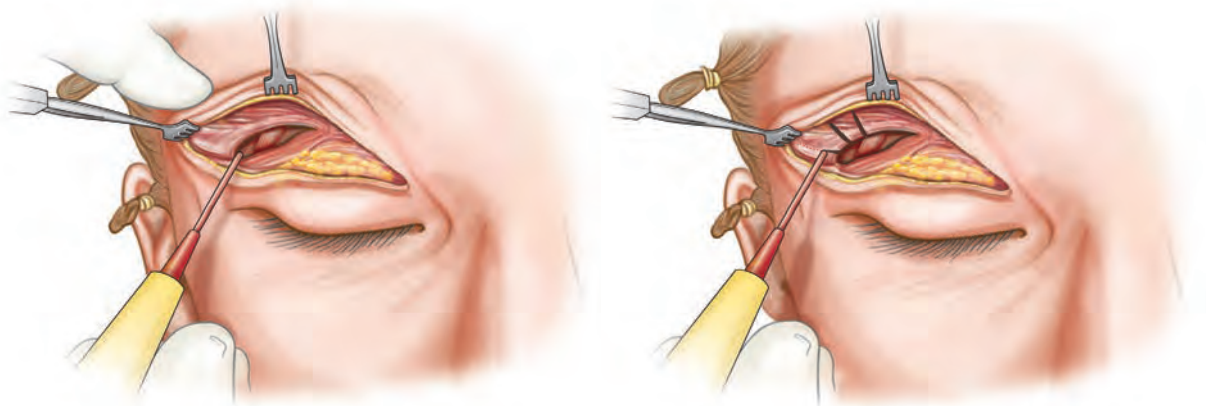


The extent of the medial subperiosteal dissection varies from patient to patient and depends on brow shape and the desired final result.

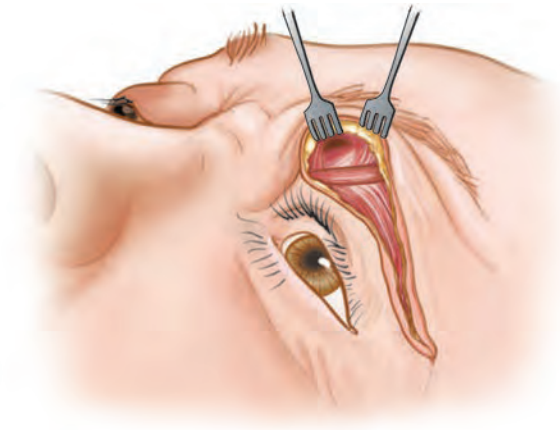
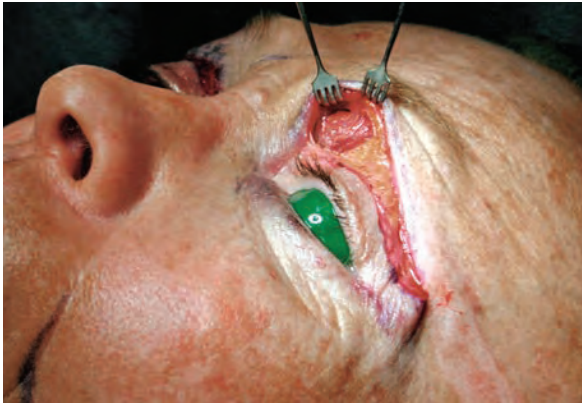
At this stage the lateral brow is tested with upward traction at the skin edge to ensure mobility by observing the upward and medial rotation of the lateral brow. If the lateral brow moves only minimally, further dissection must be performed; otherwise, there may be no brow elevation. The brow is not fixed at this stage. I then proceed with upper lid blepharoplasty and glabellar muscle modification.

Transpalpebral Glabellar Muscle Modification

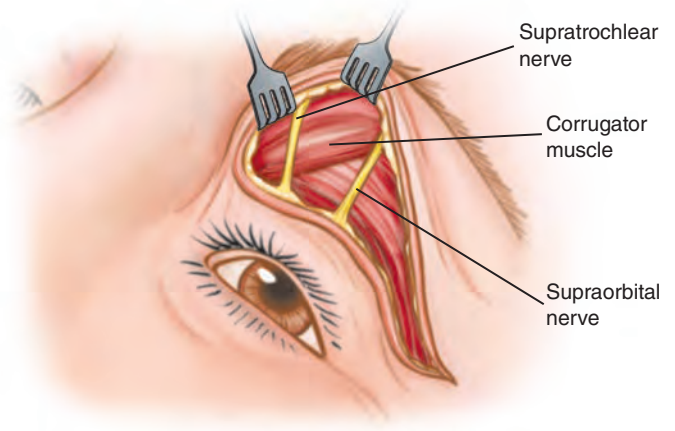
I perform the glabellar muscle modification with loupe magnification. The upper eyelid skin–muscle is excised as marked. The dissection proceeds superiorly deep to the orbicularis oculi, facilitated by two Blair retractors suspending the upper edge of the resected orbicularis. I prefer to operate with the cutting current of the Colorado tip needle. Alternatively, the dissection can be performed easily with a pair of scissors. At this stage, even if I am planning to resect upper eyelid fat, I leave the orbital septum intact, and any planned fat removal is delayed until after the glabellar muscle is excised, thus facilitating dissection of the orbicularis off the orbital septum. Laterally, the dissection is continued along the deep surface of the orbicularis until the lateral orbital dissection through the eyelid is continuous with the endoscopic dissection from above.



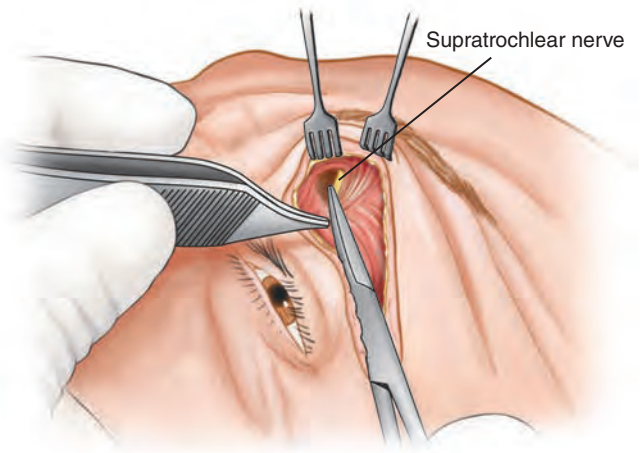
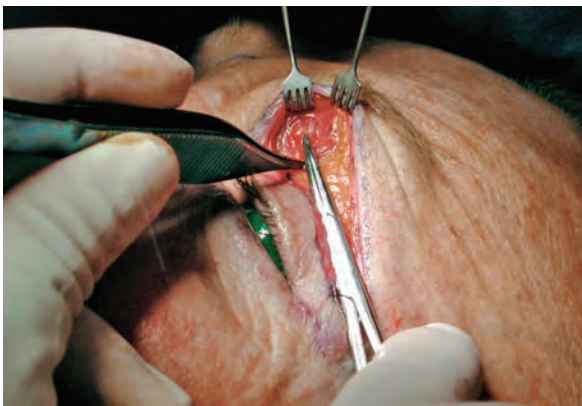
Once the communication between the eyelid and brow plane of dissection has been established, I make a number of radial cuts into the lateral orbicularis, not to permanently weaken it but to weaken it temporarily to prevent the downward pull of the orbicularis during the early postoperative phase to help maintain lateral brow position. The radial cuts are made in the muscle with the Colorado tip, and with a finger placed behind the hair-bearing brow pushing the muscle forward to facilitate scoring.



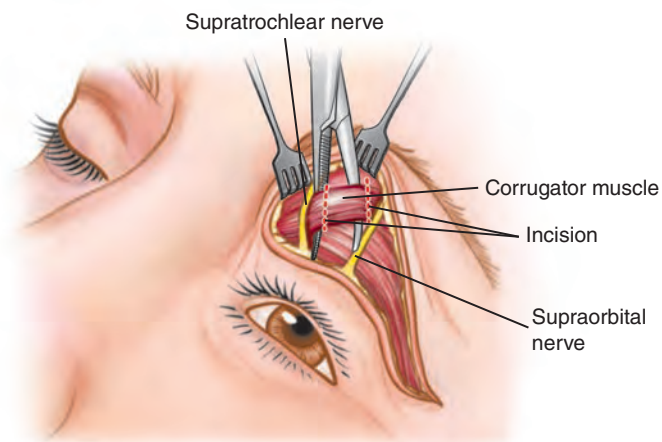
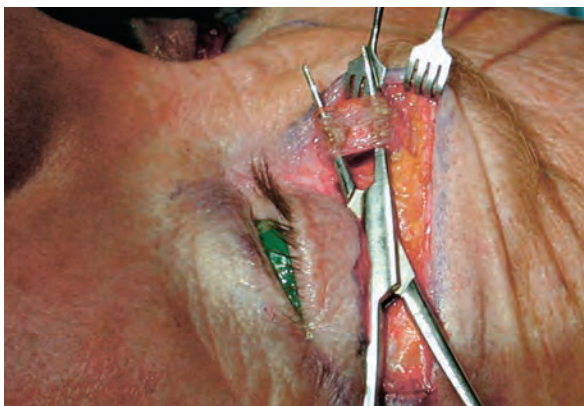
Medially, the dissection approaches the supraorbital rim. The orbicularis fibers running horizontally must be divided to reach the diagonally running muscle fibers of the corrugator supercilii muscle.



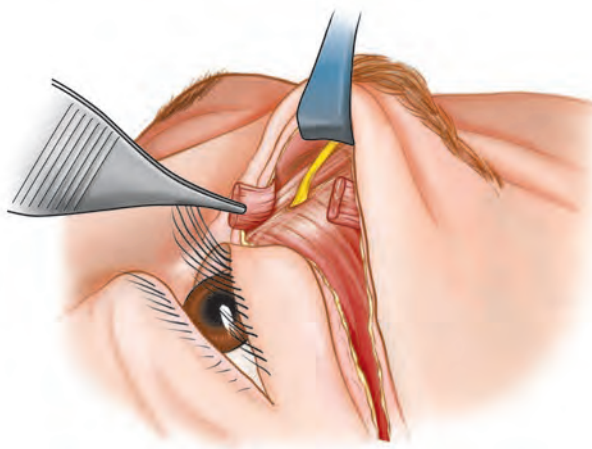
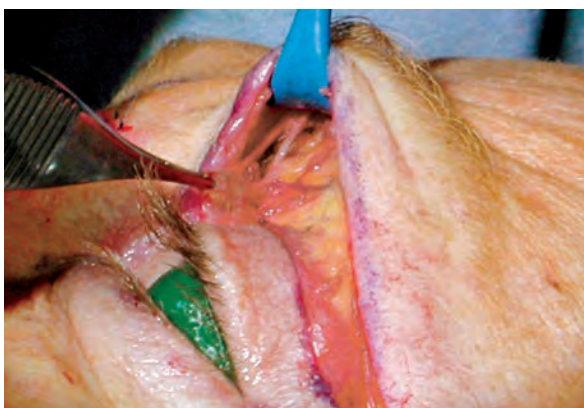
Branches of the supratrochlear nerve may also be visible at this stage.



The orbicularis muscle is divided with the Colorado tip or by spreading with the tips of scissors or a fine mosquito clamp. This immediately brings the corrugator muscle and a branch or two of the supratrochlear nerve into view.

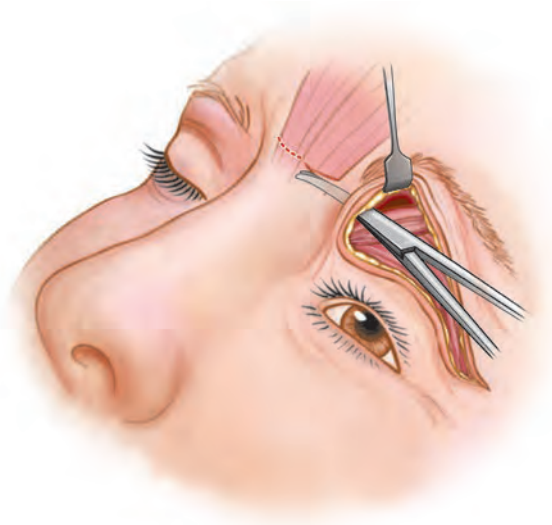


Although the corrugator muscle can be divided in stages, I prefer to insert the tips of the fine mosquito clamp around the entire muscle belly if possible; otherwise, I insert the tips partially through it, spread the tips, and resect the intervening segment of muscle. I often encounter a branch or two of the supratrochlear nerve coursing through the muscle. *The supraorbital nerve is usually lateral to this dissection.*

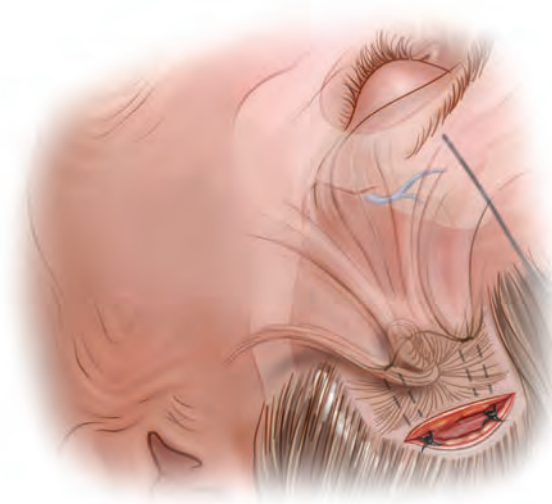


A segment of the muscle has been removed, revealing at least two intact branches of the supratrochlear nerve. These nerves are often accompanied by blood vessels that can bleed. I make every attempt to avoid these vessels. If they bleed, I cauterize them with a bipolar cautery rather than a unipolar coagulating current. The muscle division/excision should be complete to prevent postoperative recurrence of glabellar function and lines. At the completion of the procedure, there should be a significant gap in the muscle with preservation of the supratrochlear and supraorbital branches. Theoretically, dissection in the upper medial corner of the orbit may injure the trochlear or superior oblique muscles. Such injuries are very rare and are easily avoided by limiting the dissection behind the origin of the corrugator muscle.

It is rare that any contour deformities result from this excision of the corrugator; however, if there is any concern, fascia or periorbital fat serve well as filler between the cut ends of the corrugator muscle.



In patients who have transverse glabellar or dorsal nasal skin lines resulting from procerus muscle activity, the procerus is transversely divided through the blepharoplasty incision by elevating the orbicularis and then pushing a pair of scissors deep to the skin toward the nasal radix, cutting the fibers off the procerus under the skin. If necessary, periorbital fat is excised at this time.



The next step is brow fixation. The brow is rotated upward and medially, and the temporoparietal fascia is anchored down to the deep temporal fascia. I usually place two sutures of 2-0 PDS between the temporoparietal fascia and the deep temporal fascia in a diagonal or vertical vector. More medial screw fixation may be necessary, but this is rare. A minimal amount of excess scalp is excised, and the scalp incision is closed with staples. The upper eyelid incision is closed.

Postoperative Care

To minimize swelling, the patient's head is kept elevated, and ice packs are applied to the periorbital area.

Results



This middle-aged woman underwent a temporal brow lift, transpalpebral corrugator excision, a nasal compartment orbital fat flap to correct the A-frame deformity of the upper lids, transconjunctival lower blepharoplasty with fat distribution, and a face lift. She is shown several months postoperatively.



This 50-year-old woman exhibited aging of the upper and lower lids, lid-cheek junction, and face. Rejuvenation of the periorbital area and lower face was planned. She underwent a lateral temporal lift, upper and lower blepharoplasty, and a short-scar blepharoplasty. She is shown 4 years postoperatively; the improved lateral brow position has been maintained.

Problems and Complications

Infection and bleeding are rare. Alopecia may be seen along the temporal incision line. This risk is minimized by avoiding excessive tension in the scalp closure and limiting the use of coagulating current along the cut edges of the incision. Inade-

quate lateral temporal release may lead to relapse or recurrence of brow ptosis. The upper eyelid procedure increases the risk of bleeding and swelling beyond that of a standard upper eyelid blepharoplasty. Hemostasis in the corrugator muscle bed is essential. Unless combined with lower lid procedures, chemosis and other blepharoplasty complications are rarely seen.

Concluding Thoughts

Combining a lateral/temporal lift with an upper lid blepharoplasty and transpalpebral excision of the corrugator muscle through the upper eyelid is a safe and effective option for rejuvenation of the brow. It requires no special equipment beyond a pair of loupes. The best candidates have moderate lateral brow ptosis, appropriate medial brow position, and moderate vertical glabellar frown lines.

Clinical Caveats

The temporal incision must be kept over the temporalis muscle. This not only eliminates the risk of injury to the lateral branch of the supraorbital nerve, it also ensures that the temporo-parietal fascia can be anchored down to the deep temporal fascia.

Complete release of the lateral orbital attachments, adhesions, and septa is essential; otherwise, the lateral brow cannot be successfully elevated.

Dissecting instruments should be kept firmly down over the deep temporal fascia to avoid frontal branch injury.

Vertical spreading in the vicinity of the sentinel vein should be avoided to minimize the risk of stretch injuries to the frontal branch.

Loupe magnification greatly facilitates the transpalpebral excision of the corrugator muscle.

Connecting the lateral upper lid and brow dissections through the lower lid dissection facilitates lateral brow elevation.

Serial scoring of the lateral orbicularis oculi muscle minimizes downward pull of the orbicularis during the postoperative period, which assists fixation of the lateral brow position.

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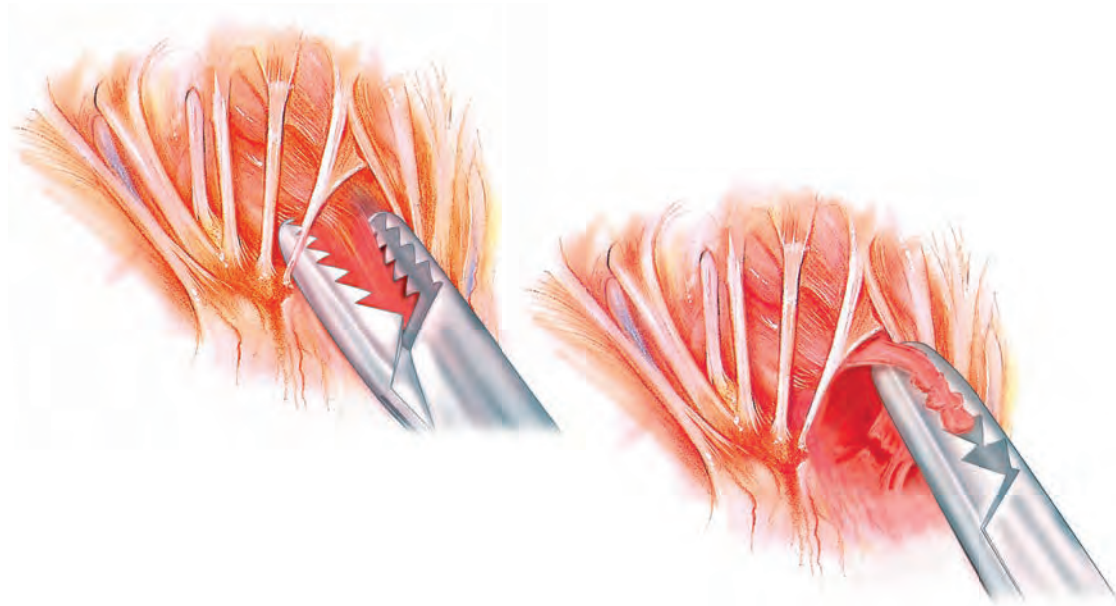
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CHAPTER 24



Endoscopic Brow Lift: *The Three-Portal Approach*

FOAD NAHAI



Low brow



High brow



Full brow



Deflated brow

For too long we have focused on brow position rather than brow shape and fullness as representing beauty and youth. Perhaps our emphasis on brow height during the early days of endoscopic brow lifting was not only a carryover of the thinking in the early 1990s, but also a desire to establish that endoscopic brow lifting could elevate and maintain brow height. Since then, our understanding of facial aging and the role of volume and deflation has been advanced significantly through the work of Lambros and Coleman. Numerous publications have also established the efficacy of the endoscopic brow lift to elevate and maintain brow position. Our current view is that a youthful or beautiful brow is related more to volume and shape than to height.

Endoscopic procedures have been modified with these ideals in mind. Repositioning the brow with amelioration of forehead and glabellar lines is an integral part of periorbital and full facial rejuvenation. In a balanced, youthful face, the eyebrow is lower medially and higher laterally, with a variable arch in between. Several publications have attempted to describe the youthful or beautiful brow through numeric measurements and formulas. However, there are many youthful and beautiful women without high eyebrows. Given these variations of beauty and normalcy, neither aging nor the success of rejuvenation in the periorbital area should be judged by brow height; brow shape and volume are far more important than brow height.



Early signs of brow and periorbital aging include deflation and brow ptosis with a lowering of the medial and lateral hair-bearing brow and development of vertical glabellar and horizontal forehead lines. These changes often result in alterations to facial expression, producing a tired, concerned, or even angry look. There is also real or apparent excess skin on the upper eyelid. A variety of techniques are available to reposition and reshape the brow and to soften vertical and horizontal frown lines. Most involve mobilization, repositioning, and fixation of the forehead and brow with modification of the forehead musculature. The open standard coronal brow lift was for many years the only option for forehead rejuvenation; it remains an effective, proven operation, the benchmark against which other techniques are measured.

In 1992 Isse and Vasconez independently pioneered what we refer to today as the *endoscopic brow lift*. Since that time, this technique has evolved significantly: it has been simplified, the instrumentation minimized, and the anatomy defined. It has steadily gained in popularity and was once, without doubt, the most common endoscopic procedure, not only in aesthetic surgery but in all of plastic surgery. However, the popularity and effectiveness of toxins in reshaping and repositioning the brow and the effectiveness of transpalpebral glabellar muscle modification combined with a temporal brow lift have affected the number of endoscopic brow lifts performed. Despite these recent developments, the procedure continues to enjoy tremendous patient acceptance. Before endoscopic forehead lifts were introduced, approximately 1 in 10 of my patients undergoing a face lift would accept a coronal brow lift. Today some form of brow lift, whether endoscopic, transpalpebral, or lateral temporal, is my routine for almost all patients undergoing facial rejuvenation.

My experience with several hundred endoscopic brow lifts over 16-plus years has been favorable. Patient acceptance has been high, morbidity low, and my results have compared favorably with those of the coronal brow lift.

The endoscopic approach affords excellent exposure for release of periorbital adhesions; muscle excision and nerve preservation are facilitated through the endoscope's magnification. The approach results in shorter scars and reduces the risks of sensory denervation of the scalp and alopecia. However, scalp excision is limited with this approach, so that elevation and maintenance of brow position must rely on muscle balance and fixation techniques, compared with the open coronal method in which scalp excision maintains brow position.

Advantages and Disadvantages of the Endoscopic Brow Lift

Advantages

- Excellent exposure for release of periorbital adhesions
- Shorter scars
- Endoscopic magnification
- Reduced risk of alopecia and scalp sensory changes

Disadvantages

- Initial cost of equipment and special instrumentation
- Technology-dependent nature of the procedures—equipment failure may prevent completion of the procedure
- Learning curve involved
- Need for additional fixation

Indications and Contraindications

GOOD CANDIDATE



POOR CANDIDATE



The best candidates for an endoscopic forehead lift are patients with short, flat foreheads with nonreceding, thick hairlines and normal skin, moderate rhytids, and minimal true skin excess laterally and over the nasal radix. Poor candidates have a high convex forehead, a high, receding hairline with thin hair, thick skin, deep rhytids, and true excess skin on the forehead and brow.

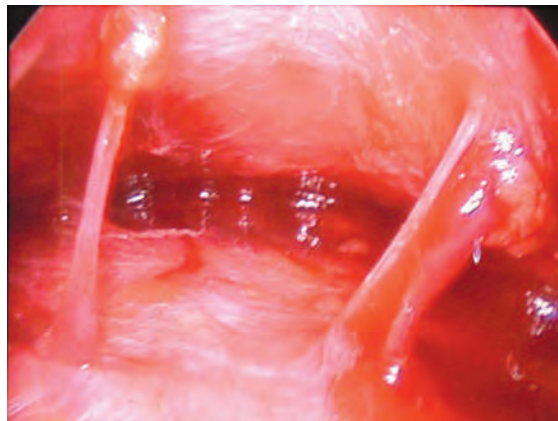
Forehead height and shape are limiting factors for a rigid endoscope. In a patient with a short, flat forehead, it is relatively easy for the surgeon to maneuver the endoscope to visualize the glabellar musculature and orbital rim. A convex forehead makes it difficult to maneuver the rigid, straight endoscope, and a high forehead places limitations on the reach of the endoscope.

Pertinent Anatomy

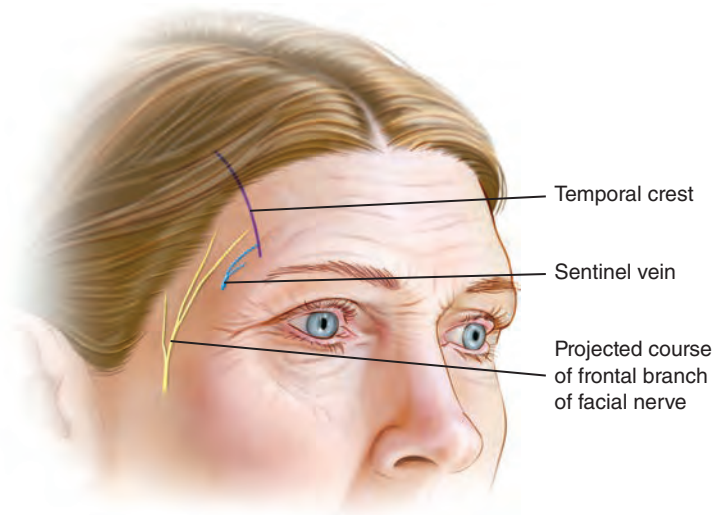
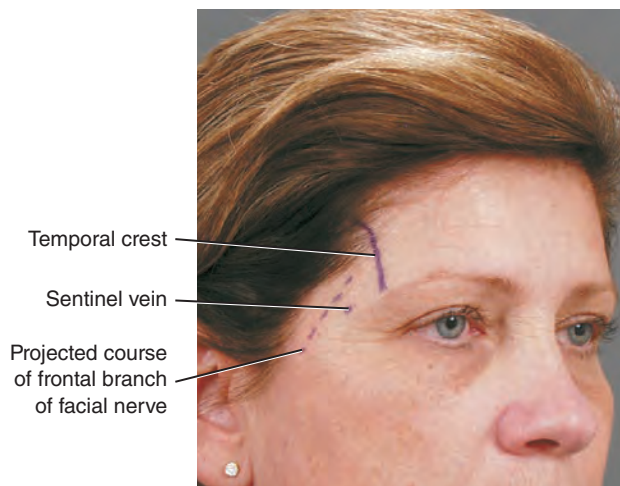
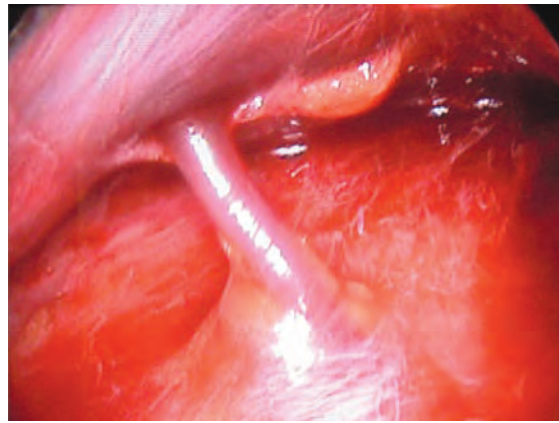
Key anatomic points include the sentinel vein, the temporalis muscle and temporal crest, periorbital septa and adhesions, glabellar muscles, and the supratrochlear and supraorbital nerves.

Sentinel Vein

De La Plaza et al described and named perforating vessels in the temporal region sentinel vessels of the lateral wall of the orbit. These zygomaticotemporal veins are communicating veins between the superficial and deep systems. There are usually two veins, one medial and the other lateral; the medial is larger and is referred to as the *sentinel vein*.



This endoscopic view shows the medial and lateral zygomaticotemporal veins. The smaller, or lateral one, is often accompanied by the zygomaticotemporal nerve.



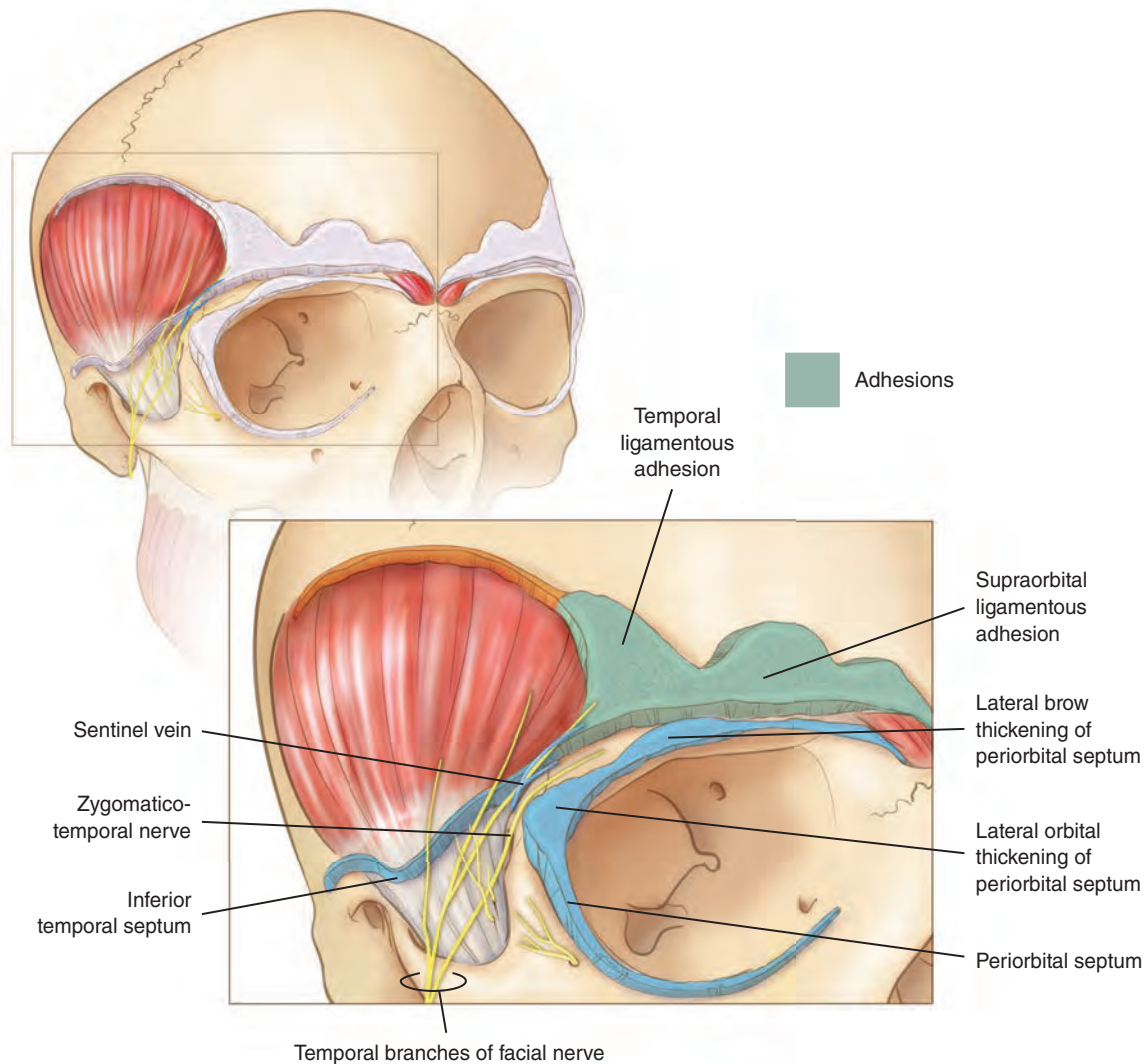
The sentinel vein (*top*) is a useful landmark for preoperative planning (*bottom*) and a key point for the release of the periorbital septa and adhesions during the operation. In most patients in the recumbent position, the sentinel vein is located 1.5 cm above and lateral to the lateral canthus. The lowest of the frontal nerve branches usually passes approximately 1 cm above the level of the sentinel vein. Thus the sentinel vein defines a danger zone for the frontal branch. I can operate rapidly toward the zone with safety; however, when approaching the vein, the dissection is slowed under endoscopic control to prevent any direct damage or stretching of the nerve.

Temporalis Muscle and Temporal Crest



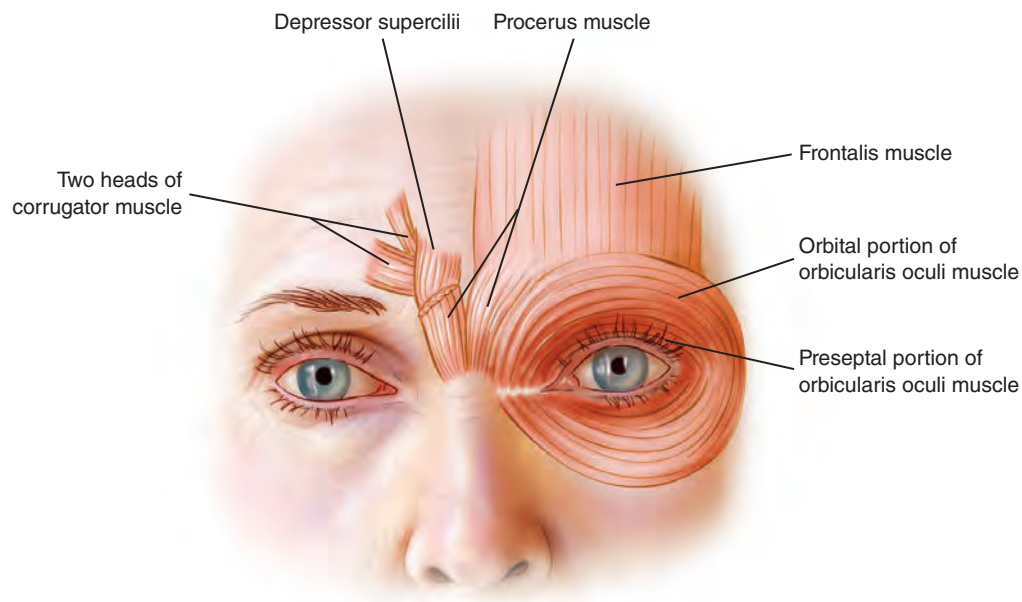
The temporal crest marks the transition from the dissection to the temporo-parietal fascial (subfascial) to the subperiosteal plane by elevating the temporal line of fusion at the temporal crest. The temporal crest also marks the lateralmost course of the lateral branch of the supraorbital nerve. Preoperatively I ask patients to clench their teeth, and I mark the temporal crest, as seen here. My left hand rests over the contracting muscle while the pen held in my right hand outlines the temporal crest just anterior to the contracting muscle. The sentinel vein is also marked.

Periorbital Septa and Adhesions



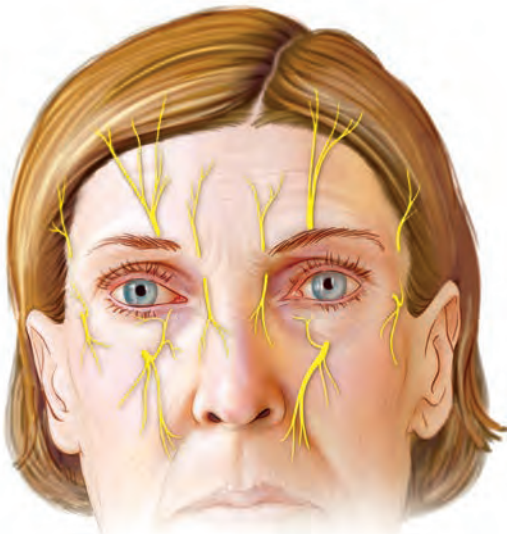
Although several authors have referred to ligaments in the periorbital area, Moss et al pointed out that rather than true ligaments, there are multiple septa and adhesions in the periorbital area. To mobilize the brow, especially the lateral periorbital brow, all of the septa and adhesions must be completely divided. I have found that skeletonizing the sentinel vein effectively releases septa and adhesions, allowing elevation of the brow.

Glabellar Muscles



The corrugator supercilii is the first muscle encountered with the endoscopic approach in the glabellar region. Medial to the corrugator are fibers of the orbicularis oculi muscle, called the *depressor supercilii*. More superficially and in the midline lie the procerus muscles. The supratrochlear nerves run within or just superficial to the corrugator. The bulk of the orbicularis muscle lies superficial to the corrugator and is only viewed once the corrugator has been excised.

Supratrochlear and Supraorbital Nerves



The supratrochlear nerves are several small filamentous nerves lying within or just superficial to the depressor supercilii and corrugator muscles. These nerves almost always emerge through notches in the supraorbital rim. Injury to one or more of these small filaments is inevitable during excision of the corrugator muscle and is of relatively little significance. A useful clinical landmark for the supratrochlear nerves is the vertical glabellar frown line if present; it is usually 1.5 to 2 cm from the midline.

The supraorbital nerve is much larger than the supratrochlear nerves; it is usually one single large nerve, although occasionally two or three branches may be seen. It emerges from the orbit through a definite notch or occasionally through a foramen that may be up to 2 to 4 cm above the supraorbital rim. Although the supratrochlear nerves lie within the fibers of the corrugator, the supraorbital nerve is usually deep to the corrugator. The lateral branch of the supraorbital nerve may course as far lateral as the temporal line of fusion. Any incision in the scalp that is medial to the temporal line of fusion runs the risk of dividing this branch, resulting in sensory loss in the forehead. A useful landmark for this nerve is the midpupillary line, or a distance of 3 to 4 cm from the midline.

Preoperative Assessment

Patient evaluation includes an assessment of the medial and lateral brow position, position of the brow in relation to the upper eyelid, assessment of glabella and forehead lines at rest and on animation, and assessment of frontal bone convexity, forehead height, and hairline. This evaluation influences the surgeon's choice of procedure. If the endoscopic brow lift is chosen, this evaluation influences the location of the incisions, extent of muscle modification, and fixation techniques, if any are needed.

In patients with normal or minimal medial brow descent, minimal or no glabellar skin excess over the radix, modest lateral brow ptosis, and superficial forehead lines at rest, I prefer the combination of a lateral temporal brow lift and transpalpebral corrugator excision, as described in Chapter 25.

The surgeon advises the patient about the following:

- The number, location, and length of the incisions, and if fixation is required, the type of fixation (for example, external screws or an Endotine fixation device [Coapt Systems, Palo Alto, CA]) and any additional incisions required for fixation

- Although the risk is minimal, there may be some alopecia at the incision sites and around the external screw fixation sites

- Temporary or even permanent sensory changes may occur in the scalp

- Some downward movement of the brow will occur within the first few months after the procedure, and over the long term the brow will not be as high as the initial result

Preoperative Planning

As with any technology-dependent technique, the surgeon must have a basic understanding of the principles. In endoscopic aesthetic surgery, the surgeon needs to have the following:

- The necessary training
- Appropriate mechanical equipment
- Knowledge of equipment troubleshooting and safety measures
- The technical skills to perform the procedure

Today endoscopic equipment, including the endoscope, camera, monitors, and so on, has become standard in operating rooms where aesthetic surgery is performed. Operating room personnel are now quite familiar with this equipment and its maintenance.



Team Preparation

The Surgeon

- Take a CME-approved endoscopic plastic surgery teaching course.
- Familiarize yourself with the endoscope and camera.
- Study a DVD or videotape of the procedure.
- Watch a colleague perform the procedure.
- If possible, have an experienced endoscopic surgeon assist you with your first case.
- Practice setting up the equipment.

The Operating Room Staff

- Receive in-service instruction from experienced operating room personnel or a manufacturer's representative.
- Dismantle and set up equipment.
- Learn troubleshooting techniques.
- Be aware of the location of backup equipment.
- Stage a dress rehearsal before performing an actual procedure.
- Learn the names of the endoscopic instruments.
- Arrange endoscopic instruments in the order in which the surgeon will use them.
- Watch a DVD or videotape of a procedure.
- Visit an operating room where these procedures are routinely performed.

Minimum Equipment Needs

Endoscope	Endoscope warmer
4 or 5 mm 30-degree angle Hopkins rod	Defogging solution
Endoscopic cannula or endoretractor—	Electrocautery
4 or 5 mm	Instrumentation
Endoscopic cart	Curved elevators (two or three)
Monitor	Endoscopic scissors
Light source	Insulated graspers
Camera (at least three-chip)	Fixation devices



Originally, up to 25 special instruments were designed and marketed for the endoscopic brow lift. Today most of us have our own half-dozen or more favorite instruments for this procedure.

As a safeguard, it is important to have a backup system available, including a second endoscope, camera, and light source. These are readily available in a large hospital or surgical center but perhaps not in a small office-based operating room. Before every operation, either the surgeon or the operating room nurse should not only test the system but also inspect all of the instruments, especially the endoscopic graspers. I specifically look for breaks in the insulation of the graspers. Because we use the graspers for cauterization, any break in the insulation could cause a burn.

Markings

The major landmarks for this procedure include the sentinel vein, the temporal crest, and fixation vectors. If the sentinel vein is readily visible with the patient sitting down, I put a mark over it and then draw the likely course of the frontal branch of the facial nerve 1 cm or so above the sentinel vein. If the sentinel vein is not visible with the patient in the sitting position, I ask the patient to lie flat, and in most patients the vein is then visible.



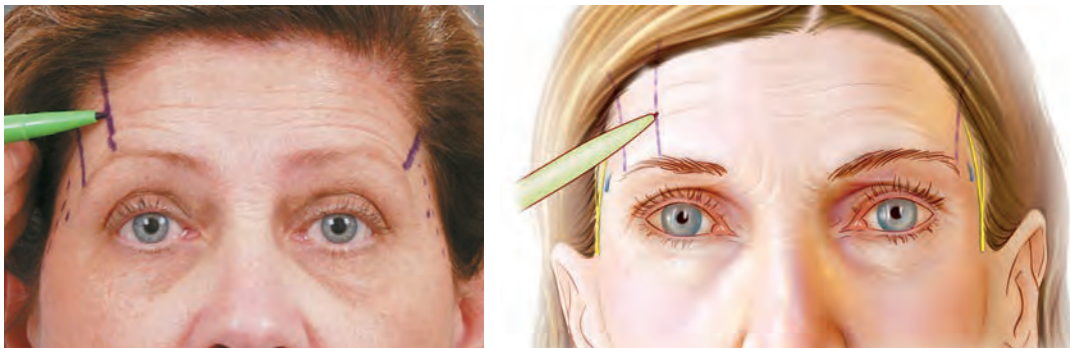
I then ask the patient to clench his or her teeth firmly. This enables me to palpate the muscle with my left hand as my right hand outlines the temporalis muscle and the temporal crest on the forehead just anterior to the contracting muscle. I then mark the access incision 1 or 2 cm behind the temporal hairline, making certain that I am over the temporalis muscle. This will facilitate fixation of the temporo-parietal fascia down to the deep temporal fascia.

These markings are made symmetrically on both sides of the head. The orientation of this temporal incision varies from radial to coronal. I individualize this based on the patient's anatomy and our goals. I prefer a coronal or horizontal incision to a radial incision, because with the radial incision I am limited to one fixation suture, whereas the other approach allows me to put in a minimum of two fixation sutures.

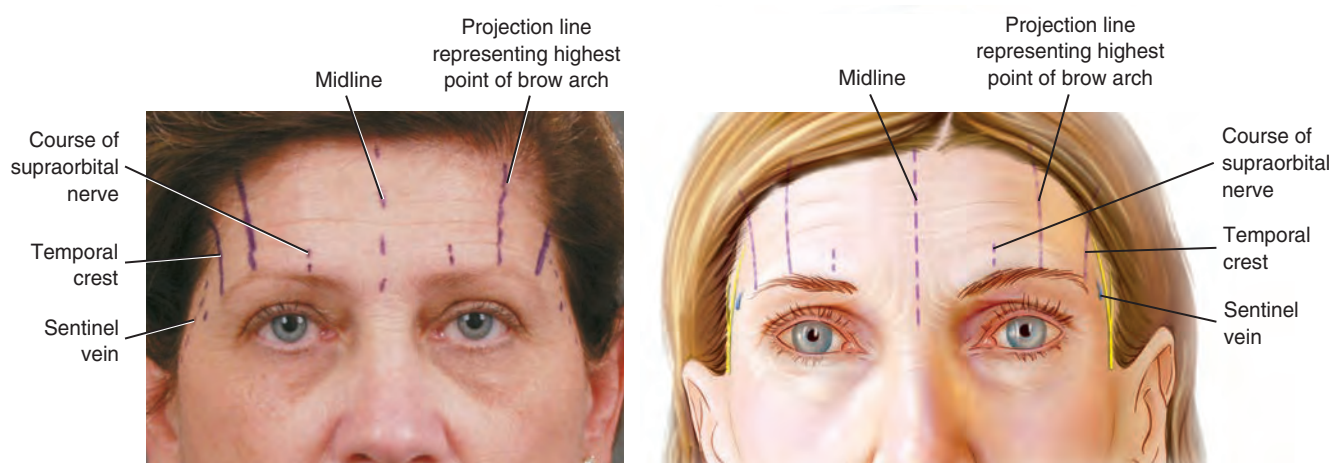
I then ask the patient to frown, which outlines the origin and insertion of the corrugator muscle. Next I mark the glabellar frown line and the course of the muscle lateral to it to be a guide for muscle excision. I also mark the midpupillary line, indicating the course of the supraorbital nerve. Another mark is placed 2 to 4 cm above the orbital rim in the midpupillary line, indicating a danger zone where the supraorbital nerve could emerge through a foramen.

Finally, the vectors for fixation are marked. For temporal fixation, I routinely rely on vector from the alar base to the lateral canthus projected onto the forehead. An alternative line is drawn from the oral commissure to the lateral canthus and then onto the forehead. This vector provides a more vertical and upward elevation of the lateral brow.

If extra fixation is planned, such as with a screw or an Endotine device, I individualize these vectors. In general, I place them on the scalp in line with the most convex arch of the brow.

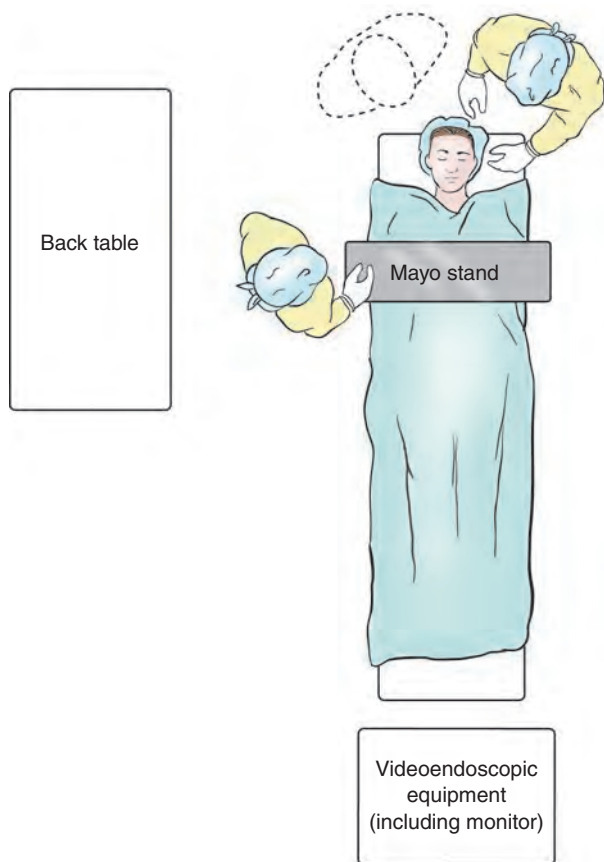


The projection of the most convex part of the brow onto the scalp is marked as the site for additional fixation.



The patient is shown with all of the final markings.

Patient Positioning



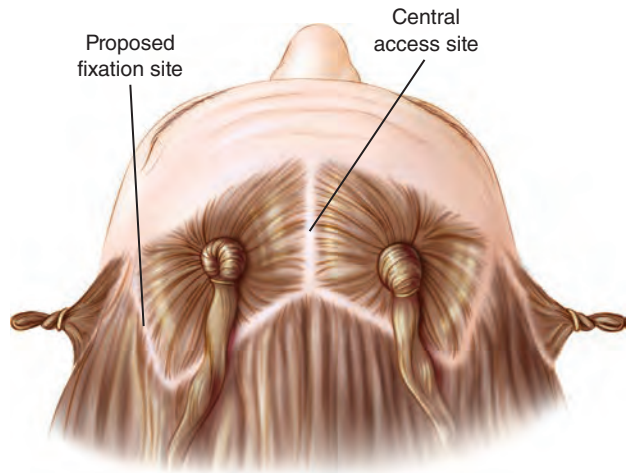
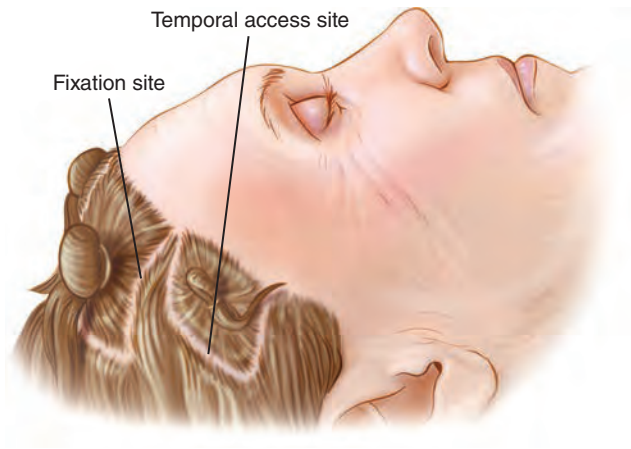
The patient is placed supine on the operating table with the head extending slightly beyond the headpiece. This facilitates maneuvering of the endoscope and endoscopic instruments. The procedure can be performed with the patient under local or general anesthesia. I prefer a general anesthetic because, in my practice, endoscopic brow-lift procedures are almost always performed in combination with other periorbital and facial rejuvenation procedures.

Operative Sequence

1. Hair preparation
2. Infiltration
3. Right temporal incision and dissection
4. Left temporal incision and dissection
5. Central access incision
6. Subperiosteal dissection
7. Division of periosteum from one lateral orbital rim to the other
8. Muscle modification
9. Drain placement
10. Closure of central access incision
11. Placement of temporal fixation sutures
12. Additional fixation, if needed
13. Tying of temporal fixation sutures
14. Temporal scalp excision, if needed

Operative Technique

Hair Preparation



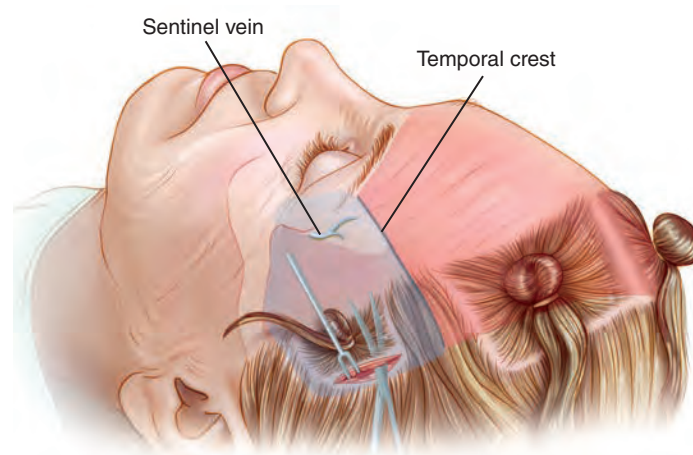
With the patient under general anesthesia, I cleanse the hair with a soapy solution and braid the hair to expose the proposed incision sites. Braiding keeps the hair out of the way during the procedure; alternatively, the hair may be stapled on each side of the proposed incisions.

Infiltration

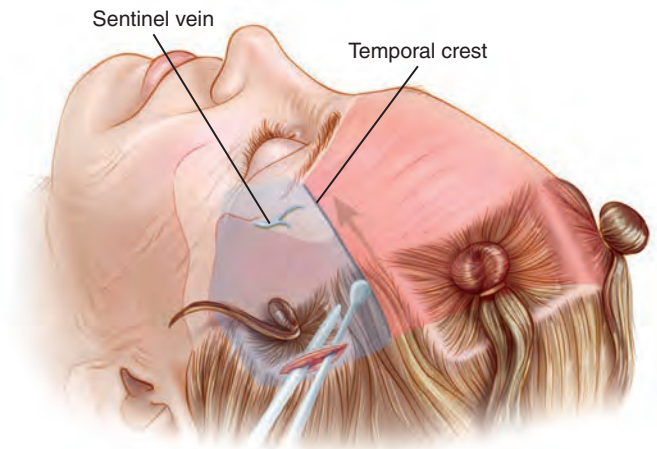
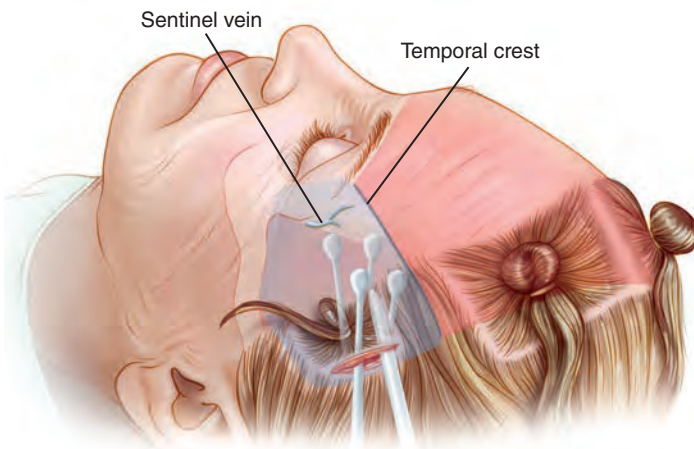
The brow area is infiltrated with a solution of 1% lidocaine (Xylocaine) and epinephrine 1:100,000, encompassing the entire area that will be undermined.

Temporal Incisions and Dissection

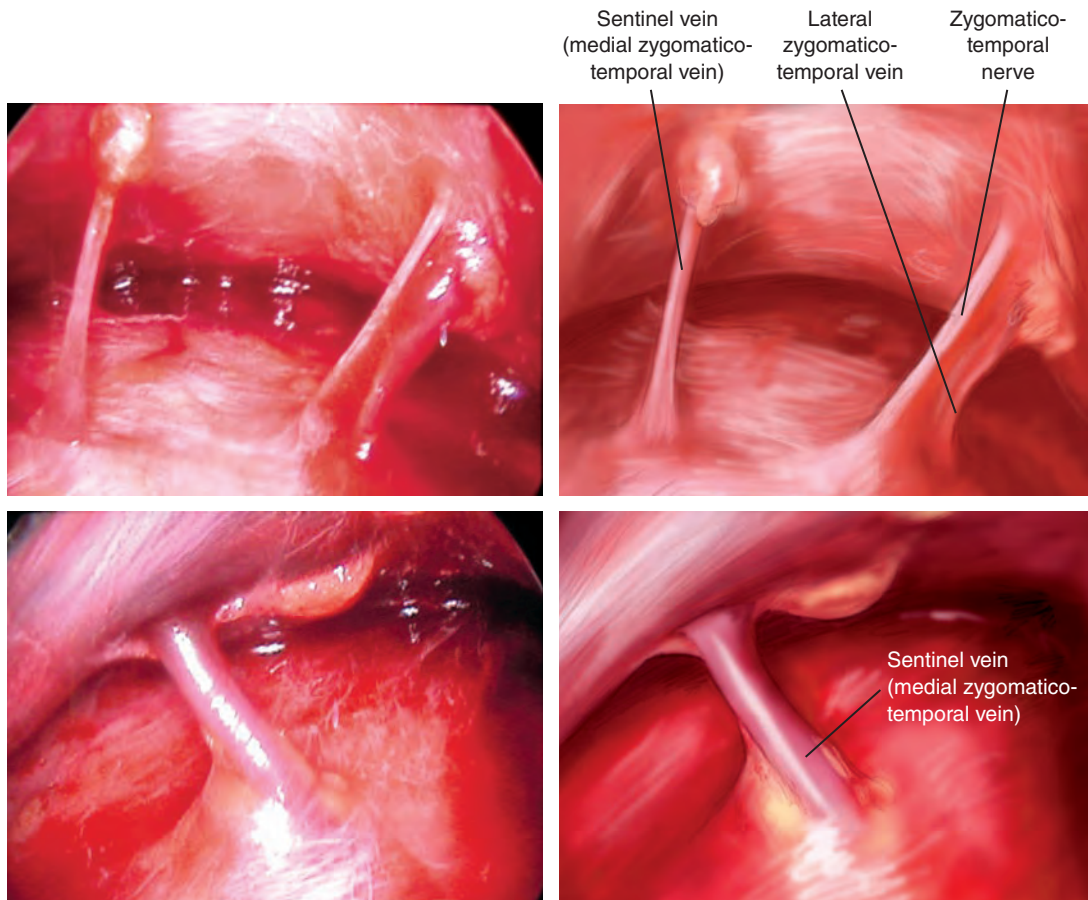
I begin the procedure on the right side; the incision is made through the scalp down to the deep temporal fascia over the temporalis muscle.



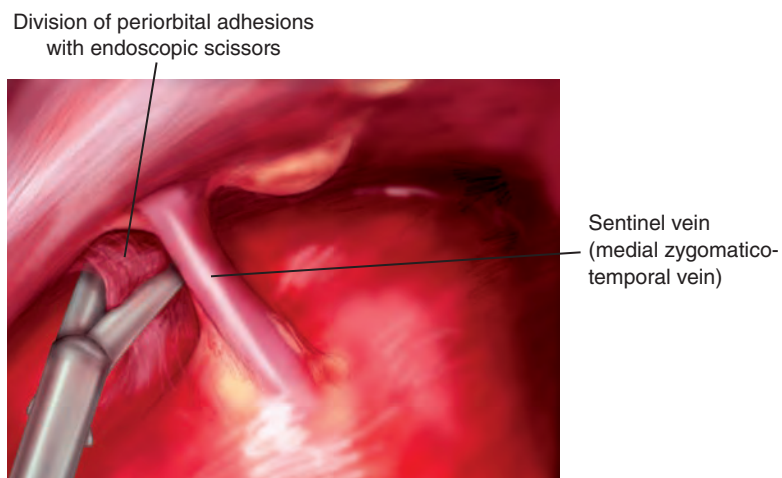
With a hook elevating the lower edge, I dissect in the plane between the temporoparietal fascia and the deep temporal fascia. This is a bloodless field, and the dissection proceeds rapidly toward the lateral orbital rim.



Once the dissection is started, I switch from Metzenbaum scissors to a Ramirez No. 4 dissector. I dissect rapidly toward the orbital rim, without the endoscope but under direct vision, with an Aufricht retractor and a headlight, keeping the tip of the dissector firmly down on the deep temporal fascia. This avoids any possible risk of damage or stretching of the frontal branch. The dissection is stopped within 1 cm of the sentinel vein. This nonendoscopic dissection is continued medially through the temporal line of fusion and then in a superior direction so that the temporal line of fusion is elevated and the subperiosteal space is entered. At this stage the endoscope is introduced, and with the same dissector the dissection is continued toward the sentinel vein and the lateral orbital rim.



The sentinel veins are easily identified. In most patients I am able to divide the septa and adhesions around the sentinel vein and extend the dissector into the upper eyelid, deep to the orbicularis and the retroorbicularis oculi fat (ROOF).



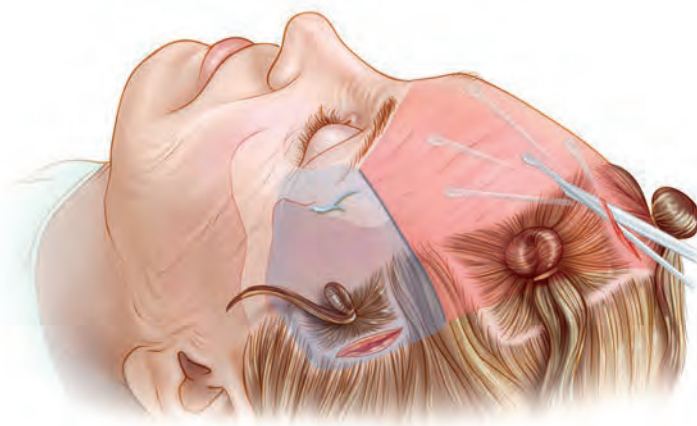
If the adhesions around the sentinel vein cannot be taken down with the dissector, I complete their division with the endoscopic scissors under direct endoscopic control.



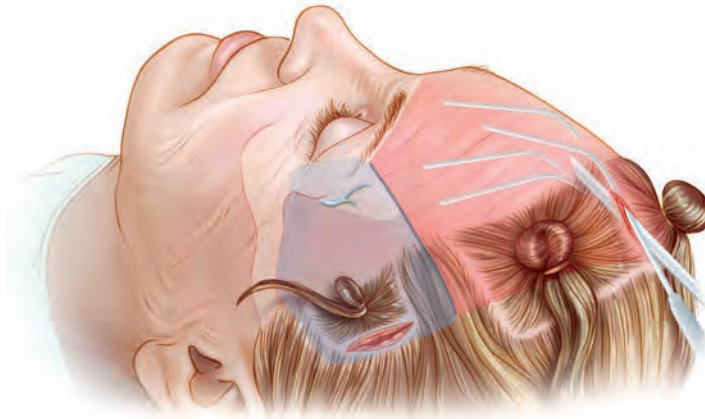
I make every effort to preserve and skeletonize the sentinel vein. At this stage I place traction on the lower edge of the incision, pulling the brow upward. This confirms whether all of the adhesions have been released and that the lateral brow is now mobile. Failing to release the lateral brow limits the result. The procedure is then repeated in exactly the same way on the left side.

Central Access Incision

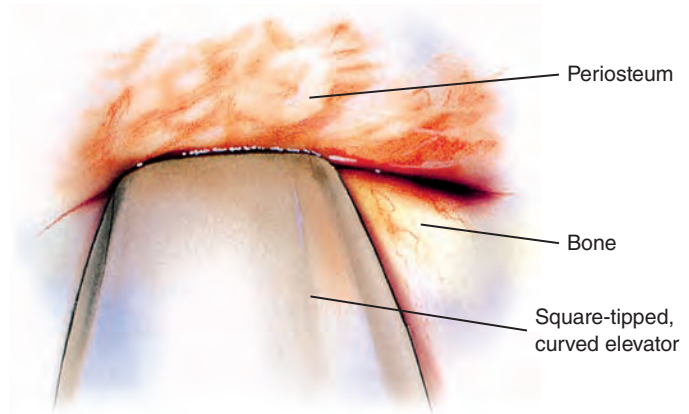
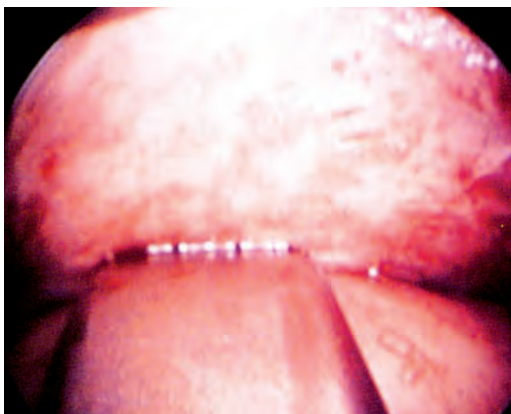
The central access incision is made in the midline, approximately 1 cm behind the hairline. This is a radial incision extending straight through to the periosteum.



The subperiosteal dissection is initiated with a straight periosteal elevator and extended toward the glabella, laterally toward the temporal incisions, and posteriorly for 3 or 4 cm. This dissection is fairly rapid, and I progress through two other periosteal elevators with increasing curvature.

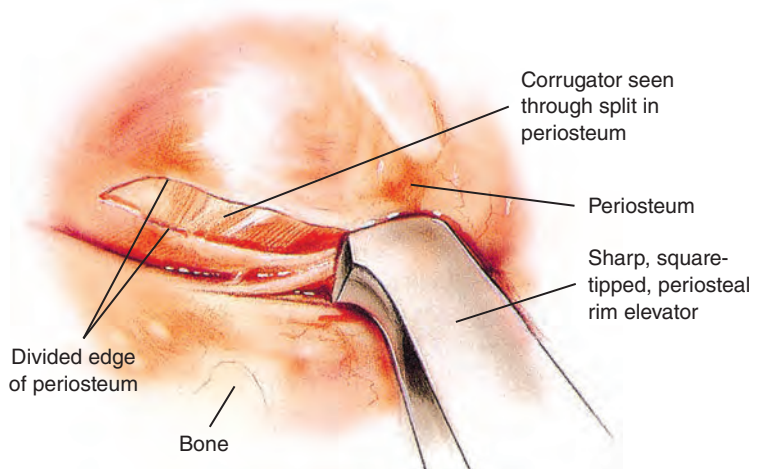
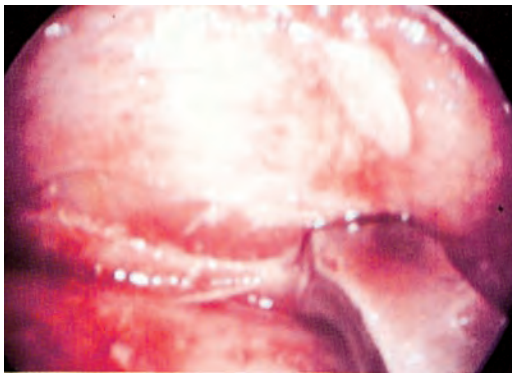


The subperiosteal dissection is connected with both temporal dissections and extended in the midline to the glabella and to a level approximately 2 to 4 cm above the supraorbital rim. This subperiosteal dissection is performed blindly.



The endoscope is then introduced through this central access incision so that the subperiosteal dissection, which is completed down to the supraorbital rim, is continued under endoscopic control to permit identification and easy preservation of the supraorbital nerve if it emerges through a foramen above the supraorbital rim.

Division of the Periosteum

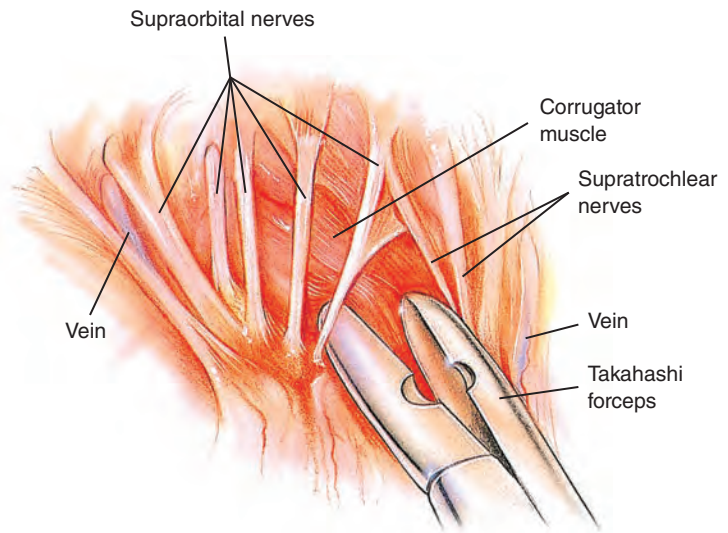
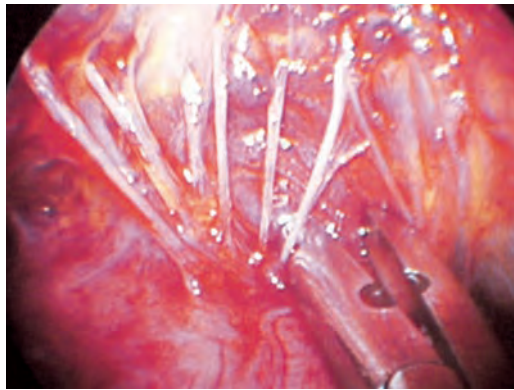


At this stage the periosteum is divided from one lateral orbital rim to the next. This periosteal division serves two purposes:

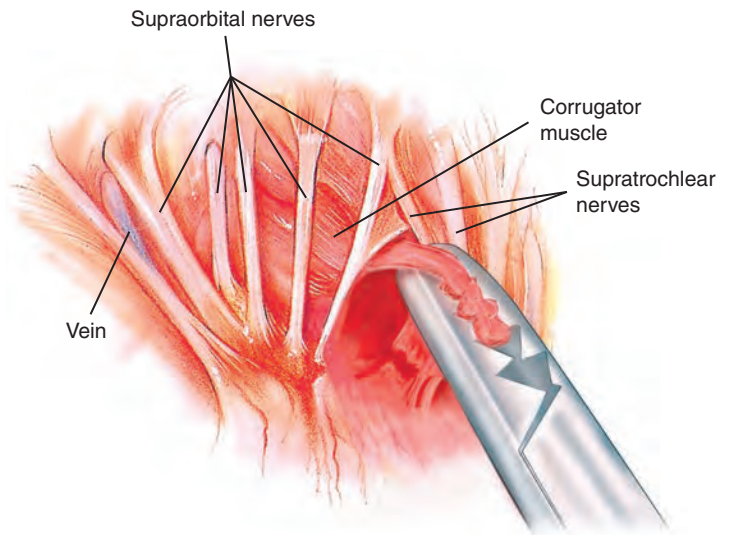
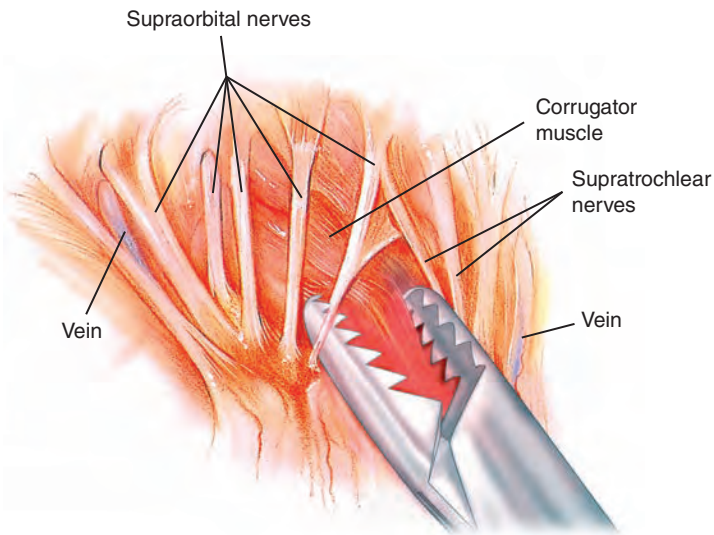
1. Division of the periosteum to allow further brow elevation laterally. The medial brow and glabellar periosteum may be left intact if medial brow elevation or separation is not desired.
2. Division of the periosteum to permit access to the glabellar musculature.

Muscle Modification

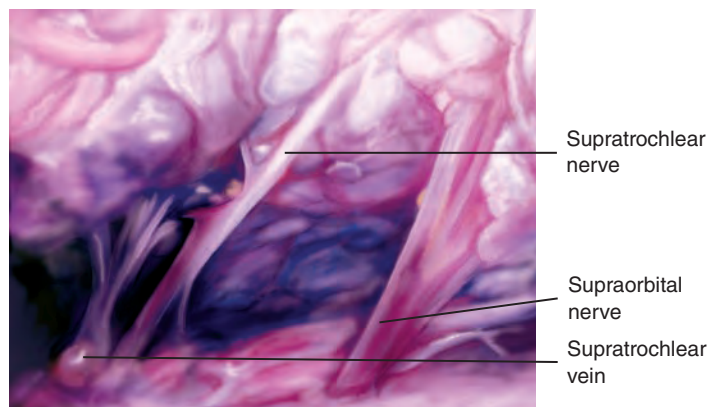
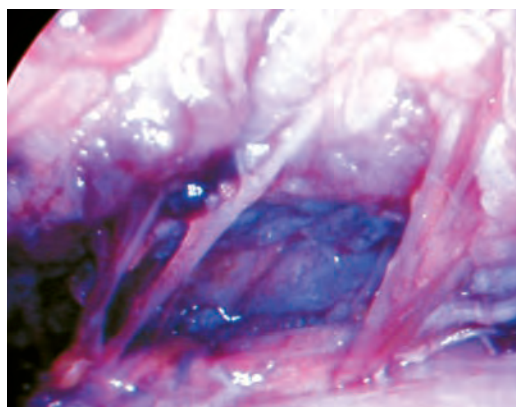
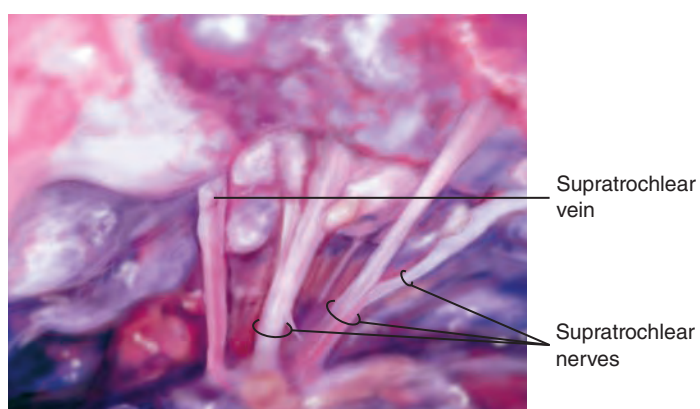
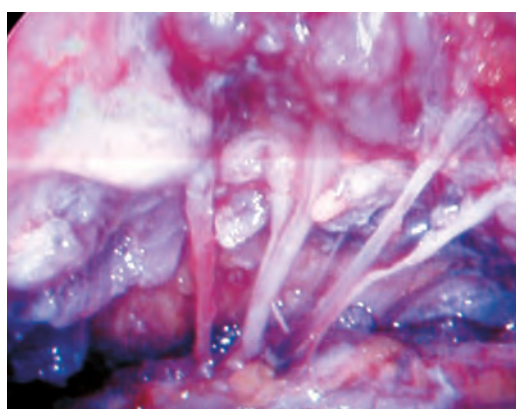
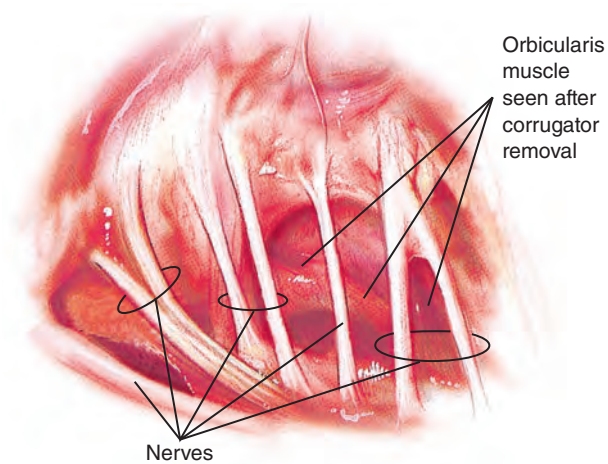
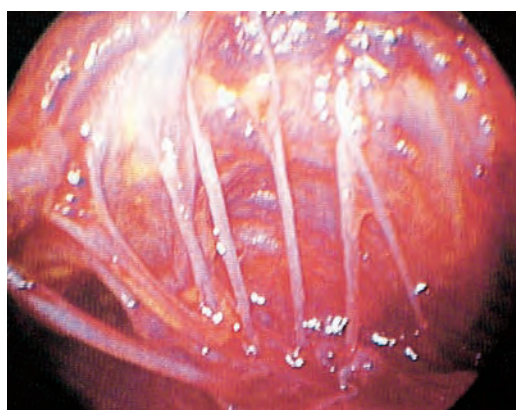
After the periosteum is divided, the corrugator, procerus, and depressor supercillii are easily seen. The direction of the muscle fibers aids in identifying each individual muscle. The procerus fibers have a slightly deeper color, with the fibers running vertically. The depressor fibers are lighter in color and vertically oriented also, whereas the corrugator fibers run diagonally.



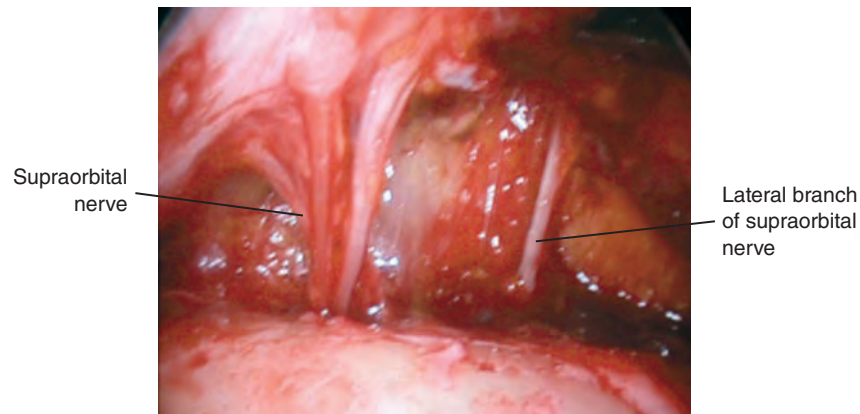
I have tried various instruments for muscle modification, including Takahashi forceps, coagulating current, a laser, and even a periosteal elevator. My preference now is the endoscopic grasper; I grasp a little muscle at a time and tease it upward.



I have found that the muscle tears very easily, but the branches of the supratrochlear nerve are more resilient. Depending on the bulk of the muscle and the severity of the patient's glabellar lines, I vary the extent of muscle division and the amount of muscle I remove.



At the end of the muscle modification, the branches of the supratrochlear nerve should lay bare within the optical field. Sometimes with a heavy muscle I extend the dissection laterally, superficial to the supraorbital nerve.



The supraorbital nerve and a separate lateral branch are shown after muscle excision. I rarely need to cauterize any vessels. The combination of the head of the table being slightly elevated and epinephrine infiltration yields a relatively bloodless field. Occasionally bleeding is encountered from veins accompanying the supratrochlear and supraorbital nerves; this bleeding is easily controlled by holding the vein with the endoscopic grasper, pulling it away from the skin, and then gently cauterizing it. It is important to pull the vein away from the skin and to set the electrocautery on a low level to avoid injury to the surrounding nerves and even the overlying skin. If there is bleeding in the field, I have found Neuro Patties to be very useful for drying up the field. I also like to have a 10 ml syringe filled with saline solution attached to the endoscopic sheath for irrigation. This irrigation is useful for clearing the field, if needed, but most of all to eliminate fogging of the endoscope.

Drain Placement



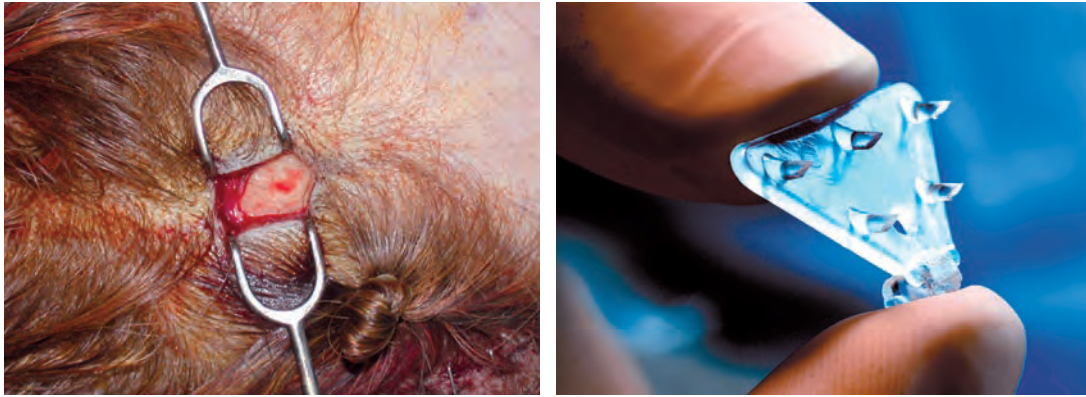
I routinely drain all endoscopic brow lifts for up to 24 hours. Although there is minimal drainage, 20 to 25 ml at most, I believe this makes a big difference with regard to upper lid swelling and ecchymosis, especially when the endoscopic brow procedure is combined with upper lid blepharoplasty. I prefer to place a 10 Fr drain directly along the supraorbital rim with the tubing exteriorized behind the ear on one side.

Closure

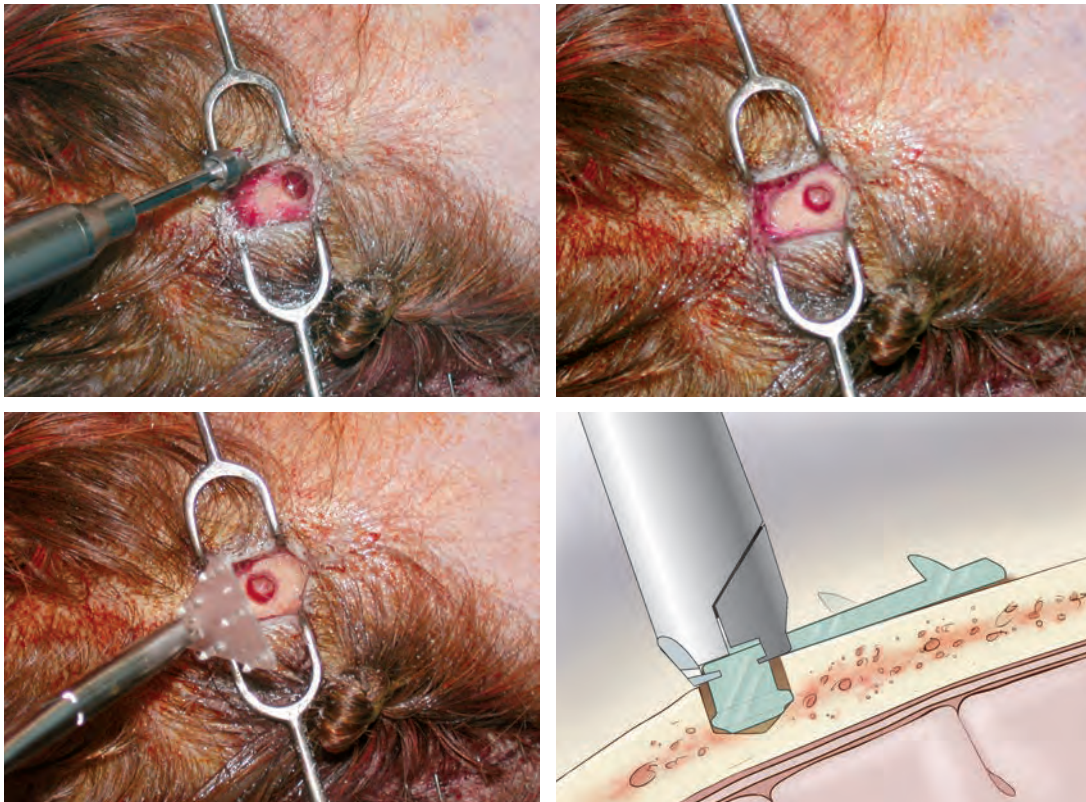
The central access incision is closed first. I routinely fix the brow in the temporal area with one or two sutures of 2-0 PDS, anchoring the temporoparietal fascia down to the deep temporal fascia. If additional paramedian fixation is needed (between the temporal crest and the central access incision), I place temporal fixation sutures, but I do not tie them until the paramedian fixation is performed. Currently my choices for paramedian fixation include external screw fixation or an absorbable Endotine device. An Endotine device affords permanent fixation and multidirectional vectors. It does require a separate incision and a special drill bit. Whether it is an Endotine device or an external screw, a single hook is placed on the scalp behind the planned fixation site. The scalp is then lifted, pulled upward, and rotated medially.



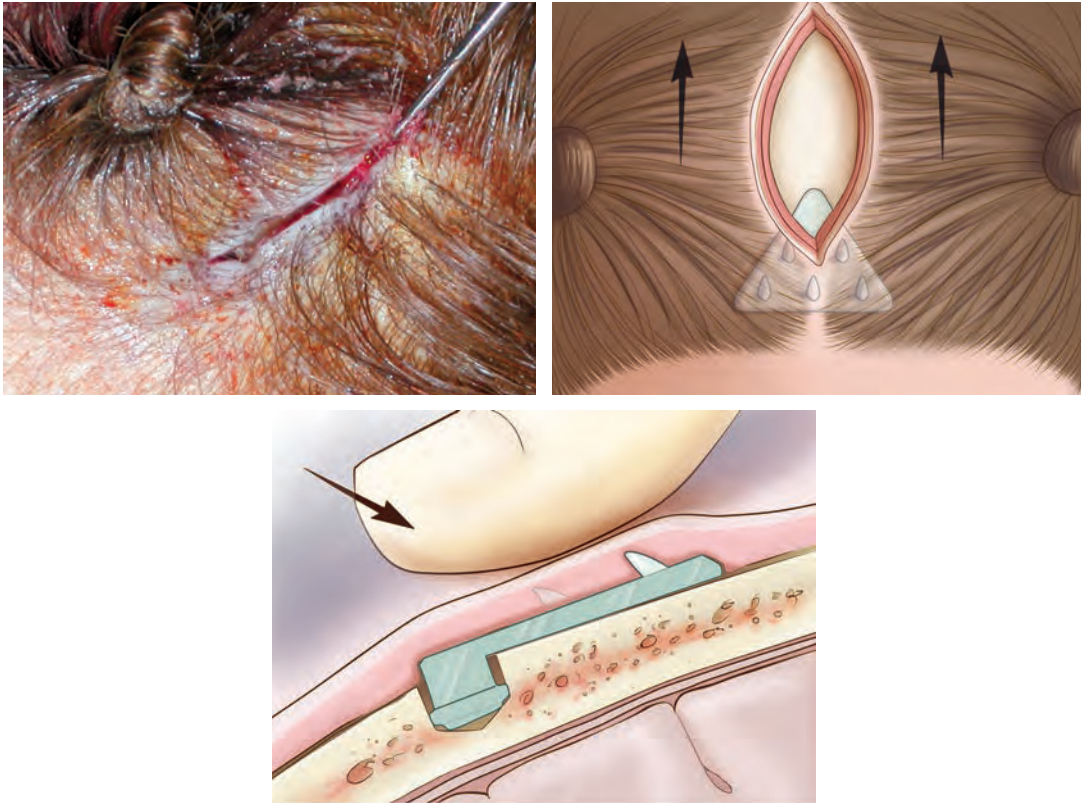
A hand drill and screw holder are shown. The drill has a 5 mm stop. For external screw fixation, with the assistant maintaining the brow in the desired position through the hook, a stab incision is made in the scalp, and a drill hole is made with the hand drill. A self-tapping screw, 16 mm in length with a 5 mm thread, is placed in the drill hole and secured. A staple is placed behind this screw, maintaining the brow position.



A separate 2 cm incision is made according to the preoperative vectors for insertion of the Endotine device (*right*). The brow is then pulled close to its desired position. The Endotine device has five prongs or tines to engage the periosteum and hold it in the new position.



Next, with a power drill, a drill hole is made into which the device is placed with the tines pointing backward. The Endotine device is inset into the drill hole. The device may be rotated according to the fixation desired.



The scalp is pulled upward and rotated medially. Then the scalp is pushed down onto the device to engage the tines.

Once this paramedian fixation has been completed, the temporal fixation sutures are tied, minimal scalp excision in the temporal area is performed if needed, and the temporal incisions are closed.

Fixation Choices

Currently there is no consensus among surgeons regarding the preferred method of brow fixation. In fact, there is even some debate about whether any fixation is needed, because the muscle balance between the glabella and the frontalis is altered, and therefore brow position will likely be maintained.

Who needs fixation, and which methods work? Temporal fixation—anchoring of temporoparietal fascia down to the deep temporal fascia—is universally applied to every patient in my practice. Paramedian fixation between the temporal crest and midline with an upward and medial rotation is selectively applied on the basis of the patient's aging changes, brow position, brow shape, sex, and desired results.

I am more likely to use permanent paramedian fixation in a man with heavy forehead skin and significant brow ptosis than in a woman with moderate or minimal brow ptosis and normal forehead skin.

Endoscopic Brow Fixation Methods

Temporary

Emory tapes
Bolster sutures
Fibrin glue
External screws

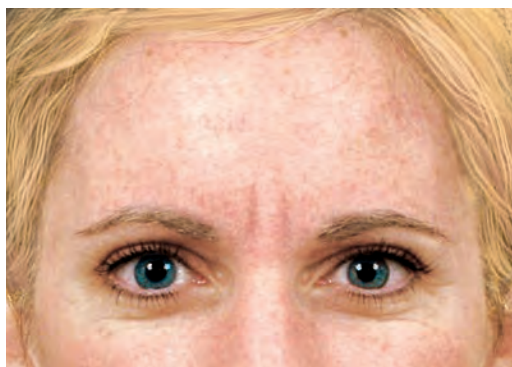
Permanent

Vertex sutures
Internal screws
Permanent
Absorbable
Mitek anchors
Permanent
Absorbable
Cortical tunnels
Endotine device

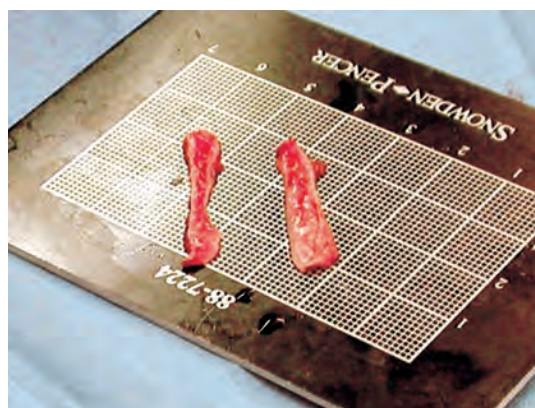
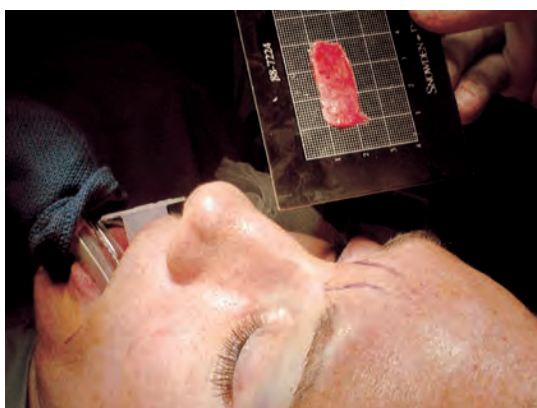
A variety of methods for brow fixation are available. I have had experience with all of the fixation methods listed here, except for the Mitek anchors. The fixation methods can be further divided into temporary and permanent fixation. How long does it take for brow position to become fixed? How long does the periosteum take to adhere? Opinions vary: from 8 days to as long as 6 weeks. The only study available in a rabbit model showed that it took the periosteum 6 weeks to stick back down. The general consensus is that to be effective, the fixation should last at least a couple of weeks. Based on this information, I consider the external screws, which we normally take out at 1 week to 10 days, to be temporary and the Endotine device to be permanent.

Ancillary Procedures

Frequently ancillary procedures are performed in combination with an endoscopic brow lift to further improve the result. These include peels, laser resurfacing, and injection of tissue fillers. In patients with deep vertical frown lines at rest in whom muscle modification alone will not eradicate the lines, I thread a piece of autologous tissue, temporal fascia, or orbicularis muscle just deep to the dermis. I have found this method to be rapid, effective, and relatively free of problems or complications. The volume of the transferred tissue is preserved over time.



This woman in her thirties had brow ptosis and very deep, established glabellar frown lines. She was a candidate for endoscopic brow lift and autologous temporal fascia grafts to the grade 5 rhytids in her glabellar area.



During the endoscopic brow lift for this patient, a 1 by 3 cm piece of deep temporal fascia was harvested. The fascia was split in half longitudinally into equal 0.5 by 3 cm strips.



With a No. 57 Beaver blade, a subdermal tunnel was made under the left glabellar rhytid. The blade not only creates the tunnel but also releases the deep dermal attachments. The blade exits the lower end of the rhytid, making a small incision in the skin.



A fine grasper is passed through the tunnel from above and out through the lower incision. The grasper firmly holds the fascial strip, which is pulled into the tunnel. The procedure is repeated on the right side. With both strips placed subdermally, the protruding fascia is trimmed flush with the skin and the stab incisions are closed with 6-0 suture material. My preference is 6-0 rapid-absorbing catgut.



Comparing the preoperative view with the patient's postoperative results 1 year after treatment demonstrates improved brow position, improved upper eyelids without an upper eyelid blepharoplasty, and effective elimination of the glabellar frown lines. The split-face image confirms the improvement.

Postoperative Care

Because most endoscopic brow procedures in my practice are performed in conjunction with other aesthetic facial procedures, these patients usually spend the night in our overnight facility. They are kept comfortable, with the head elevated and an ice pack over the eyes. Every effort is made to alleviate nausea and to monitor blood pressure and keep it under control.

Antihypertensive medication and sedatives are administered routinely in men and as needed in women. The drain is usually removed the next morning before the patient goes home. The patient is advised to keep his or her head elevated, to avoid strenuous activity for up to 3 weeks, and is scheduled to return for follow-up within 3 to 6 days.

Outcomes

Patient acceptance of this procedure has been high. There have been few problems such as alopecia, dysesthesias, and temporary nerve paralysis. In a personal series of approximately 700 patients, there was no permanent facial nerve paralysis. Temporary facial nerve paralysis was seen in less than 1% of patients, and alopecia at the screw fixation site was seen in 4%.



This woman's preoperative view demonstrates brow asymmetry, brow ptosis, glabellar and transverse forehead rhytids (grade 4), and aging of the upper and lower eyelids with crow's-feet. The patient underwent an endoscopic brow lift with external screw fixation and upper and lower lid blepharoplasty. The early postoperative view and a split-face image demonstrate improvement of brow asymmetry, elevation of the brow position, and improvement of rhytids.



A close-up of the left side of her scalp shows a 1 by 1.5 cm area of alopecia at the site of the external screw fixation. This area was excised to eliminate the bald spot.

Most patients experienced mild temporary dysesthesias. I have personally reoperated on only one of my earliest endoscopic brow patients for recurrent brow ptosis.

Results



This woman in her late forties had brow ptosis, grade 5 glabellar lines, and full facial aging; she underwent an endoscopic brow lift with no paracentral fixation. She also had upper and lower eyelid blepharoplasty and face and neck lift. Her postoperative result at 18 months demonstrates an elevated brow position with significant improvement in the glabellar lines. This is most readily apparent in the split-face image, demonstrating elevation of the medial and lateral brow.



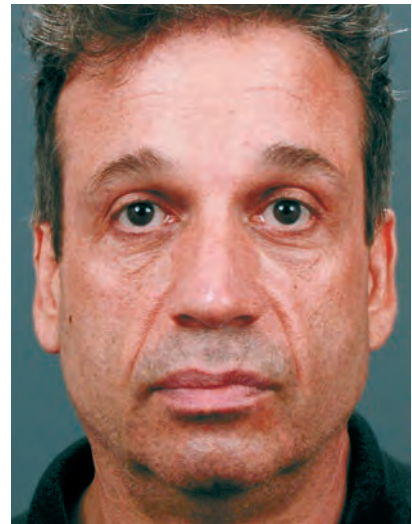
This woman in her early fifties had heavy, ptotic brows with grade 4 glabellar rhytids. She underwent an endoscopic brow lift with external screw fixation as well as a lower lid blepharoplasty and transpalpebral midface lift. Her postoperative result demonstrates improvement of brow position, amelioration of rhytids, and improvement of the lower lid-cheek junction and midface area.



Preoperative



4 months postoperatively



7 years postoperatively



Preoperative



7 years postoperatively

This man in his forties had a heavy ptotic brow and deep grade 5 transverse forehead lines. He underwent an endoscopic brow lift with Emory taping, upper lid blepharoplasty, and transconjunctival removal of fat from the lower eyelids. Postoperative results at 4 months and at 7 years demonstrate maintenance of brow elevation, including the exaggerated medial brow elevation that was typical of our early endoscopic brow lifts with the central Emory T to V scalp excision. I abandoned the central scalp excision because it led to these exaggerated medial brow elevations.



Preoperative



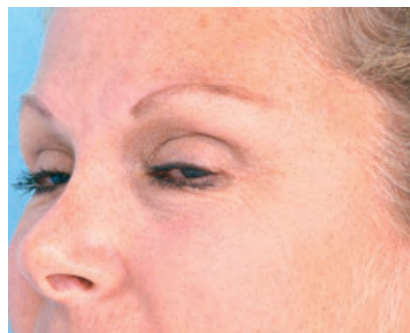
7 years postoperatively



8 years postoperatively



Preoperative



8 years postoperatively



Preoperative

8 years
postoperatively

This woman in her late forties had heavy brows and brow ptosis. She had an endoscopic brow lift with Emory taping. She is shown at 7 years and at 8 years postoperatively, demonstrating maintenance of the elevated brow position.



This 40-year-old woman had brow ptosis, grade 4 glabellar lines, and aging of the midface and neck. Despite the high forehead, she elected to have an endoscopic brow lift, a lower lid blepharoplasty with transpalpebral midface lift, and an endoscopic neck lift. The postoperative view demonstrates repositioning of the brow, amelioration of the glabellar lines, improvement of the upper eyelids (without an upper eyelid blepharoplasty), and improvement of the lower lid and midface area.

Concluding Thoughts

Although the use of neurotoxins and even less-invasive brow lift techniques (see Chapter 23) have gained in popularity and the overall numbers of coronal and endoscopic brow lifts are in decline, there is still a role for the endoscopic approach. Based on my 16-plus years of experience, during which I have performed several hundred endoscopic brow lifts, I conclude that the procedure is effective and safe, with lasting results. With technical modifications, the exaggerated medial brow elevation has been eliminated. The need for fixation, if any, and the type of fixation remain a matter of debate, and we each have our own thoughts based on experience.

Clinical Caveats

An endoscopic brow lift is a technology-dependent procedure. The surgeon and operating room personnel should be familiar with the endoscopic equipment and be able to troubleshoot problems involving the camera, light source, and monitor. The success of this procedure depends on adequate release of the periorbital septa and adhesions.

Vertical spreading should be avoided during the temporal dissection to prevent stretch injury of the frontal branch of the facial nerve.

Keeping the dissector firmly down on the deep temporal fascia and temporalis muscle prevents any injury to the frontal branch of the facial nerve.

Release of the periosteum is essential for brow elevation.

While resecting the glabellar musculature, the surgeon should avoid removal of subcutaneous fat, which could result in a depression.

Every attempt should be made to preserve the sentinel vein. Sacrifice of the vein leads to engorgement of the superficial veins, which will become readily visible in thin-skinned individuals.

If medial brow elevation is not desired, subperiosteal dissection should be avoided in the medial brow area.

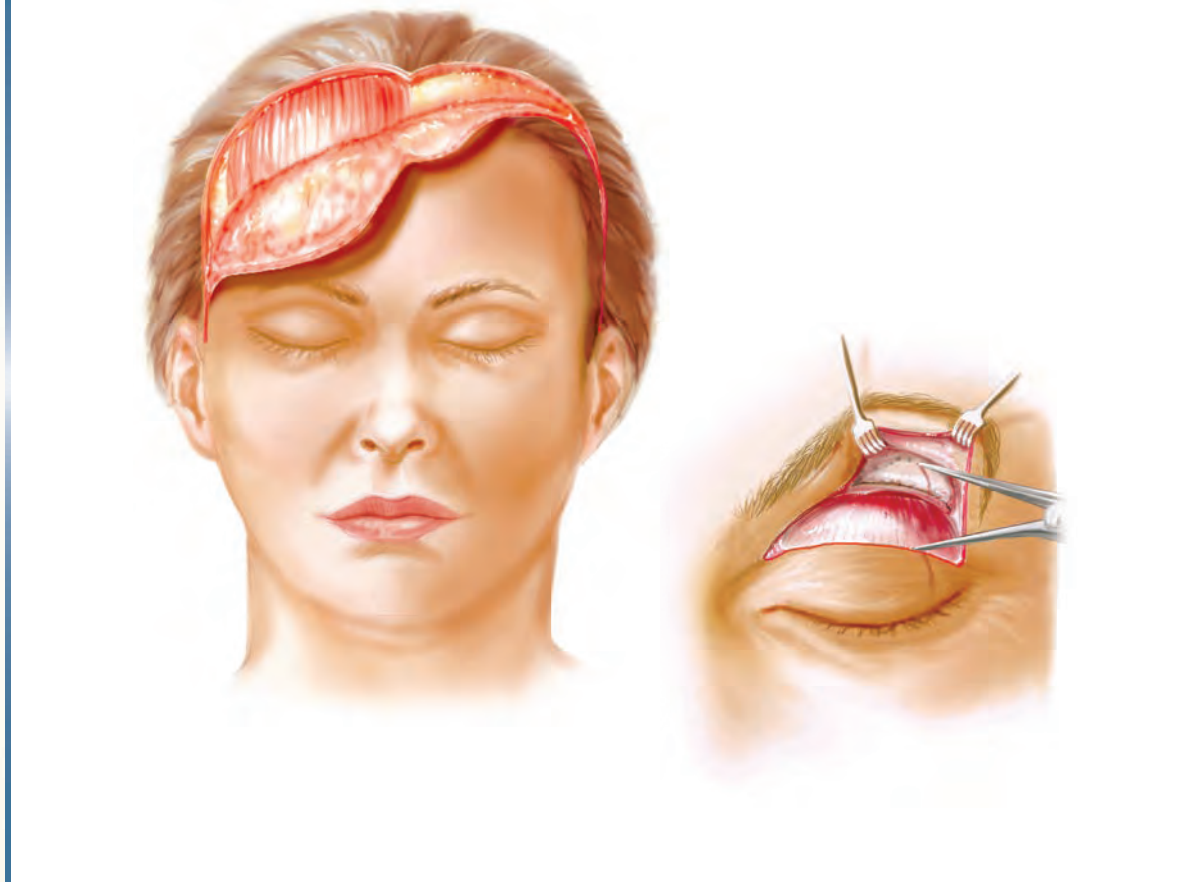
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CHAPTER 25



Other Approaches to Brow Lift

FOAD NAHAI

A variety of options are available for rejuvenation/repositioning of the brow and forehead, ranging from the open coronal forehead lift to neurotoxins and including the following:

- Coronal brow lift
- Endoscopic forehead lift
- Lateral-temporal brow lift
- Transpalpebral excision of corrugator and procerus muscles
- Lateral-temporal brow lift combined with transpalpebral excision of corrugator and procerus muscles
- Direct brow lift
- Transpalpebral browpexy
- Injection of neurotoxins

Successful rejuvenation of the brow and forehead includes repositioning of the hair-bearing brow, improvement of vertical glabellar and horizontal forehead lines, reversal of the brow descent, and conversion of a tired or angry expression into a rested and contented look.

As surgeons we look for safe and efficacious procedures rendering lasting results, whereas our patients look for an effective procedure with minimal scarring and a short recovery time.

The coronal lift remains the benchmark against which the results, morbidity, and longevity of the other procedures can be compared. Not everyone undergoing facial rejuvenation is a candidate for or will consent to a coronal brow lift. Therefore alternatives must be sought to provide the desired result without the coronal incision.

Not all the alternatives will match the results of the coronal brow lift; however, they are all far less invasive. Each alternative has its own benefits and limitations. Careful patient evaluation facilitates matching the patient to the best option (see Chapters 23 and 24).

SPECIFIC CLINICAL APPLICATIONS

Coronal Brow Lift

Despite the popularity of the endoscopic forehead lift (see Chapter 22), the coronal brow lift is an excellent option. Many surgeons consider it the method of choice for all patients; some surgeons limit the coronal lift to patients who are not candidates for an endoscopic approach.

This approach affords excellent exposure, facilitating release of periorbital septa and adhesions, muscle excision, and brow mobilization. Through scalp excision, the desired preplanned brow elevation and brow shaping can be achieved.

Indications and Contraindications

The coronal brow lift may be applied universally to anyone who is a candidate for forehead rejuvenation. It is my opinion that the best candidates are those who are not suitable for the endoscopic approach; these include patients with high foreheads, significant frontal bone convexity, a high or receding hairline, extremely thick skin or deep lines, and significant brow ptosis with excess skin over the lateral brow and glabella. Patients who would have similar results with less-invasive procedures would not be candidates for the coronal approach.

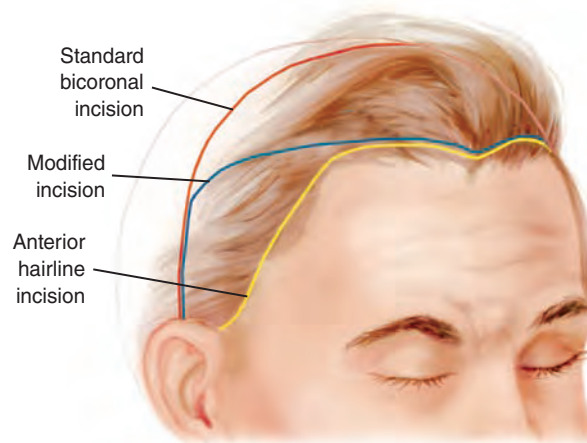
Preoperative Planning

Markings

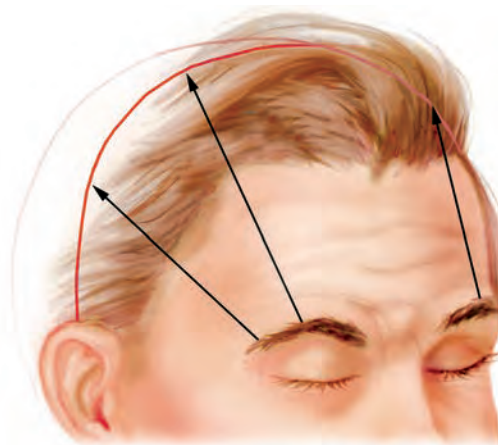
As with other brow-lift procedures, the coronal brow lift is rarely performed in isolation. It is typically combined with other periorbital procedures or full facial rejuvenation. This is a full, open procedure; therefore preoperative markings are not as critical as the markings for the endoscopic approach. However, it is useful to mark the sentinel vein, the temporal crest, and the course of the supraorbital and supra-trochlear nerves.

Incisions

The incision will vary, depending on the patient's hairline and the desired results. There are three options for planning the incision: (1) a standard coronal incision, (2) a modified coronal incision, and (3) an anterior hairline incision.



The standard coronal incision is placed 6 to 8 cm behind the frontal hairline. It is easily concealed within the hair in patients with normal hair thickness. The modified coronal incision is curved anteriorly in the frontal area. This is best for individuals who have a normal temporal hairline but a very high frontal hairline. By modifying the incision and bringing it to the hairline in the frontal area, the height of the forehead may be reduced. The frontal portion of the incision may be visible. The anterior hairline incision is best reserved for an individual with a high forehead and a receding hairline in the temporal and frontal areas. In such individuals this incision allows reduction in the forehead height and temporal hairline. This entire scar may be visible, and most surgeons and patients prefer to avoid this incision. Any or all of these incisions, particularly the anterior hairline incision, may be made in a zigzag fashion to break up the resultant scar.

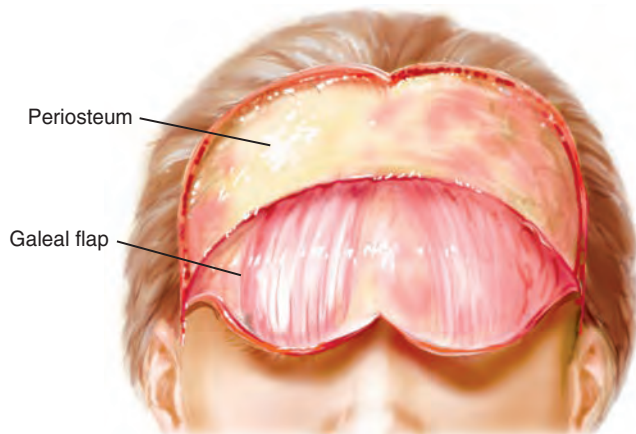


Vectors of fixation are also marked on the forehead; these will include a line projected onto the head from the most convex portion of the hair-bearing brow. These vectors are a guide to scalp excision and brow positioning.

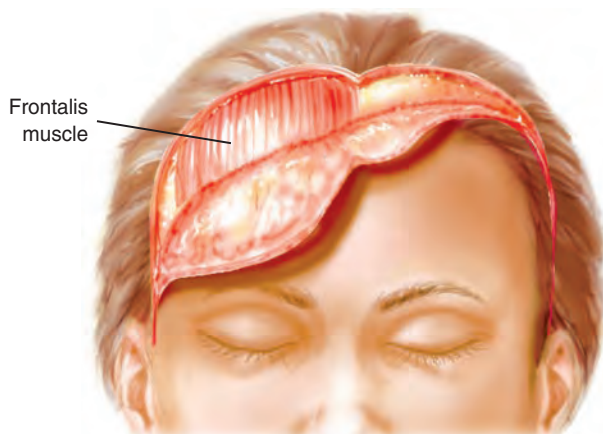
Operative Technique

Although the procedure can be performed with either a local or a general anesthetic, our preference is general anesthesia, because other procedures are usually performed in combination. With the patient lying supine on the operating table, with the head slightly elevated to decrease venous engorgement, the hair is washed with soap and braided, and the proposed area of scalp excision may be shaved. The entire area is infiltrated with 0.5% lidocaine and epinephrine 1:200,000. The field is then prepared with povidone-iodine (Betadine) and draped.

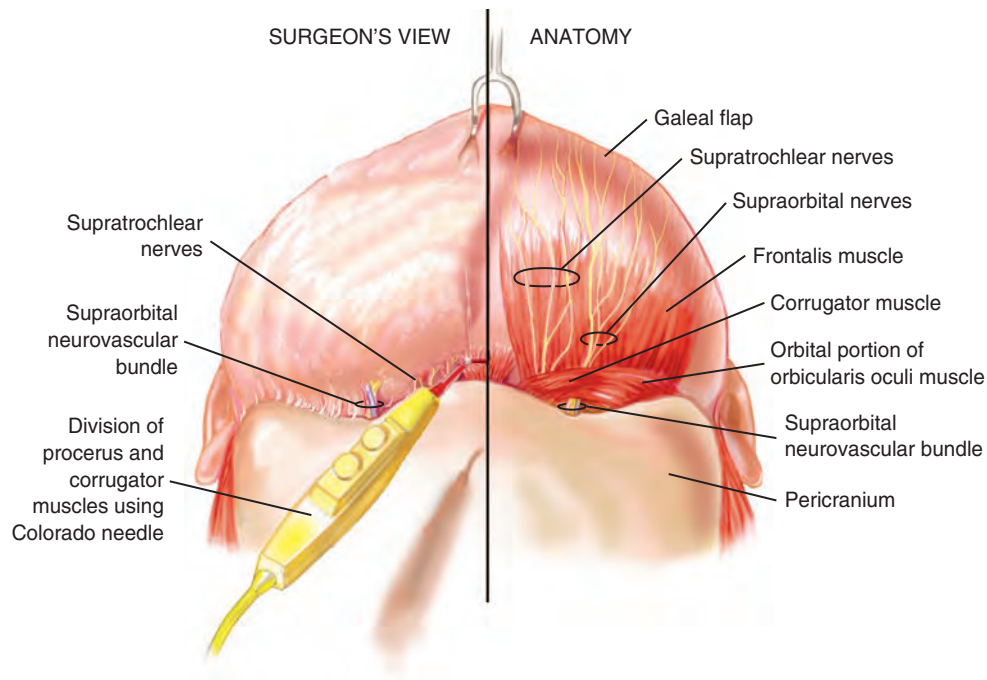
After allowing sufficient time (8 to 10 minutes) for the epinephrine to take effect, the surgeon makes the incision through the scalp, down to the deep temporal fascia in the temporal area, and more centrally down to the periosteum. The knife blade is beveled so that it runs parallel with the hair roots to preserve as many hair follicles as possible. This is more critical with the modified and anterior hairline incisions. The anterior hairline incision is not made anterior to the hairline, as its name indicates, but must be made 1 or 2 mm behind the hairline so that some hair follicles are left within the cut edges.



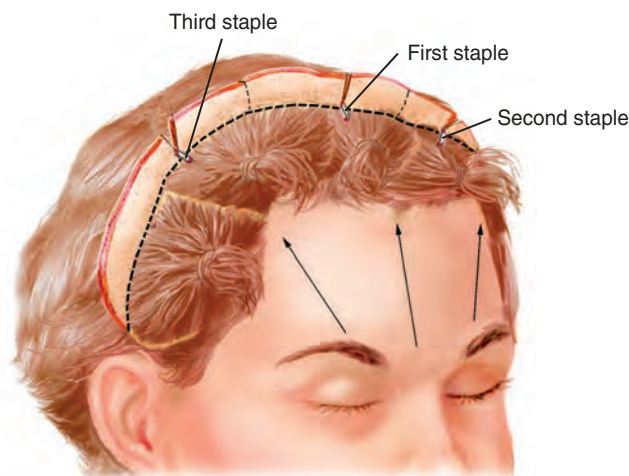
Once the incision is made, the elevation of the forehead flap proceeds very rapidly in a bloodless field between the temporoparietal fascia and deep temporal fascia laterally and the subperiosteal plane centrally. The flap is elevated to the orbital rims. This elevation will release the periorbital septa and allow easy access to the glabellar musculature.



The anterior hairline approach will allow dissection in the subcutaneous plane. This subcutaneous plane is directly over the frontalis muscle. This allows significant reduction of transverse forehead lines through the release of the fibrous septa, which run between the muscle and the overlying skin. An added advantage of this approach is better preservation of the scalp's sensory innervation.



Once the flap is elevated, the corrugator, procerus, and depressor supercilii muscles are easily identified. The muscles are divided, avulsed, or cauterized, according to the surgeon's preference. To weaken the frontalis muscle, the lowest portions of the muscle are incised. The surgeon notes the course of the supratrochlear and supraorbital nerves and divides the frontalis muscle, carefully avoiding the nerves. A variety of techniques have been used to weaken the frontalis in this area, including horizontal division, crisscross division, and even a 1 cm strip excision. The scalp flap is then retracted superiorly and the degree of elevation is adjusted.



Next the scalp is incised at key sites, and fixation sutures or staples are placed. Usually the scalp is fixed at three sites: one centrally and one on each side, according to the preoperative vectors.



The intervening scalp is excised and closed in two layers with sutures and staples.

Postoperative Care

The patient's head is elevated, ice packs are placed over the eyes, and measures are taken to prevent an elevation in blood pressure and nausea and vomiting. Most patients undergoing a brow lift with additional procedures are kept overnight. Staples and sutures are removed 5 to 7 days postoperatively, and physical activities are restricted for 2 to 3 weeks.

Outcomes

This procedure has proved effective, with acceptable morbidity. The results have stood the test of time. Complications include alopecia, dysesthesias, and sensory loss in the scalp.

Direct Brow Lift

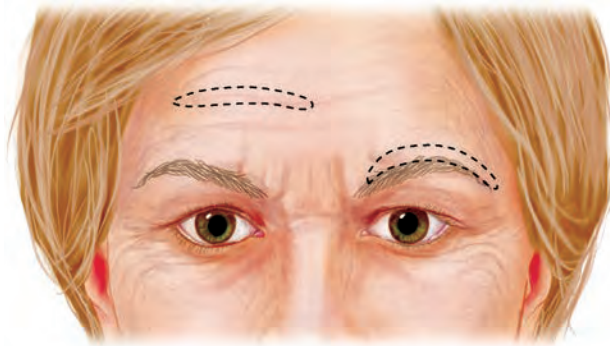
A direct brow lift is an effective method for elevating the brow, particularly the lateral brow. However, the direct lift is rarely used, because it may leave a visible scar. This approach offers excellent brow elevation through direct excision of the redundant skin. It will also allow access to the muscles. It is a quick, simple procedure that can be performed with a local anesthetic and carries minimal risk to the sensory nerves.

Indications and Contraindications

The best candidates are older individuals with heavy lateral brows and deep transverse forehead creases where the scar can be hidden. This is a relatively quick procedure and may be an acceptable alternative for patients who are not candidates for other options that require lengthier operations. The disadvantage is the scar.

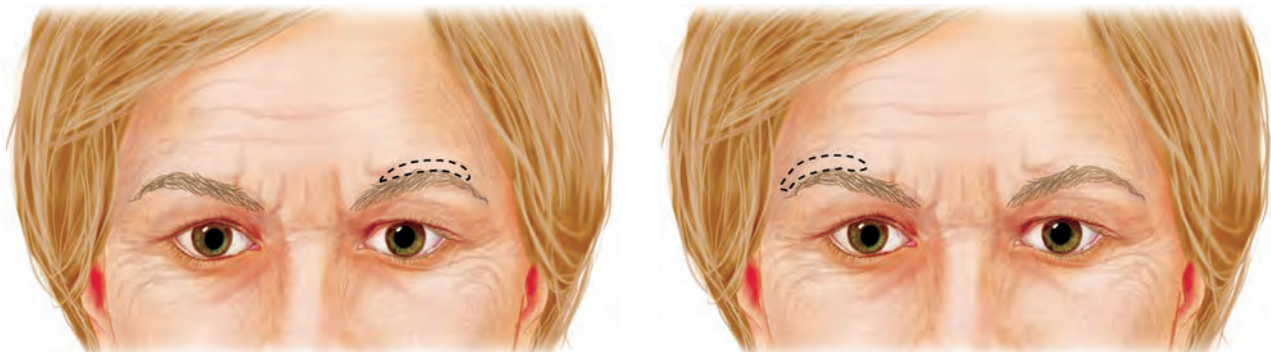
Preoperative Planning

Markings and Incisions



The incision choices include an incision directly above the hair-bearing brow, which follows the shape of the brow, or an incision higher up, within a preexisting crease.

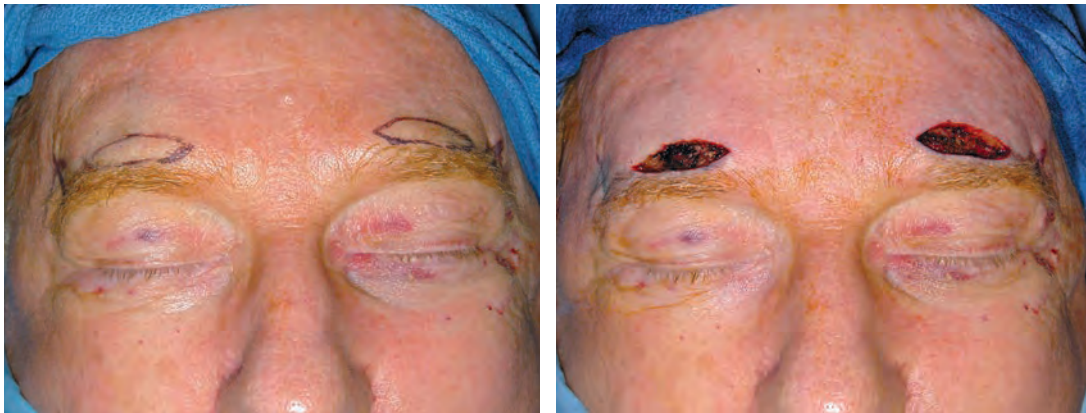
For the incision along the hair-bearing brow, a mark is made that follows the upper border of the hair-bearing brow. The skin above is then pinched to bring the brow into the proposed position, and the upper border of the skin excision is marked.



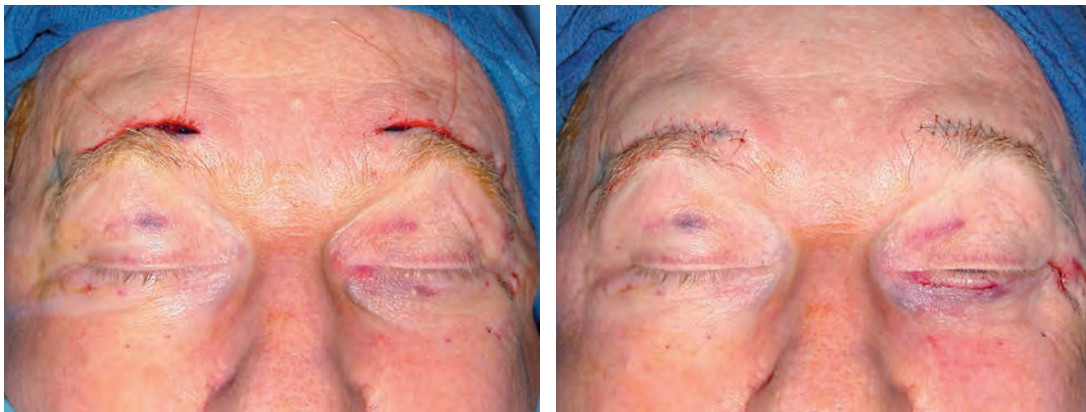
The design is varied to allow direct upward elevation of the brow (*left*) or lateral elevation (*right*). The incision within the crease is marked with the patient actively elevating the brow. The amount of forehead skin to be excised is then assessed and marked by pinching the forehead skin.

Operative Technique

The procedure is performed with a local anesthetic unless it is combined with other procedures.



Following the markings for a central brow elevation, the surgeon excises the predetermined skin. This is limited to a skin excision to avoid injury to the frontal branch of the facial nerve and the sensory nerves. (It is possible through the transverse incision to access the glabellar musculature; however, this is not commonly performed. This operation is usually limited to skin excision.)



The wound is then closed in two layers with 5-0 Monocryl sutures to the dermis, and the skin is closed with intracuticular Monocryl or simple 6-0 Prolene sutures.

Postoperative Care

Postoperative swelling is prolonged and noticeable. To minimize this, it is important to keep the patient's head elevated, with ice packs on the eyelids. We also consider the use of diuretics and a short course of methylprednisolone (Medrol Dose Pack).

Outcomes

The direct brow lift is an effective way of elevating the lateral brow. In carefully selected patients, the scar may be imperceptible.

Results



Courtesy Clinton D. McCord, Jr., MD

This elderly man underwent a direct brow lift with upper and lower lid blepharoplasties. His postoperative result shows lateral brow elevation with an imperceptible scar.

Transpalpebral Browpexy

The transpalpebral approach offers minimal lateral brow elevation through an upper lid blepharoplasty and is best as an adjunct to upper lid blepharoplasty rather than a primary brow-lift procedure.

Indications and Contraindications

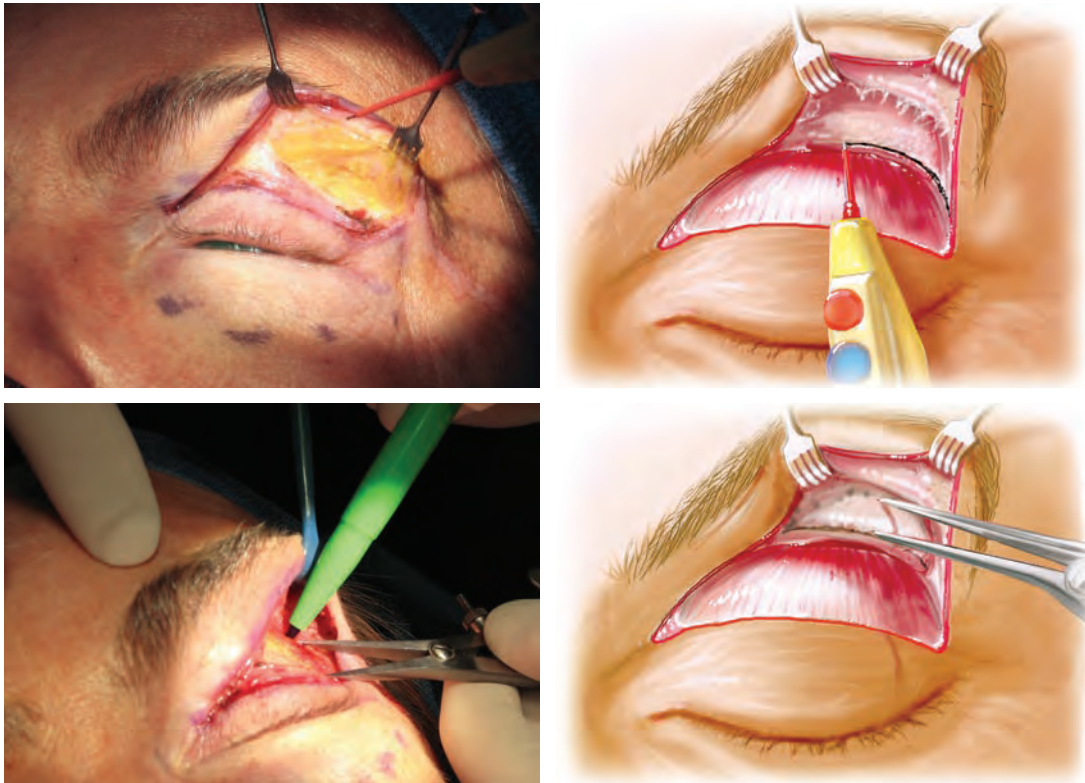
The limited elevation seen with this approach limits its application to patients with mild lateral brow ptosis and with no medial brow ptosis or excess skin at the nasal radix.

Preoperative Planning

Markings

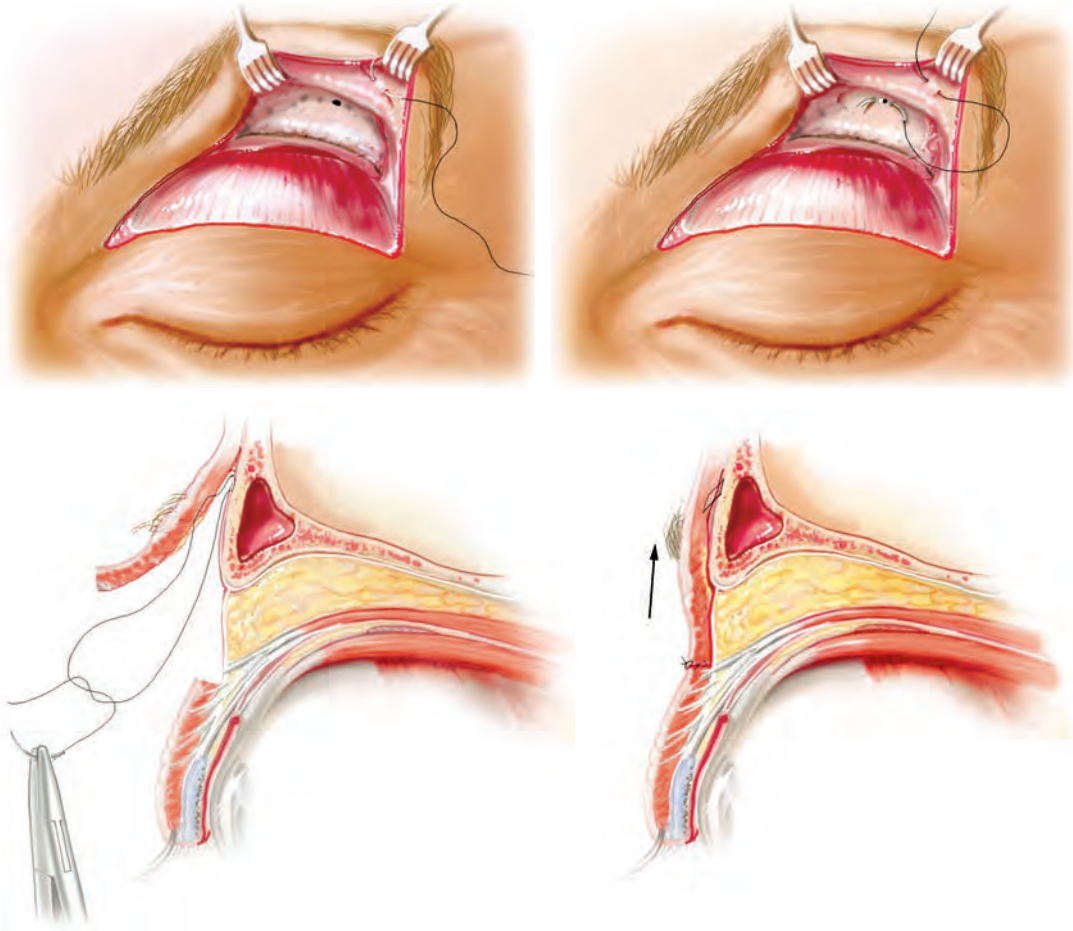
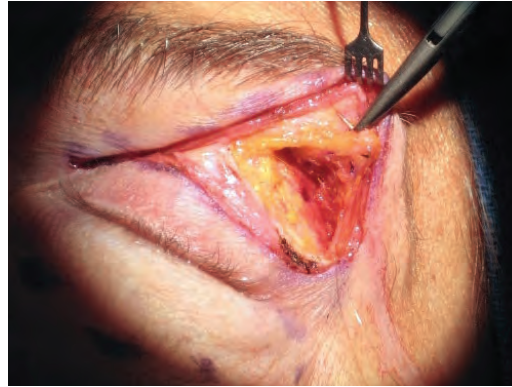
The brow is held in the projected position, and the upper eyelid is marked for an upper lid blepharoplasty.

Operative Technique



The incisions are made and the skin-muscle excision for the blepharoplasty is completed. The orbicularis muscle is retracted upward with two Blair retractors and with the cutting current and a Colorado tip. The dissection is continued deep to the orbicularis to the lateral orbital rim, staying above the periosteum. The dissection continues upward laterally for 2 to 3 cm. Care should be taken to preserve the sentinel vein, which is easily identified. This dissection releases some of the adhesions and septa of the lateral orbital area. The plane of dissection is deep to the course of the frontal branches of the facial nerve.

The calipers are then used to mark a point 5 to 10 mm above the orbital rim.



Then a 5-0 absorbable PDS or permanent clear nylon suture is used to fix the hair-bearing brow to the periosteum. The suture is first placed through the orbicularis, the retro-orbicularis oculi fat (ROOF), and the deep layers of the dermis, right in the middle of the hair-bearing brow. Next, the needle is passed through the previously marked periosteum. The suture is then tied, moving the brow upward. The eyelid skin is closed. Dimpling may result if the suture through the orbicularis and ROOF extends too far into the skin. Skin redundancy may result above the point of fixation if the lateral brow is inadequately undermined.

Postoperative Care

Postoperative care is the same as for upper lid blepharoplasty (see Chapter 28).

Outcomes

Only minimal elevation is possible with this technique. The results have been effective and maintained over time.

Results



This patient was seen in consultation for upper and lower lid blepharoplasty. He requested improvement of the heaviness of his upper eyelids and the excess skin and bags of his lower eyelids. In addition to excess skin in the upper lids and aging of the lower lids, he had lateral brow ptosis. He underwent upper and lower lid blepharoplasty with an internal transpalpebral browpexy. The split-view image shows his result at 2 years. Note the elevation of the brow through the internal browpexy suture.

Concluding Thoughts

The popularity and effectiveness of injectable neurotoxins has led to a decline in the number of brow lifts performed. Despite that, there is still a role for these alternative procedures. Patient selection and matching the procedure to the patient is the key. Although coronal brow lifts and direct brow lifts have limited application in my practice, the transpalpebral browpexy has proved very useful.

Clinical Caveats

Coronal Brow Lift

The surgeon can avoid creating a surprised look by limiting traction and scalp excision.

The incision line is beveled to preserve hair follicles.

The anterior hairline incision should be placed 1 to 2 mm behind the hairline to preserve hair roots rather than in front of the hairline.

Supraorbital and supratrochlear nerve branches should be preserved while dividing the frontalis muscle.

Direct Brow Lift

Incisions are best placed within preexisting creases.

The excision should be limited to skin only to avoid nerve injury.

Transpalpebral Browpexy

Dimpling can be avoided by limiting the suture placement to the deep dermis.

An overhang can be avoided by adequately undermining the lateral brow.

Annotated Bibliography

Friedland JA, Jacobson WM, Terkonda S. Safety and efficacy of combined upper blepharoplasties and open coronal browlift: a consecutive series of 600 patients. *Aesthetic Plast Surg* 20:453-462, 1996.

Many surgeons and several reports question the safety of blepharoplasty and open coronal foreheadplasty being performed concomitantly. The technique used in this series is presented in detail. The consistently excellent results obtained satisfy the aesthetic goals of both patients and surgeons—and suggest a renewed interest in the technique based on its simplicity and easily reproducible results.

Kaye BL. The forehead lift: a useful adjunct to face lift and blepharoplasty. *Plast Reconstr Surg* 60:161-171, 1977.

The forehead lift, with interruption of the continuity of the frontalis muscle, has been an effective method for improving the appearance of the upper third of the face. It can be done independently, or combined with facial rhytidectomy, blepharoplasty, and/or other ancillary procedures. In some cases of apparent upper lid redundancy, it can eliminate the need for upper lid blepharoplasty. The results are pleasing and seem to be lasting, while the complications have been few and mild. The authors describe the operation and discuss its indications, contraindications, advantages, and disadvantages.

Knize DM. Limited-incision forehead lift for eyebrow elevation to enhance upper blepharoplasty. *Plast Reconstr Surg* 97:1334-1342, 1996.

A forehead lift technique with temporal scalp incisions only 4.5 to 5.0 cm long can produce a result comparable with that of the coronal incision approach when combined with transpalpebral resection of the corrugator supercilii muscles and transection of the procerus muscle. This eyebrow elevation technique minimizes the risk of permanently injuring the supraorbital nerve branches that innervate the frontoparietal scalp and can effectively treat cases of advanced eyebrow ptosis. This forehead lift technique describes a method for determining the appropriate area of eyelid skin for excision when a forehead lift and upper blepharoplasty are performed concomitantly.

Knize DM. Transpalpebral approach to the corrugator supercilii and procerus muscles. *Plast Reconstr Surg* 95:52-60, 1995.

The author describes the most effective method for treating glabellar area skin contour irregularities produced by hyperactive corrugator supercilii and/or procerus muscles. A transpalpebral technique, performed on 40 patients who were followed for 6 to 24 months, is described, and the cadaver and nerve block studies on which this technique is based are discussed. The postoperative cosmetic improvement of the glabellar area is comparable in appearance to that achieved from a coronal incision approach.

Paul M. The evolution of the brow lift in aesthetic plastic surgery. *Plast Reconstr Surg* 108:1409-1424, 2001.

For nearly 100 years, aesthetic improvement of the aging face has included surgical elevation of the brow. Within the past decade, the minimal incision approach to brow lifting afforded with the endoscope radically changed surgical options in forehead rejuvenation. Further advances have added to these options and have provided a palette of alternatives in aesthetic correction of the upper third of the aging face.

Suggested Readings

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Connell BF, Lambros VS, Neurohr GH. The forehead lift: techniques to avoid complications and produce optimal results. *Aesthetic Plast Surg* 13:217-237, 1989.

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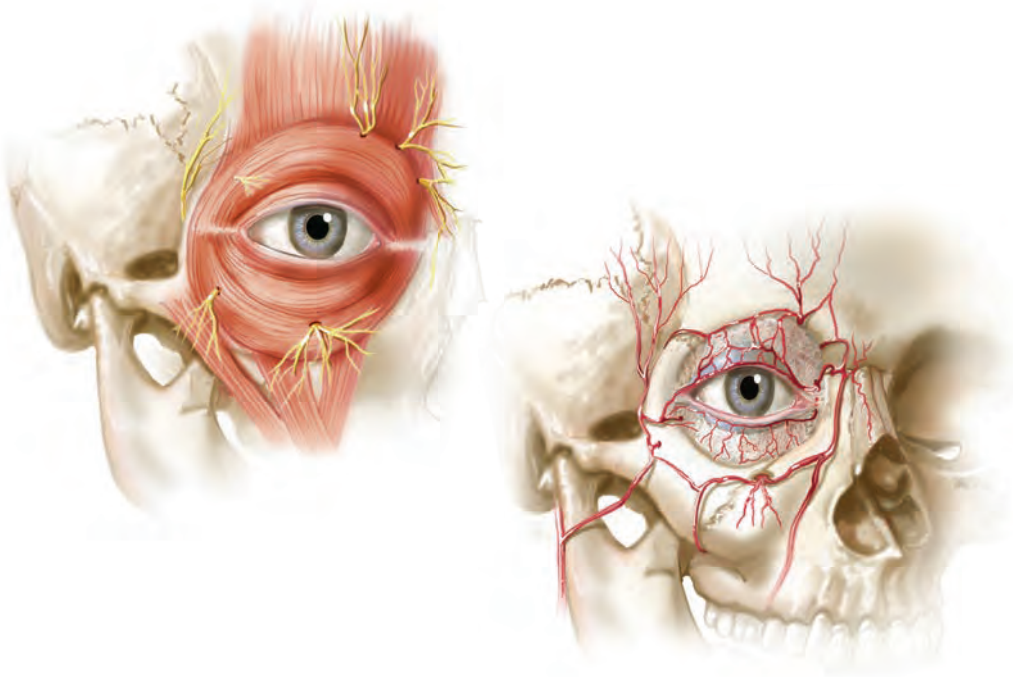
PART VI

EYELID SURGERY



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CHAPTER 26



Applied Anatomy of the Eyelids and Orbit

MARK A. CODNER, MICHELLE B. LOCKE

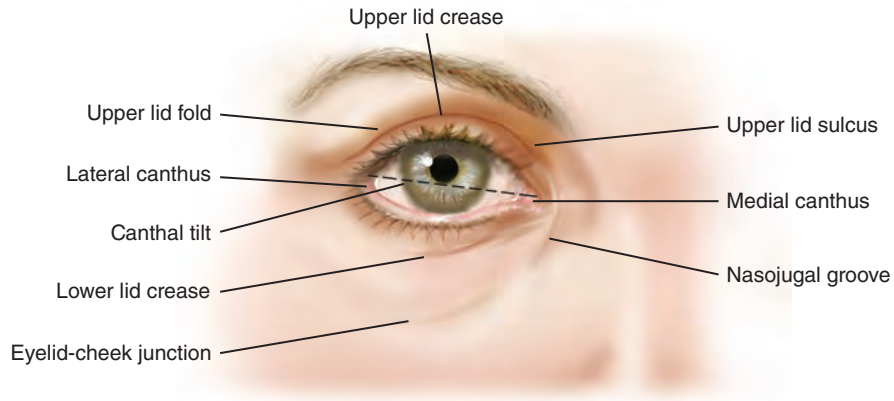
The fundamental key to success in surgery of the eyelids and periorbital region is precise knowledge of the pertinent anatomy. The eyelids and periorbital area represent an anatomically complex and intricate region that contains a number of critical structures in close proximity to areas requiring surgical manipulation. The anatomy of the eyelids and orbit also influences the form, function, and appearance of the eyelids. Knowledge of the anatomy should include both the areas planned for surgical correction and the areas that can be secondarily affected by surgical manipulation or by complications.

Many of the new techniques for eyelid surgery have an anatomic basis that requires solid grounding in anatomy to ensure that these procedures are performed safely and to maximize the aesthetic and functional results. Furthermore, knowledge of the anatomy is required to avoid and treat complications that may occur after blepharoplasty. Numerous studies have contributed to defining the anatomy of the eyelids and orbit. Jelks and Zide described the anatomic structures encountered during blepharoplasty; Jelks and Jelks described vector analysis of the globe and infraorbital region to identify patients at risk for lid malposition after blepharoplasty. Additional clinical anatomic studies by Rees and LaTrenta discussed the morphologically prone eye in which the risk of dry-eye syndrome is increased after blepharoplasty. Hirmand et al used Hertel exophthalmometry preoperatively to identify patients with prominent eyes, who are at high risk of lid retraction and scleral show following blepharoplasty.

More recent anatomic studies have focused on the relationship between the lower eyelids and the midface, including the orbital septum described by Pessa, the orbicular ligament described by Kikkawa et al, and the anatomy of the malar mounds described by Mendelson and colleagues. Rohrich et al and Mendelson et al described the anatomic subcutaneous units of the periorbital region as well as the face, and the aging changes associated with these structures.

Structures of the Eyelids and Orbit

The eyelid is a bilamellar structure consisting of an anterior lamella and a posterior lamella. The anterior lamella consists of skin and the orbicularis oculi muscle; the posterior lamella includes the tarsoligamentous sling, which comprises the tarsal plate, the medial and lateral canthal tendons, the capsulopalpebral fascia, and conjunctiva. The septum is the dividing layer, which originates at the arcus marginalis along the orbital rim and inserts into the dermis, creating the upper and lower eyelid creases. The septum separates the anterior and posterior lamella, and is often referred to as the middle lamella. The horizontal interpalpebral fissure is formed by the lid margin and measures approximately 30 to 31 mm transversely and 8 to 10 mm vertically.



Normal eyelid surface anatomy

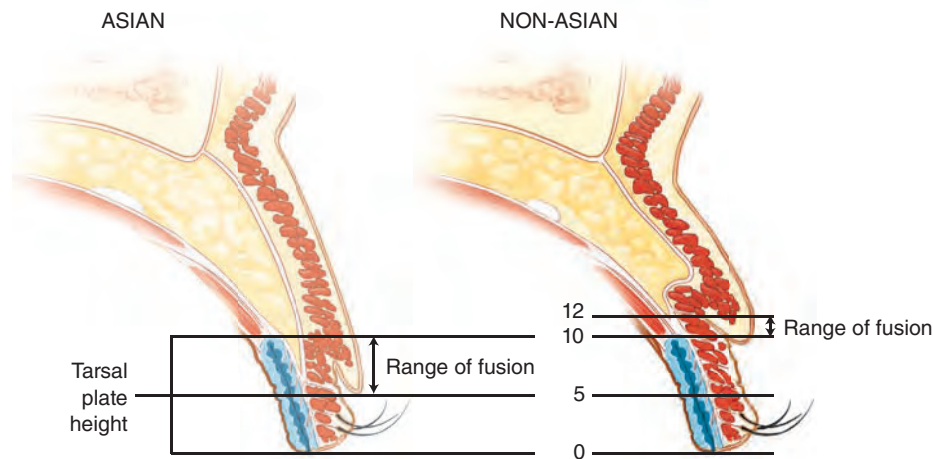
The lateral canthal angle is formed by the lateral commissure and is generally positioned approximately 2 mm superior to the medial canthus, giving the eyelid a slightly upward lateral inclination to the palpebral fissure (canthal tilt). The position of the lateral canthus, however, varies according to age, family traits, race, and sex. In primary gaze, the upper eyelid margin is positioned 1.5 mm inferior to the superior corneoscleral limbus, and the lower eyelid margin rests just at the inferior limbus of the cornea. The upper eyelid margin forms a smooth arch with the highest point positioned between the medial limbus and the pupil. With age, there is a gradual lateral shift of this point as the tarsal plate migrates laterally. The horizontal crease in the upper eyelid is formed by the dermal insertion of the levator aponeurosis after it passes through the orbicularis muscle. The eyelid fold is the excess skin and muscle that overhang the crease, which is a fixed line.



Prominent eye

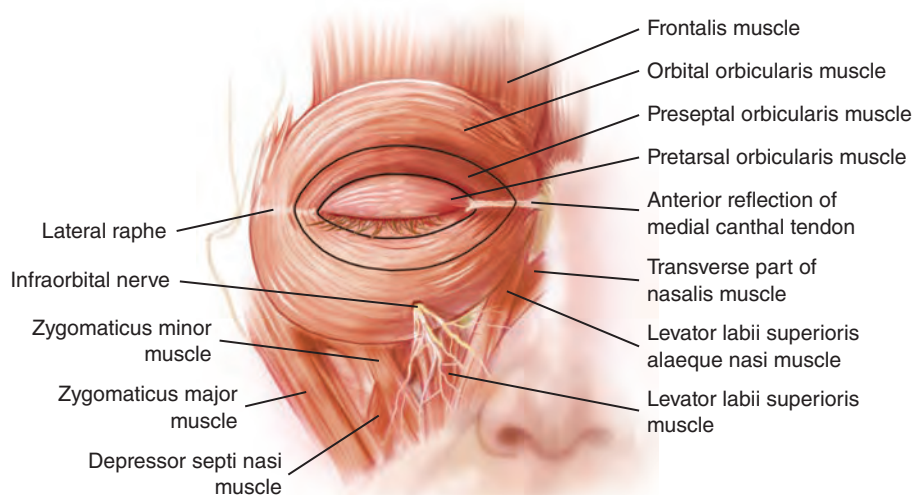


The degree of eye prominence depends on the relationship between the globe and the bony orbit. This can be difficult to accurately assess clinically, because the soft tissue anatomy of the region can mask the bony landmarks. Preoperative assessment with Hertel exophthalmometry is the most reliable method. Normal protrusion is 15 to 17 mm and is slightly greater in black patients. This results in a negative vector to the globe-orbital rim relationship.



Both the upper lid crease and fold vary according to sex. The lid crease in the eyelid of an individual of European ancestry is approximately 7 mm above the lash margin at the midpupillary line in men and 10 mm above the lash margin in women. In the lower lid, there is an analogous eyelid crease 2 to 3 mm from the lash margin, which is more apparent in youth and diminishes with age. The Asian upper eyelid typically has a crease that is more inferior, often 3 to 4 mm above the lash margin, because of the low insertion of the septum, which allows preaponeurotic fat to migrate inferiorly into the pretarsal space.

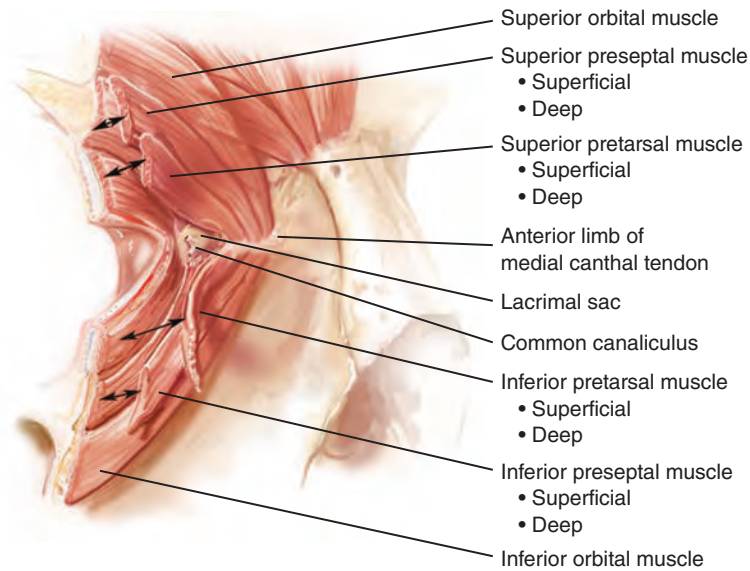
Orbicularis Oculi Muscle



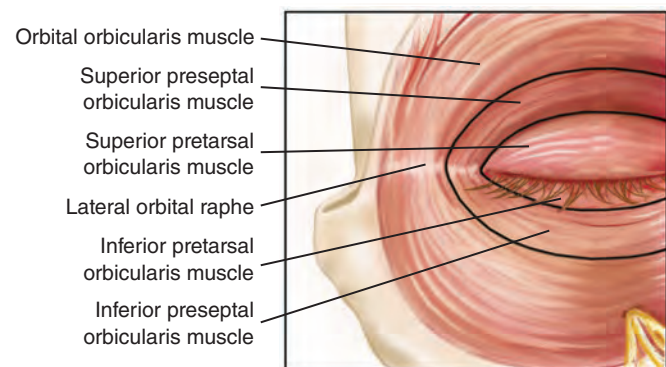
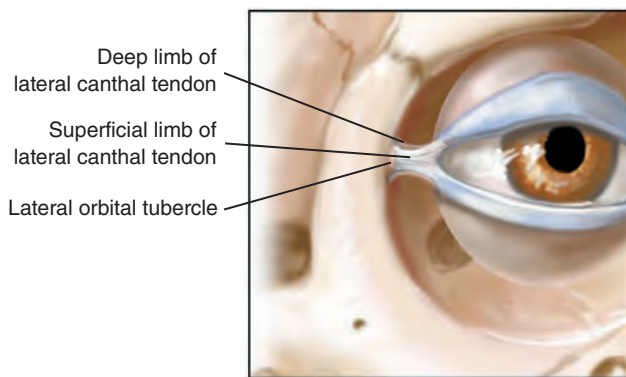
The orbicularis oculi muscle lies deep to the dermis, with minimal subcutaneous fat. The muscle is divided into three major portions: pretarsal, preseptal, and orbital. The pretarsal portion of the orbicularis is superficial to the tarsal plate and functions for lid closure during involuntary blinking. The pretarsal orbicularis is further subdivided into a superficial and a deep head. The preseptal orbicularis also has a

superficial and a deep component. In addition to controlling voluntary blinking, it functions as part of the lacrimal pump for tear drainage. The orbital orbicularis is the largest division of the orbicularis muscle and functions to protect the globe with forced eyelid closure as well as medial brow depression. The orbicularis oculi is a complex muscle that has multiple deep and superficial components. The origin of the orbicularis is from the medial canthus and medial orbit, whereas the insertion is at the lateral canthus and lateral orbit. The pretarsal fibers have a dense attachment to the upper and lower lid tarsal plates. The deep pretarsal muscle, Horner's muscle, originates at the posterior lacrimal crest, and the superficial pretarsal muscle originates from the anterior reflection of the medial canthal tendon, which originates from the frontal process of the maxillary bone. The lacrimal sac is clasped between the two heads. Both pretarsal orbicularis muscles insert laterally into Whitnall's tubercle, 1.5 mm inside the lateral orbital rim. Riolan's muscle is a dense group of pretarsal orbicularis muscles that form the subcutaneous component of the gray line along the lid margin. This is an important anatomic landmark that is used to realign the lateral canthus after canthoplasty.

The preseptal orbicularis also has a superficial and a deep component. The deep muscle, Jones's muscle, originates from the lacrimal sac fascia. The superficial preseptal muscle originates from the anterior reflection of the medial canthal tendon, along with the superficial pretarsal muscle. Both preseptal muscles insert onto the lateral palpebral raphe, which creates the superficial component of the lateral canthus. With each blink, contraction of Jones's muscle creates negative pressure in the tear sac, thereby draining the canalicular system. The lower lid orbital orbicularis originates from the maxilla, and the upper lid orbital orbicularis originates from the frontal bone converging on the superficial component of the medial canthal tendon. The lateral insertion of the orbital orbicularis creates the anterior raphe along the lateral orbital rim.

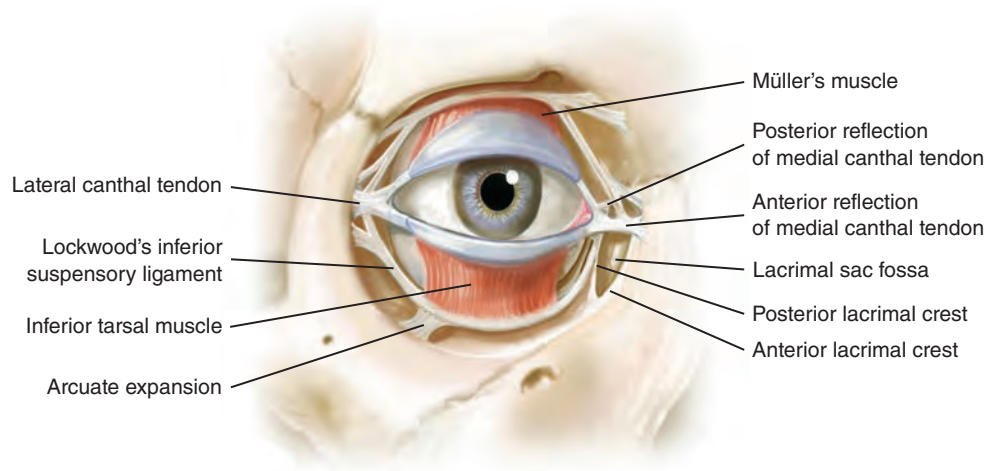


The 10 separate heads of the orbicularis oculi muscle all originate from the medial aspect of the orbit and insert along the lateral aspect of the orbit. Therefore the medial canthus represents the “business end” of the orbicularis muscle, including the dominant blood supply and innervation originating medially and contributing to the major contractile forces used for blinking, the lacrimal pump, and eye protection.



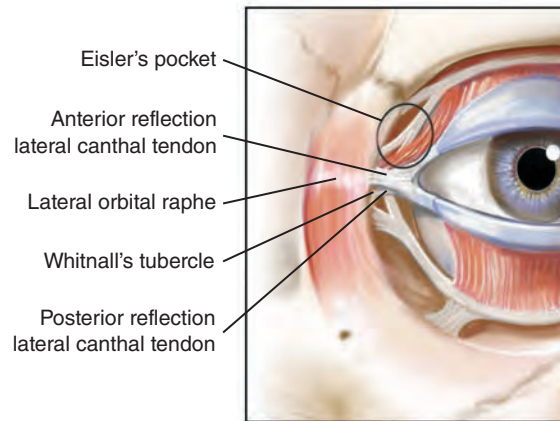
In contrast to the medial origin, the lateral insertion of the orbicularis oculi muscle simply acts as a lateral anchor with a deep and a superficial component forming the lateral canthal tendon and lateral orbital raphe. The lateral aspect of the orbicularis represents the fixed anchor point to the bony rim, which functions as a relatively stable fulcrum for the eyelids, thereby allowing the forces of medial contraction to change lid position. However, with extreme abduction of the globe, the lateral canthus can mobilize up to 2 mm.

Tarsoligamentous Sling

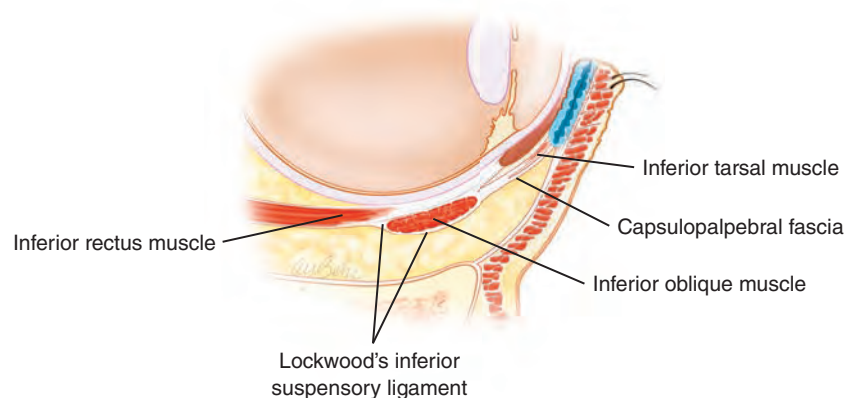


Whereas the skin and muscles comprise the anterior lamella, the tarsoligamentous sling creates the support structure for the posterior lamella. The tarsal plates constitute the connective tissue framework of the upper and lower eyelids. The upper lid tarsal plate is approximately 30 mm horizontally and 10 mm vertically at its widest dimension. Attachments to the upper lid tarsal plate include the pretarsal orbicularis and the levator aponeurosis on the anterior surface, Müller's muscle on the superior border, and conjunctiva on the posterior surface. The lower lid tarsal plate measures approximately 28 mm horizontally and 4 mm in vertical dimension. Attachments to the lower lid tarsal plate include the pretarsal orbicularis, capsulopalpebral fascia, and conjunctiva. The tarsal plates of the upper and lower eyelids are attached to the orbital rim by the medial and lateral canthal tendons and retinacular support structures. The canthal ligaments are the fibrous extensions of the tarsal plate, whereas the canthal tendons represent the insertion of the deep heads of the orbicularis oculi muscle to the bone, thereby constituting a true tendon.

The medial canthus is a complex structure that forms the medial fixation point for the medial commissure consisting of an anterior and posterior reflection of the medial canthal tendon as well as the medial retinaculum. The anterior reflection of the medial canthal tendon inserts on the anterior nasolacrimal crest formed by the frontal process of the maxilla and is anterior to the lacrimal sac. The posterior reflection of the medial canthal tendon is deep to the lacrimal sac and inserts on the posterior lacrimal crest on the lacrimal bone. The medial retinaculum is a complex structure formed by the deep head of the pretarsal orbicularis, the orbital septum, the medial extent of Lockwood's inferior suspensory ligament, the medial horn of the levator aponeurosis, the medial rectus cheek ligaments, and Whitnall's ligament. The medial retinaculum represents a fixed fulcrum point to maintain medial canthal position, allowing the orbicularis muscles to act on lid position rather than medial canthal position.



The lateral canthus also consists of a complex connective tissue framework that functions as an integral fixation point for the lower lid. The lateral canthal tendon, which is approximately 5 mm in length, is formed by fibrous crura which connect the tarsal plate to Whitnall's lateral orbital tubercle within the lateral orbital rim. In addition, the lateral retinaculum is formed by ligamentous structures from the lateral horn of the levator aponeurosis, lateral rectus cheek ligaments, Whitnall's suspensory ligament, and Lockwood's inferior suspensory ligament, which converge at the lateral canthal tendon. Although the lateral retinaculum represents the lateral point of fixation, there is some lateral mobility of the commissure during lateral gaze in order to increase the lateral visual field. This anatomic finding predisposes the lateral canthus to the development of laxity and phimosis or medial migration with age, as opposed to the medial canthus, which remains relatively fixed.

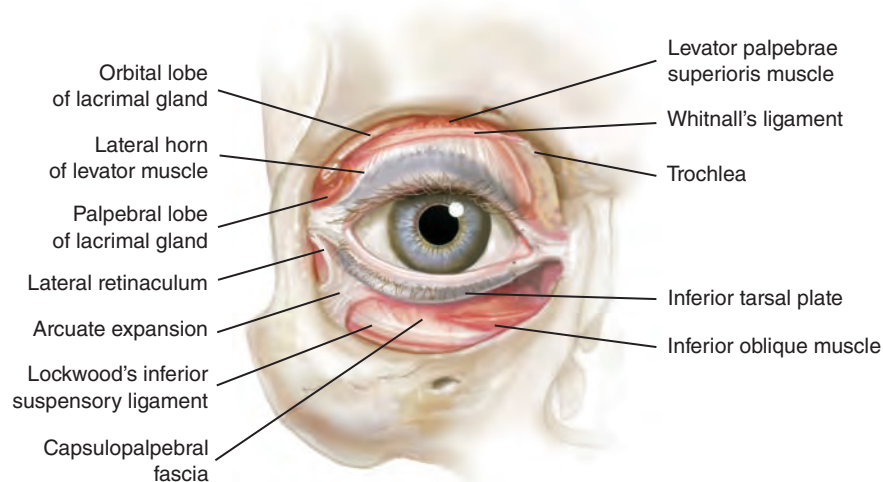


In addition to the tarsal plates and canthal tendons, support structures in the upper and lower eyelids stabilize the tarsoligamentous sling. The superior transverse ligament of Whitnall is partially formed by the fascia of levator palpebrae superioris. Whitnall's ligament has a medial insertion at the trochlea of the superior oblique and a lateral insertion at the lacrimal gland pseudocapsule and the frontal bone of the lacrimal sac fossa. The function of Whitnall's ligament is to act as a fulcrum to con-

vert the vector of pull of the levator palpebrae superioris muscle from a posterior vector originating from the lesser wing of the sphenoid to a superior vector in order to elevate the eyelid. Therefore Whitnall's ligament functions as an anatomic pulley or check ligament so that the upper lid does not pull away from the globe during opening. The lower eyelid has an analogous inferior suspensory ligament, Lockwood's ligament. Lockwood's ligament arises from the medial and lateral retinaculum and fuses with the capsulopalpebral fascia anterior to the inferior oblique muscle, prior to inserting on the inferior tarsal border. The arcuate expansion of Lockwood's ligament, Clifford's ligament, inserts into the inferolateral orbital rim and fuses with the interpad septum between the central and lateral fat compartments of the lower eyelid. The function of Lockwood's ligament is to stabilize the lower lid on downgaze, while the lower lid retractors cause lid depression of the eyelid to increase the inferior visual field during downgaze.

Upper Lid Retractors

Levator Palpebrae Superioris and Müller's Muscle



While the primary function of the orbicularis oculi muscle is to provide varying degrees of eyelid closure, the muscle antagonists located within the orbit function to open the eyelids. The upper eyelid retractors include the levator palpebrae superioris muscle and Müller's superior tarsal muscle. The levator muscle is striated muscle and is innervated by the superior division of the third cranial nerve. The levator muscle originates from the lesser wing of the sphenoid at the orbital apex and inserts along the anterior surface of the tarsal plate, stabilizing the pretarsal orbicularis muscle. The levator aponeurosis begins at the musculoaponeurotic junction, which is 10 to 14 mm below Whitnall's ligament and 5 to 7 mm above the superior border of the tarsal plate. The levator aponeurosis inserts into the dermis at the superior tarsal border and fuses with the septum to create the upper eyelid crease. Disinsertion of

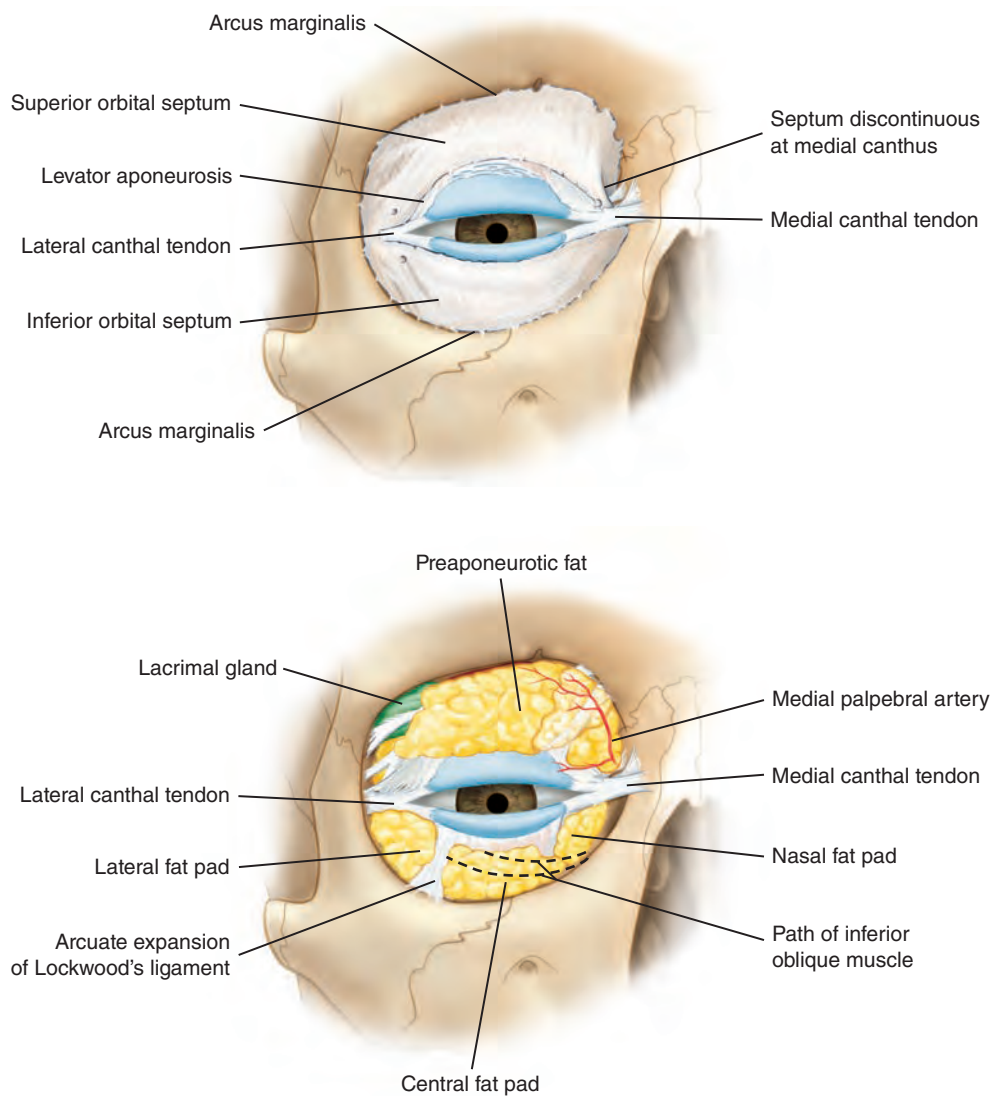
the levator aponeurosis results in lid ptosis with descent of the tarsal plate and elevation of the lid crease. Inferior to Whitnall's ligament, the levator aponeurosis widens to form lateral and medial horns. The lateral horn divides the lacrimal gland into orbital and palpebral lobes, and inserts into the lateral orbital tubercle and lateral retinaculum as well as the capsulopalpebral fascia of the lower eyelid. The medial horn inserts into the posterior reflection of the medial canthal tendon. The function of the levator horns is to distribute the forces of the levator muscle equally along the aponeurosis, thereby allowing the majority of lid elevation to occur centrally.

In addition to the levator palpebrae superioris muscle, Müller's superior tarsal muscle contributes to eyelid opening. Müller's muscle is smooth muscle that originates from the posterior surface of the levator muscle and inserts into the superior tarsal border. Müller's muscle is innervated by the sympathetic nervous system from the superior cervical ganglion. Innervation passes through the cavernous sinus and optic canal to enter to orbit with the ophthalmic artery. As well as mechanical dehiscence of the levator aponeurosis, upper lid ptosis can be caused by abnormalities of the third cranial nerve resulting in levator muscle weakness or by loss of sympathetic nerve supply causing Müller's muscle weakness resulting in Horner's syndrome. Orbital Horner's syndrome from orbital apex tumor or trauma includes ptosis and meiosis, whereas Horner's syndrome from a Pancoast thoracic tumor includes ipsilateral anhydrosis to complete the triad.

Lower Lid Retractors

The lower lid retractors include the capsulopalpebral fascia and the inferior tarsal muscle, which are closely applied. The capsulopalpebral fascia originates from the inferior rectus fascia and splits to envelop the inferior oblique muscle. The capsulopalpebral fascia inserts into the inferior tarsal border and the dermis to create the lower eyelid crease. The capsulopalpebral fascia is lined by conjunctiva and the inferior tarsal muscle. The inferior tarsal muscle is smooth muscle innervated by the sympathetic nervous system, which functions to depress the lower lid on down gaze. In the lower eyelid the capsulopalpebral fascia is analogous to the levator aponeurosis in the upper lid, and the inferior tarsal muscle is analogous to Müller's muscle.

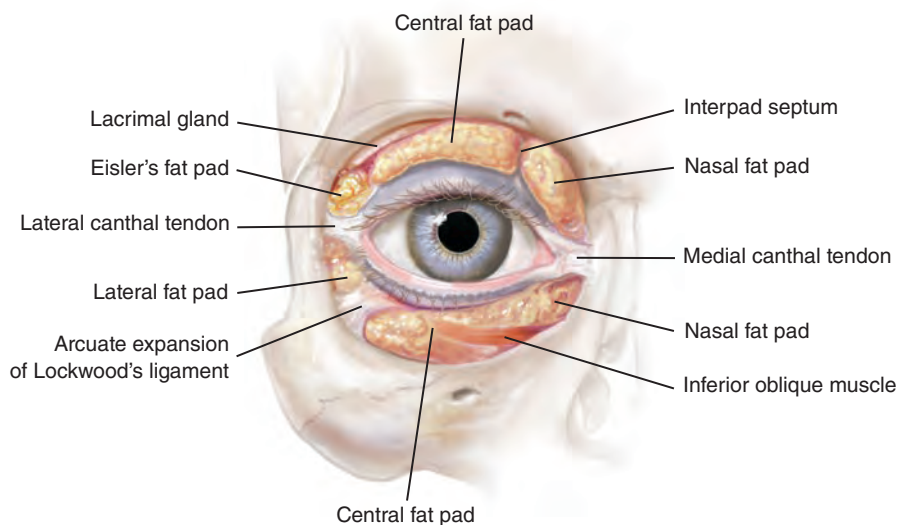
Orbital Septum



The orbital septum separates the anterior and posterior lamella, and helps maintain periorbital fat within the anatomic confines of the orbit. The orbital septum originates from an area of periosteal thickening called the arcus marginalis at the orbital rim. The orbital septum originates deep to the lacrimal sac along the posterior lacrimal crest and continues around the orbit in a spiral fashion passing deep to Whitnall's tubercle at the level of the lateral orbital rim. Inferomedially, the septum originates from the anterior lacrimal crest. It is therefore discontinuous at the medial canthus. In the upper eyelid, the septum fuses with the levator aponeurosis approximately 2 to 3 mm above the tarsal plate. In the lower lid, the septum fuses with the capsulopalpebral fascia just below the tarsal plate. There are numerous additional interpad and intrapad septal structures, which separate the central and nasal fat pad in the upper eyelid and the central and lateral fat pad in the lower eyelid.

Appreciation of the anatomy of the septum is important, particularly when surgical procedures such as resetting, tightening, or excising the septum are considered. A rare cause of blindness following blepharoplasty is retrobulbar hematoma, also known as acute orbital compartment syndrome. The globe and retrobulbar contents are enclosed within a relatively rigid cone, with bony walls to the orbit laterally and posteriorly, and the inexpandable orbital septum anteriorly. Therefore any increase in orbital content volume increases pressure in the compartment and decreases tissue perfusion. This can occur following blepharoplasty due to postseptal bleeding from orbital vessels and can lead to blindness if not promptly treated. In 2004 Hass et al published results of a survey of members of the American Society of Ophthalmic, Plastic and Reconstructive Surgeons (ASOPRS) to ascertain the incidence of retrobulbar hematoma following blepharoplasty. The reported incidence was 0.055% (149 of 269,433 patients), and the reported rate of permanent visual loss following this was 0.0045% (12 patients). Most cases occurred within 3 hours, with 96% occurring by 24 hours. Hemorrhage was commonly associated with Valsalva-type maneuvers such as coughing or vomiting.

Orbital Fat Pads



Posterior to the orbital septum, the periorbital fat pads play an important role in both upper and lower blepharoplasty. There are two main fat pads in the upper eyelid and three fat pads in the lower eyelid. The two upper fat pads are referred to as the central and nasal fat pads, which are located in the preaponeurotic space just anterior to the levator aponeurosis. The interpad septum arises from the orbital septum and inserts into the levator aponeurosis. It separates the central and nasal fat pads and is continuous with a septal fascial connection to the trochlea. The nasal fat pad has been shown to be more fibrous and is pale in color compared to the more yellow colored central fat pad.

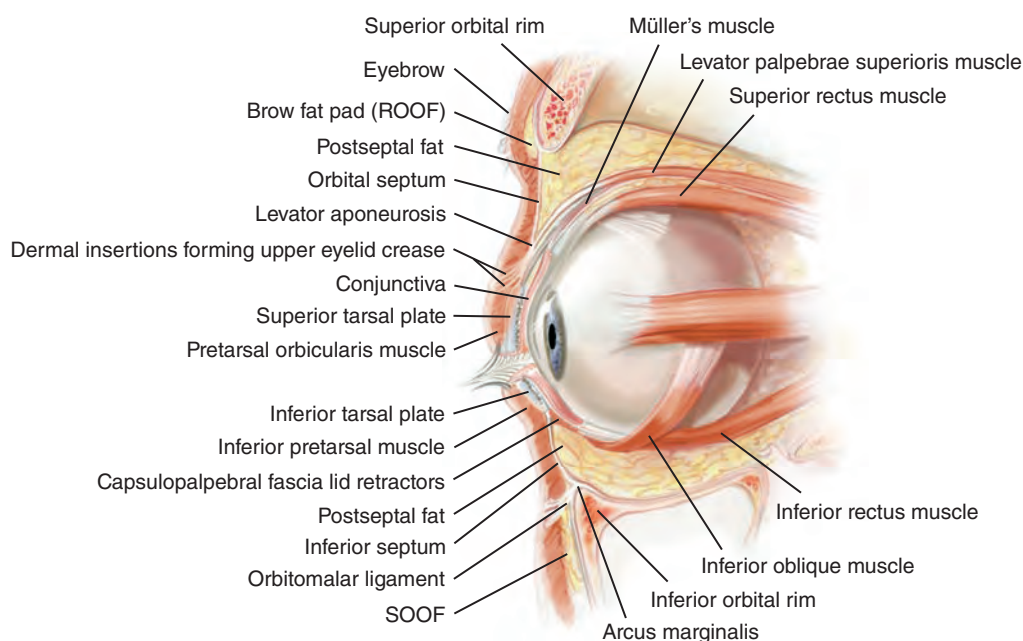
The intrapad septum separates the nasal fat into two compartments. The medial palpebral artery is located in the inferior nasal compartment and can contribute to significant bleeding during blepharoplasty. The central fat pad is superficial to the levator aponeurosis, in the preaponeurotic space, and contributes to the fullness of the upper lid fold. Histologically, the nasal fat pad has larger fat globules, and the central fat pad has more intrapad septa and finer blood vessels. These differences are thought to be due to different embryologic origins as well as different fatty acid constituents of the nasal and central fat pads.

Although the lateral compartment of the upper eyelid consists of the lacrimal gland, studies have shown that a lateral extension of the central preaponeurotic fat pad extends to the lateral upper compartment in 15% to 20% of patients. The lateral extension of the central fat pad is anterior to the orbital lobe of the lacrimal gland and can be easily dissected away from the gland. The lacrimal gland lacks a true capsule, and is divided into the orbital and palpebral lobes by the lateral horn of the levator. The orbital lobe is positioned in the fossa glandulae lacrimalis, which is a shallow fossa in the frontal bone at the superolateral orbit. The smaller palpebral lobe is connected to the orbital lobe by an isthmus posterior to the lateral horn of the levator muscle. Lacrimal gland ptosis is caused by dehiscence of Sommering's ligaments, which are the fibrous interlobular septa that connect the gland to the orbital rim fossa. Fullness in the lateral aspect of the upper eyelid is often caused by lacrimal gland ptosis. Lateral to the lacrimal gland is a separate compartment just above Whitnall's tubercle. Eisler's pocket, which was described by Kestinbaum, is formed by the space created by the septum and the lateral canthal tendon inserting on Whitnall's tubercle. Eisler's fat pad is a small accessory fat pad located in Eisler's pocket, which serves as a useful anatomic landmark for Whitnall's tubercle. The location of this fat pad is clinically useful during placement of the lateral canthoplasty suture.

There are three fat pockets in the lower eyelid: central, nasal, and lateral. The nasal compartment in the lower eyelid is similar in makeup to the nasal compartment of the upper eyelid with more fibrous, pale fat. The inferior oblique muscle is commonly visible during blepharoplasty and separates the nasal and central fat compartments. The central and lateral fat compartments are separated by an interpad septum as well as a fascial extension from Lockwood's ligament, the arcuate expansion. Recent MRI imaging of the orbit has demonstrated an increase in the total orbital fat volume with age, particularly in the central and lateral regions. This increase was not seen anterior to the orbital rim. Darcy et al think that increased fat volume is a contributing factor to increased lower lid prominence with age and support the removal of fat from the central and lateral compartments during blepharoplasty. The arcuate expansion of Lockwood's ligament should be preserved during lower lid dissection to maintain lateral support. Because the nasal and central fat pads envelop the inferior oblique muscle, aggressive fat transposition techniques that suture the

fat below the rim can result in diplopia from impaired inferior oblique function from a lasso effect. The lateral extent of the lateral fat pocket includes the lateral retinaculum and lateral canthal tendon.

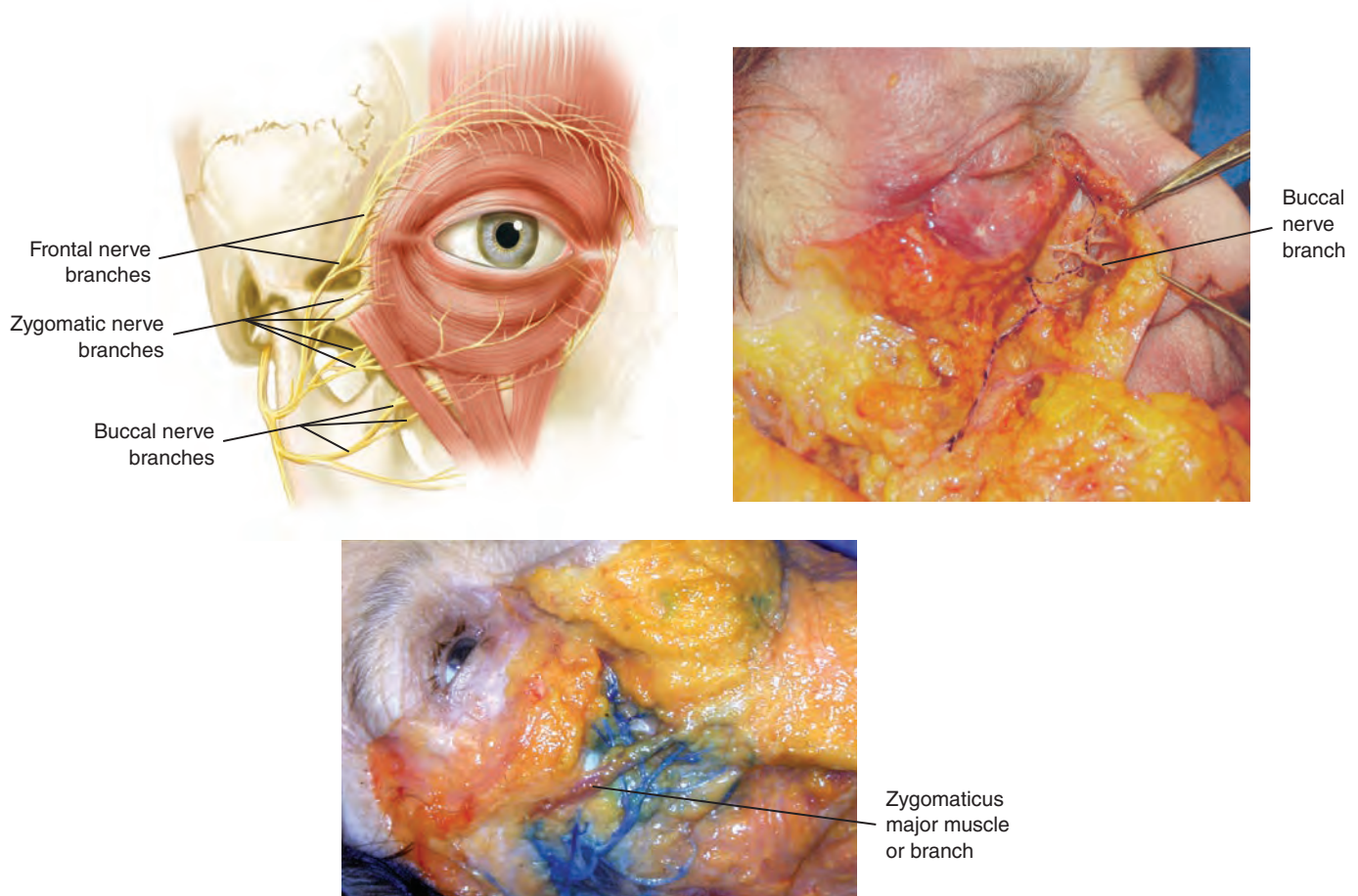
The most posterior layer of the eyelid is the conjunctival lining, which reflects on itself at the fornix and covers Tenon's capsule. The palpebral portion of the conjunctiva is closely adherent to the posterior surface of the tarsal plate and the lid retractors. At the fornix, the conjunctiva becomes bulbar conjunctiva overlying the globe to the corneoscleral limbus. Small accessory glands are located within the conjunctiva, creating the aqueous portion of the tear film.



The cross-sectional anatomy of the eyelid and periorbital region demonstrates the creation of the upper lid crease formed by the fusion of the orbital septum, levator aponeurosis, and upper lid dermis. The anatomy of the lower eyelid fornix is clinically important because the transconjunctival approach to blepharoplasty is often used. The orbital fat can be removed by a transeptal (preseptal) approach, which divides the conjunctiva, capsulopalpebral fascia, and septum, or by a retroseptal (postseptal) incision through the conjunctiva and capsulopalpebral fascia, leaving the septum intact.

Neurovascular Supply

Motor Innervation

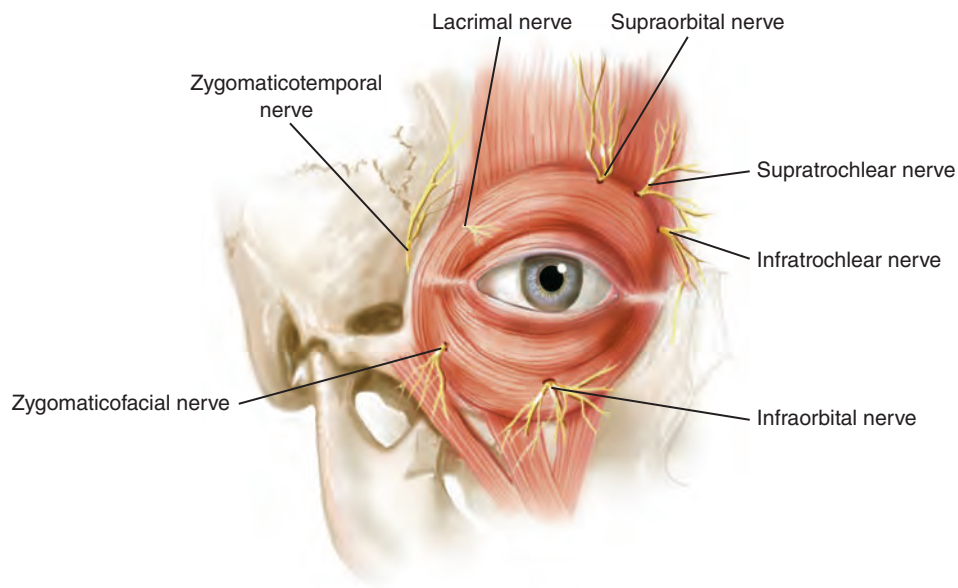


The motor innervation to the orbicularis oculi muscle is quite diffuse, with contributions from multiple branches of the facial nerve, including the frontal, zygomatic, and buccal branches. The major nerve supply enters the medial aspect of the orbicularis, along with an additional supply laterally. The terminal muscles innervated by the frontal branch include the frontalis muscle and the transverse head of the corrugator supercilii. Additionally, the frontal branch provides innervation to the upper lid pretarsal and preseptal divisions of orbicularis, which are noted clinically by the presence of a weakened blink after frontal branch injury. The terminal muscles innervated by the zygomatic branch of the facial nerve include the zygomaticus major and the oblique head of the corrugator muscle. The buccal branch of the facial nerve innervates the terminal facial mimetic muscles medially and the procerus muscle.

Cadaveric dissection reveals a diffuse plexus of nerves innervating the orbicularis oculi muscle. These branches pass both superficial to the origin of the zygomaticus major supplying the lateral orbicularis and deep to the zygomaticus major continuing to supply the medial orbicularis.

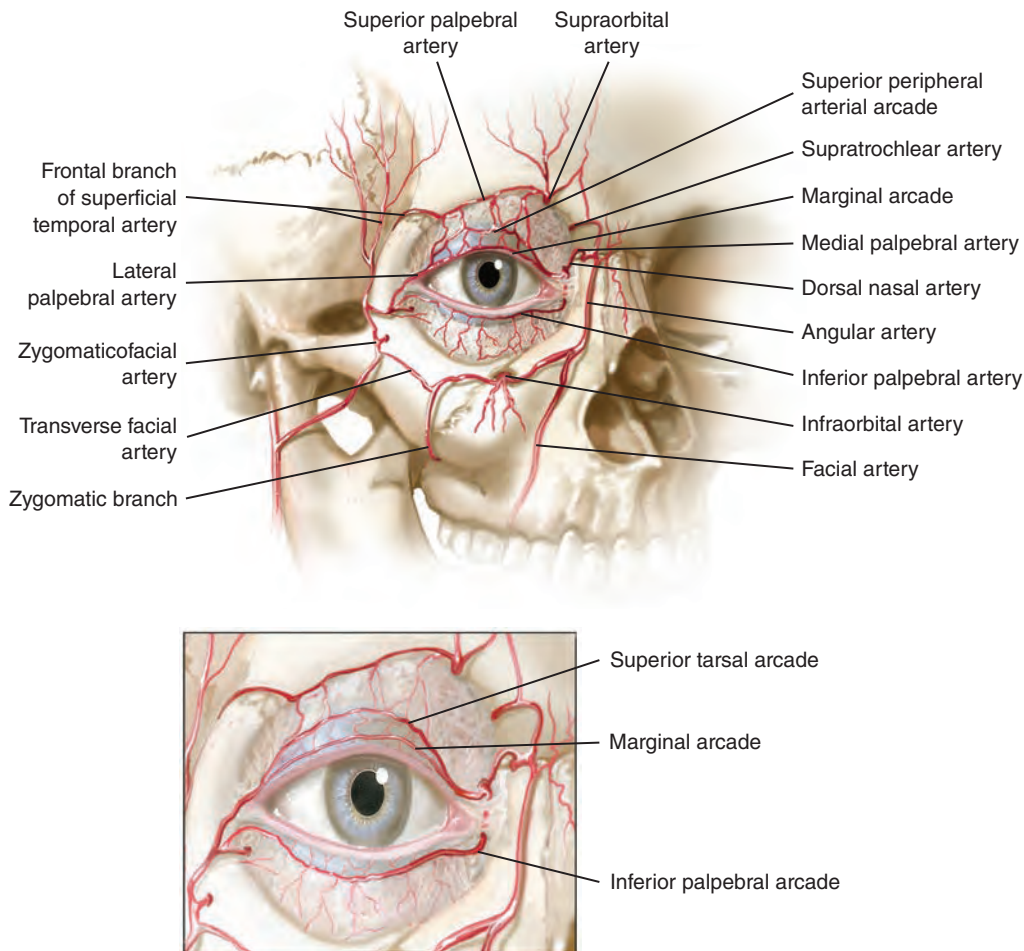
The buccal branch also supplies a diffuse plexus of nerve branches to the medial palpebral orbicularis, including the deep heads in both the upper and lower eyelid that contribute to voluntary and involuntary lid closure. This is clinically evident by impaired upper eyelid closure after an isolated medial lower lid incision over the nasolacrimal crest following dacryocystorhinostomy (DCR) or Mohs surgery, despite the absence of an upper lid incision.

Sensory Innervation



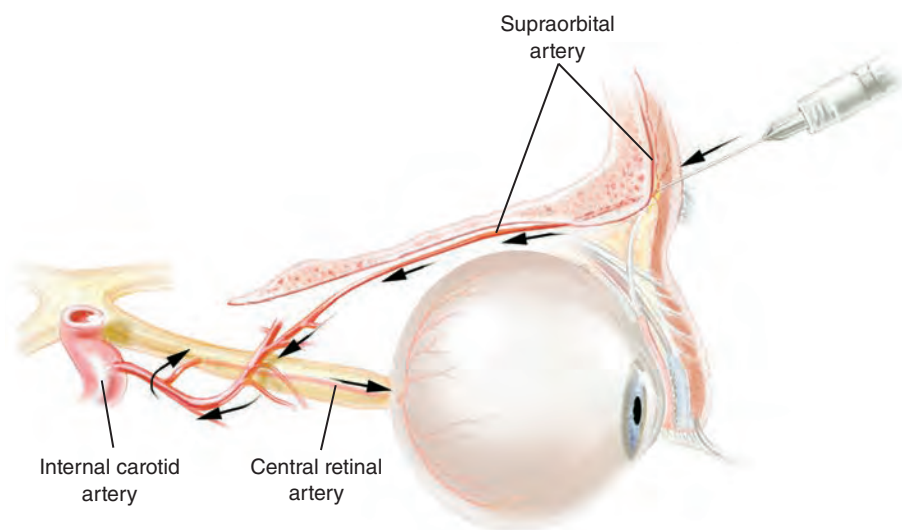
Sensory innervation of the eyelids arises from the ophthalmic and maxillary divisions of the trigeminal nerve. Upper lid sensory impulses are transmitted through supratrochlear, supraorbital, and lacrimal nerves, which are branches of the ophthalmic division. The ophthalmic nerve also provides sensation to the medial portions of the upper and lower eyelids by the infratrochlear branch. The major sensory input to the lower lid is from the infraorbital nerve, which is a major branch of the maxillary nerve. The remainder of the lower lid receives sensory input from the zygomaticofacial branch and the zygomaticotemporal branch of the maxillary nerve.

Arterial Supply



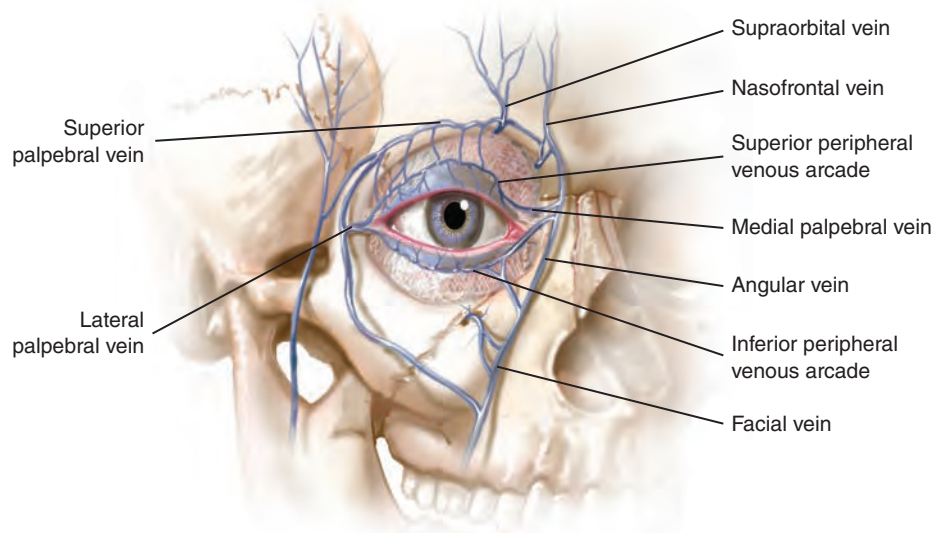
A dual arterial supply to the eyelids exists, which arises from both the internal carotid and external carotid system. The dominant supply arises medially. The internal carotid artery provides the blood supply to the orbit from the ophthalmic artery, which exits the orbit medially at the dorsal nasal and medial palpebral vessels, and exits the orbit superiorly at the supratrochlear and supraorbital arteries. Branches from the lacrimal artery, a branch of the ophthalmic artery given off in the orbital apex, provide the blood supply to the lateral aspect of the orbit. The internal and external carotid systems communicate through multiple arterial anastomoses. There are three main divisions: medial, central, and lateral. The medial blood supply from the external carotid system includes the facial and angular vessels, which anastomose with the dorsal nasal artery from the internal carotid. The central blood supply is provided by the internal maxillary and infraorbital vessels. The lateral blood supply is from the superficial temporal, transverse facial, deep temporal, and zygomaticofacial branches.

The blood supply to the upper lid margin includes two arcades, the superior tarsal arcade and the marginal arcade, which are branches of the medial palpebral and lacrimal arteries. The superior tarsal arcade is located superior to the border of the tarsal plate between Müller's muscle and the levator aponeurosis. The lower eyelid has a single inferior palpebral arcade along the lid margin just below the tarsal plate supplied by the medial and lateral inferior palpebral arteries, and including an anastomosis with the infraorbital artery from the external carotid system. Thus both lids have a dual blood supply from the medial and lateral aspects, allowing safe lateral canthotomy with preservation of the dominant blood supply from the medial inferior palpebral artery.



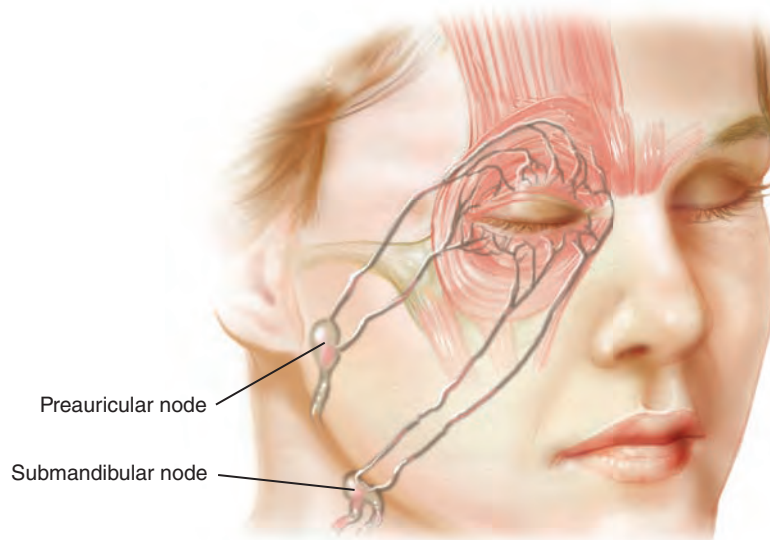
An understanding of the arterial anatomy of the eyelid and orbit is particularly important because a rare cause of blindness after blepharoplasty is periorbital arterial injection. Blindness can occur with inadvertent injections to the supraorbital or supratrochlear vessels, with retrograde flow into the ophthalmic artery causing central retinal artery embolization; this includes periorbital injection of fillers. A second cause of blindness is retrobulbar hematoma, which results in increased pressure behind the globe, causing central retinal artery occlusion.

Venous Drainage



Similar to the arterial system, venous drainage of the eyelid and periorbital region includes a dual superficial and deep system. The external periorbital area is drained by the internal jugular vein from branches including the anterior facial vein, superficial temporal vein, and external jugular vein. The central orbital area is drained into the cavernous sinus from branches including the superior ophthalmic vein, anterior ophthalmic vein, and pterygoid plexus.

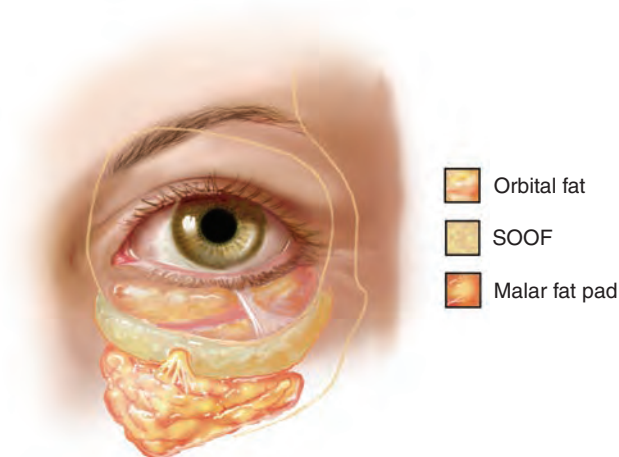
Lymphatic Drainage



The lymphatic drainage of the upper and lower eyelids includes dual drainage to the preauricular parotid nodes and the submandibular lymph nodes. The upper eyelid, lateral canthus, and lateral half of the lower eyelid lymphatic vessels drain to the preauricular lymph nodes. The nasal aspect of the upper and lower eyelids and the

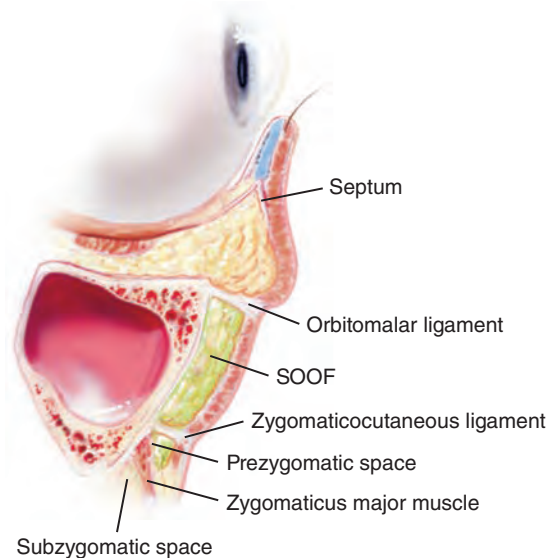
medial canthus have lymphatic drainage along the facial vein, then inferiorly to the submandibular lymph nodes. Lymphatic drainage is clinically relevant both as a contributing factor to the formation of chemosis after blepharoplasty and for potential metastatic spread of malignant neoplasms or infection involving the periorbital region.

Midfacial Anatomy

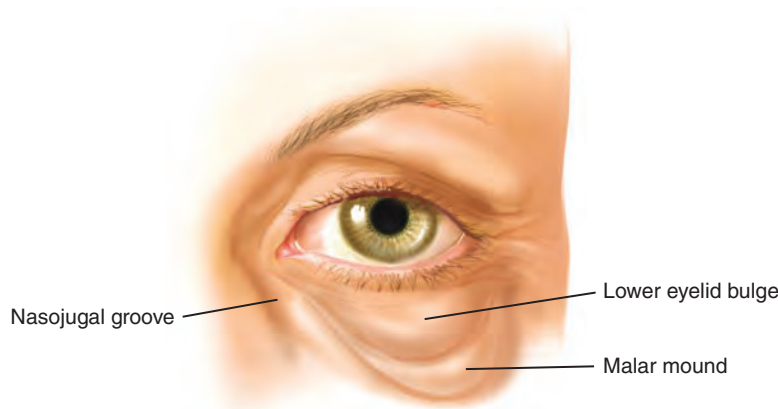


The anatomic relationship between the lower eyelid and the midface must be appreciated because changes in midface anatomy influence the appearance of the lower eyelid. In addition to the periorbital fat compartments, two additional fatty layers exist in the midface. Deep to the orbicularis oculi muscle is the suborbicularis oculi fat (SOOF). This layer is readily appreciated after suborbicularis dissection below the infraorbital rim. As the arcus marginalis is encountered and subsequently traversed, the SOOF becomes apparent between the overlying orbital portion of the orbicularis and the underlying soft tissue structures of the midface including facial mimetic muscles. The SOOF may be compartmentalized by septa into vertical and horizontal components, and the upper lid SOOF is divided into medial and lateral compartments. These septa may have a role in the regional blood supply, as vascular supply to the skin of the face is thought to be carried in the intercompartmental septa. The SOOF's greatest thickness and volume is lateral to the infraorbital foramen. The SOOF is deep to the superficial musculoaponeurotic system (SMAS) and also envelops the zygomaticus major and minor muscles. In addition to the SOOF, the malar fat pad is a triangular pad in the midface area, which is in the subcutaneous plane superficial to the SMAS. The midface presents with aging caused by the descent of the malar fat pad, which often unmasks the orbital fat pads as a result of inferior migration and thinning of the overlying tissue. The periorbital fat becomes visible, with pseudoherniation of the orbital septum.

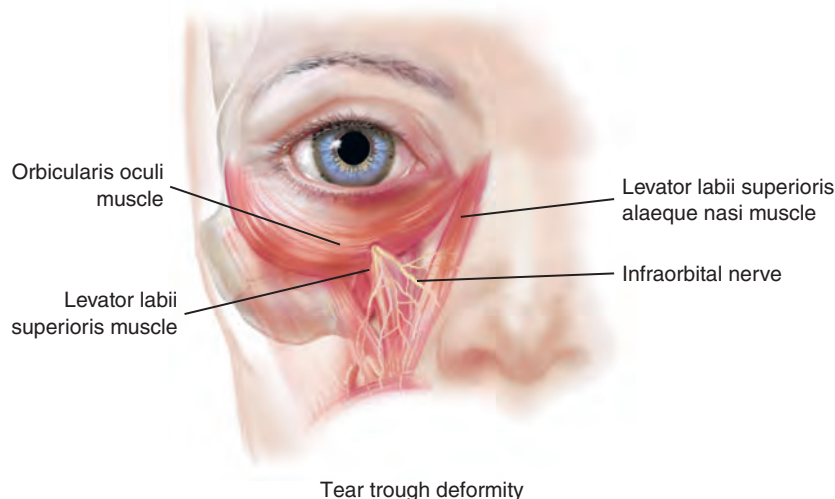
It is not only soft tissue changes that occur with age; assessment of the human skull collection at the Smithsonian Institution suggests that progressive remodeling and retrusion of the orbital rim occurs throughout life. Others have found that while retrusion of the midface relative to the upper face does occur with age, this change happens below the level of the infraorbital rim. The exact manner of age-related bone change differs among patients, but overall, aging does remodel the orbital region and seems to increase the negative vector in older patients.



This cross-section of the periorbital anatomy illustrates the fat compartments, supporting ligaments, prezygomatic space, and subzygomatic space. In 1996 Kikkawa et al described a major supporting structure of the midface, the orbitomalar ligament, as the primary retaining ligament of the midface. It was thought to be an osseocutaneous ligament that originated at the inferior orbital rim just below the arcus marginalis and to penetrate the orbicularis oculi muscle anteriorly, inserting into the dermis. Muzaffar et al applied the more commonly used nomenclature, orbicularis retaining ligament (ORL), in 2002. Mendelson and colleagues further delineated this region in cadaver dissections and specified that there is a direct attachment of orbicularis oculi muscle to the orbital rim inferomedially, from the anterior lacrimal crest to about the level of the medial corneoscleral limbus. Farther laterally, the ORL provides an indirect attachment from the undersurface of the orbicularis oculi muscle to the orbital rim as far as the lateral canthal region, where it blends with the lateral orbital thickening. In its lateral section, the ORL lies directly orbital to the zygomaticofacial nerve, which is a reliable landmark for its location. The ORL is similarly continuous in the upper eyelid, from the medial to the lateral orbit. The orbital septum inserts into the most marginal part of the orbital rim, with the ORL inserting 2 to 3 mm outside this point. The merging of these two structures at their insertion forms the arcus marginalis. The prezygomatic space is the soft tissue area overlying the skeleton of the midface, namely the zygoma and maxilla. The infrazygomatic space covers the vestibule of the oral cavity.



The orbitomalar ligament contributes to formation of the malar crescent and malar bag, which are common findings with midface aging. Laxity of the ORL with age allows descent of the central fat pad and the lid-cheek junction. Descent is more prominent lateral than medially due to the direct attachment of the orbicularis oculi muscle to the orbital rim medially. In addition, the orbitomalar ligament contributes to the formation of the lid-cheek junction.



The orbitomalar ligament along with the origin of the levator labii superioris and levator alaeque nasi muscles contribute to formation of the tear trough. The anatomy of the tear trough is complex, with contributions from bone, muscle, and overlying soft tissue. The concavity begins at the anterior nasal lacrimal crest and is formed by the arcus marginalis, orbitomalar ligament, origin of the orbicularis oculi muscle, levator labii superioris, and levator alaeque nasi muscles inferiorly. With aging changes, descent of the SOOF contributes to attenuation of the overlying soft tissue, thereby unmasking the nasojugal groove. As mentioned, the ORL attaches to the orbicularis oculi at the junction of the infraorbital rim, and the division of the orbicularis retaining ligament provides mobilization of the SOOF and separates the prezygomatic space from the preseptal space. Appreciation of the anatomy of the midface is important when techniques are used to correct midfacial aging.

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Hamra ST. The zygorbicular dissection in composite rhytidectomy: an ideal midface plane. *Plast Reconstr Surg* 102:1646-1657, 1998.

Composite rhytidectomy adds repositioning of the orbicularis oculi muscle to the deep plane face lift to achieve a more harmonious appearance of the face by adding periorbital rejuvenation. These two modifications allow a more predictable and impressive result. They reinforce the concept of periorbital rejuvenation as an integral part of facial rejuvenation, which produces a more harmonious immediate result and prevents the possible unfavorable sequelae of conventional rhytidectomy and lower blepharoplasty.

Jelks GW, Jelks EB. The influence of orbital and eyelid anatomy on the palpebral aperture. *Clin Plast Surg* 18:183-195, 1991.

This article discusses the multitude of factors influencing the palpebral aperture. Unique individual combinations of the orbital anatomic influences cause the variations in the palpebral apertures.

Mendelson BC, Hartley W, Scott M, et al. Age-related changes of the orbit and midcheek and the implications for facial rejuvenation. *Aesthetic Plast Surg* 31:419-423, 2007.

This paper describes the anatomy of the soft tissue and bony orbit. Changes that occur during the aging process are discussed. CT imaging was performed in three groups of patients of both sexes and different ages ranging from 21 to 70. Bony changes occurred that demonstrated retrusion of the anterior maxillary wall, which may contribute to midfacial aging.

Mendelson BC, Muzaffar AR, Adams WP. Surgical anatomy of the midcheek and malar mounds. *Plast Reconstr Surg* 110:885-896; discussion 897-911, 2002.

The authors describe the anatomy of the midcheek to explain midcheek aging and malar mounds. A cadaver study located a glide plane space overlying the body of the zygoma. Together the function of this space, as well as the anatomic boundaries and anatomic features of this area, determine the characteristic aging changes that occur in this region and explain malar mounds. The authors discuss the surgical implications resulting from this anatomy.

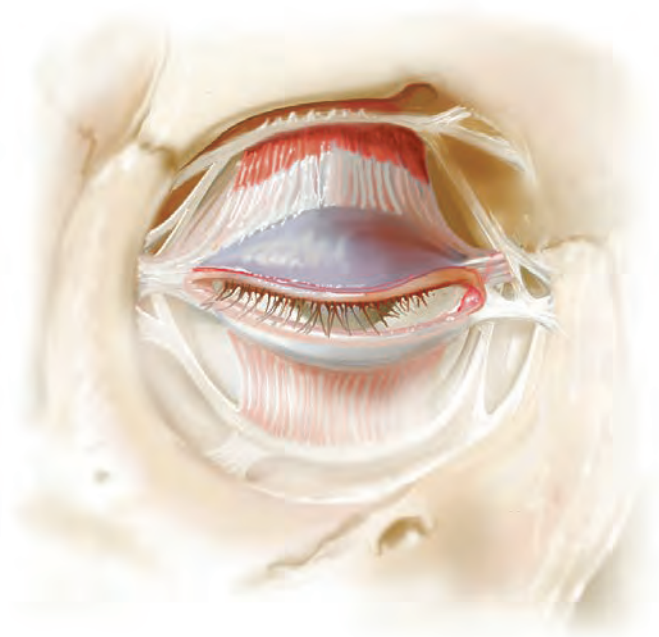
Muzaffar AR, Mendelson BC, Adams WP. Surgical anatomy of the ligamentous attachments of the lower lid and lateral canthus. *Plast Reconstr Surg* 110:873-884; discussion 897-911, 2002.

The authors describe the surgical anatomy of the superficial fascia of the face, which must include its deep attachments. Release of the deep ligamentous attachments (lateral orbital thickening and orbicularis retaining ligament) of the orbicularis fascia is important in some canthopexy and in rejuvenation procedures. The release allows effective redraping and upward mobilization of the orbicularis of the lower lid and the premalar soft tissues.

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CHAPTER 27



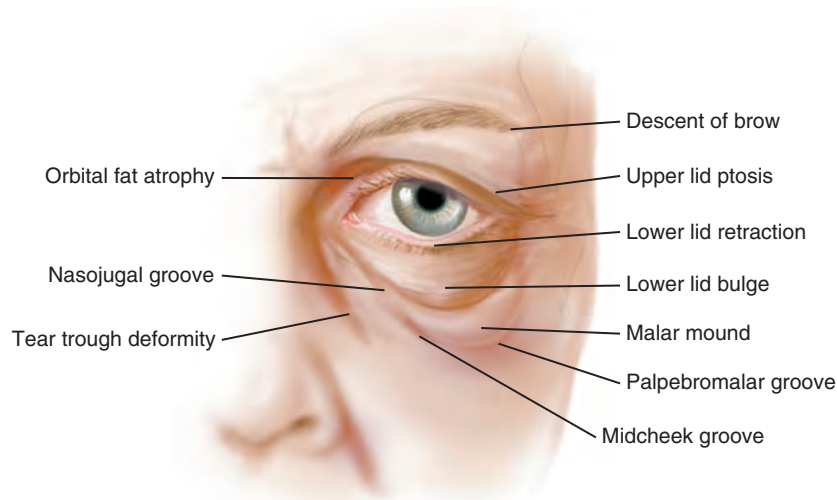
Clinical Decision-Making in Aesthetic Eyelid Surgery

FOAD NAHAI

Evaluation



The hallmark of youthful-appearing eyelids is a smooth contour that extends from the brow to the upper lid and from the lower lid to the cheek and midface. The lid-cheek junction lies over the infraorbital rim and is usually 5 to 12 mm below the lid margin. The skin is tight and the tissues are full. There is an upward slant from the medial canthus to the lateral canthus, and eyelid tone is normal: a snapback test results in rapid lid recovery, and lid distraction will be 6 mm or less.



In contrast, the aged eye appears hollow, with a definite demarcation from the brow to the upper lid and the lower lid to the cheek and midface. In most individuals, the eye fissure becomes smaller and rounder with age. The lid-cheek junction lies well below the infraorbital rim, 15 to 18 mm from the lid margin. There is a downward slant from the medial canthus to the lateral canthus and eyelid tone is significantly

reduced, with a very slow result to the lid snapback test and a lid distraction of 6 mm or greater. (See Chapter 28 for further discussion of evaluation of the aged eye.)

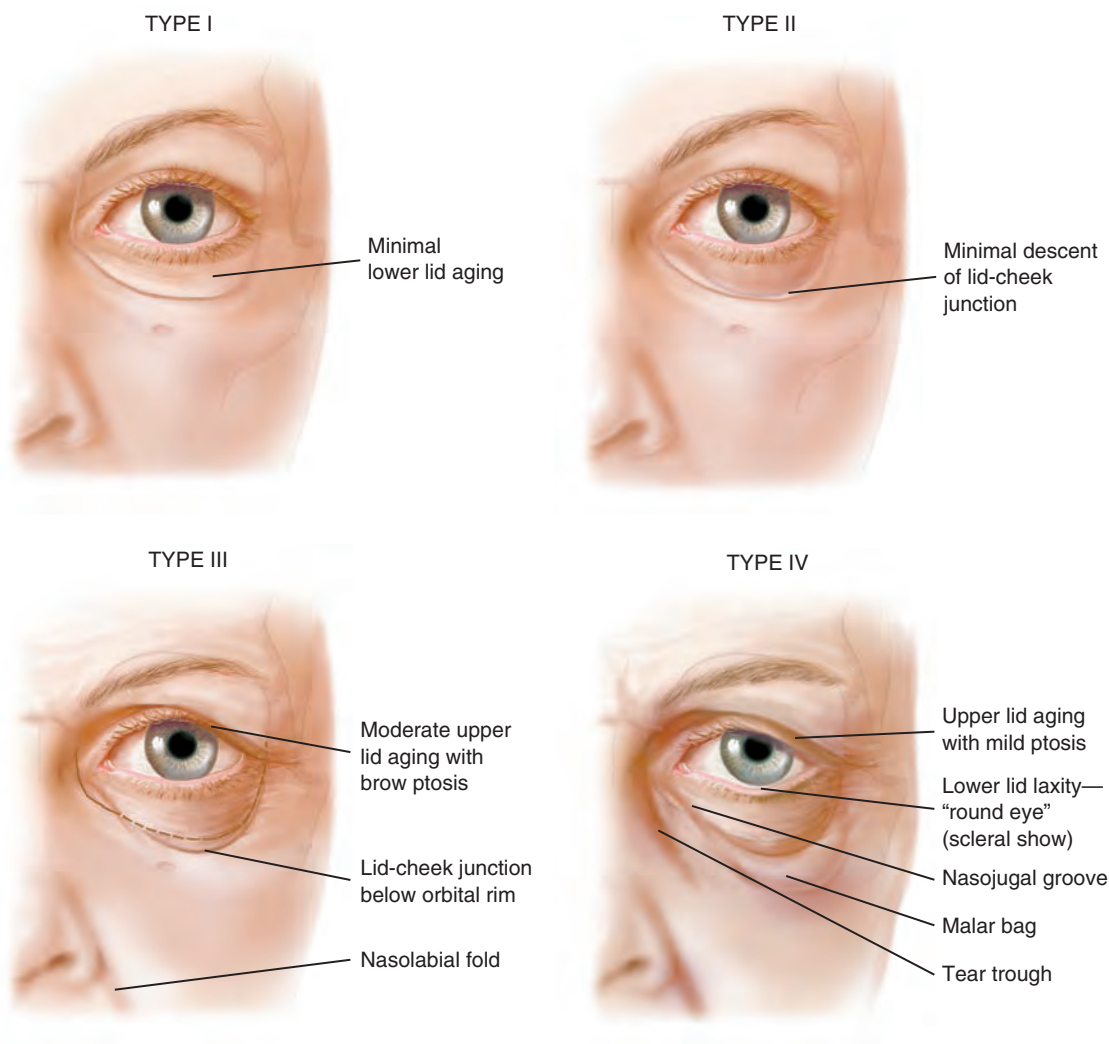
These aging changes, which develop gradually over time, are a combination of volume loss, loss of skin elasticity, and downward descent of the tissues. These changes are classified into the following four types:

Type I: Aging confined to the lower lid, with skin and muscle laxity and pseudoherniation of the fat

Type II: Aging no longer confined to the lower lid; in addition to skin and muscle laxity, there is skin excess and minimal descent of the lid-cheek junction

Type III: Lower lid aging with volume loss, descent of the lid-cheek junction and malar eminence; skeletonization of the orbital rim and deepening of the nasolabial fold, loss of skin elasticity and lid laxity are also common findings

Type IV: Further volume loss and descent of the lid-cheek junction; deepening of the nasojugal groove; presence of malar bags; further loss of skin elasticity, lateral canthal descent and lid laxity with scleral show





This classification is most useful in selecting appropriate procedures to address specific problems for each patient type. In addition to addressing the lower eyelid, it also demonstrates that aging of the lower lid and midface are intertwined. Rejuvenation of one without the other will lead to a suboptimal or patchwork result. Concomitant with the aging changes of the lower lid and lid-cheek junction, there is a real or apparent loss of volume that must be addressed.

A component evaluation of the eyelids to determine aesthetic options will also minimize complications. Components of eyelid evaluation are discussed next.

Decision-Making Factors in Eyelid Surgery	
<i>Aesthetic Factors</i>	<i>Safety Factors</i>
Skin	Upper lid ptosis
– Quality	Lid tone
– Quantity	Eye prominence
Muscle	Canthal position
Fat	
Lid-cheek interface	
Scleral triangles	
– Medial	
– Lateral	

Skin

As an individual ages, the elasticity of eyelid skin diminishes, causing the skin to appear loose and wrinkled. There is real or apparent skin excess. The physician evaluates the quality and quantity of the skin. In assessing upper eyelid skin excess, the brow should be held in its ideal position. The eyelids should always be evaluated with the eyes open as well as shut.

Muscle

Muscle activity and morphology are noted. With aging, the orbicularis oculi muscle may become lax and hypertrophic, especially in the pretarsal area. Infratarsal fullness may also be present. Although this fullness is often associated with a youthful eye, some patients are concerned about infratarsal fullness.

Fat

Two pockets of periorbital fat are contained within the upper lid, with three in the lower lid. The surgeon notes these and decides whether to preserve, redistribute, or remove this fat. In addition, the retroorbicularis oculi fat (ROOF) lying along the lateral orbital rim between the orbicularis oculi muscle and the periosteum is also assessed. Under rare circumstances, some of this fat will need to be resected to improve the contour of the lateral orbital rim.

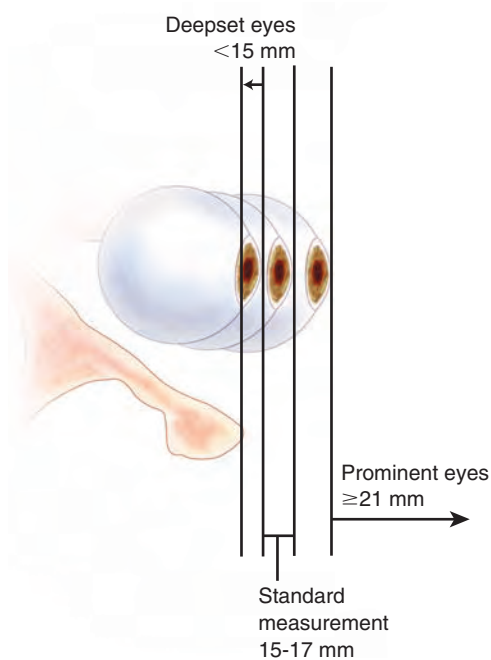
Upper Lid Ptosis

The presence or absence of upper lid ptosis should always be recorded. If present, it is pointed out to the patient and plans are discussed to correct it at the time of blepharoplasty.

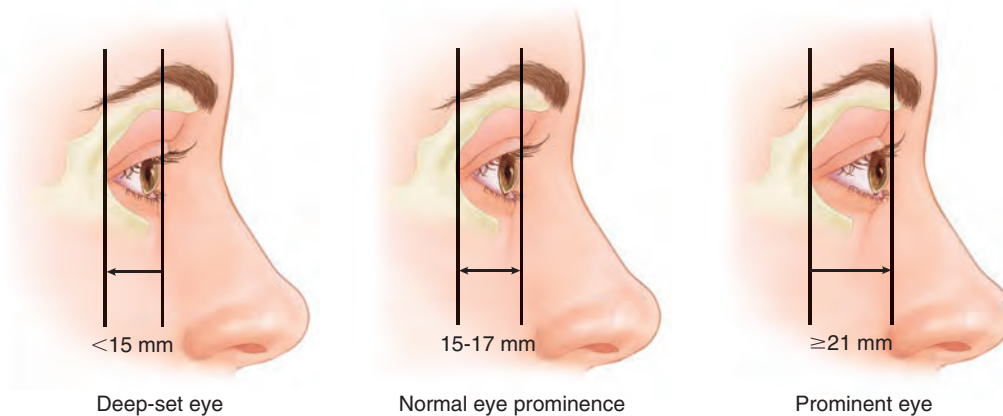
Lid Tone

Lower eyelid tone is evaluated with the lid distraction test and lid snapback test. Routine correction of lower lid laxity is essential to minimize complications.

Eye Prominence (Hertel Measurement)

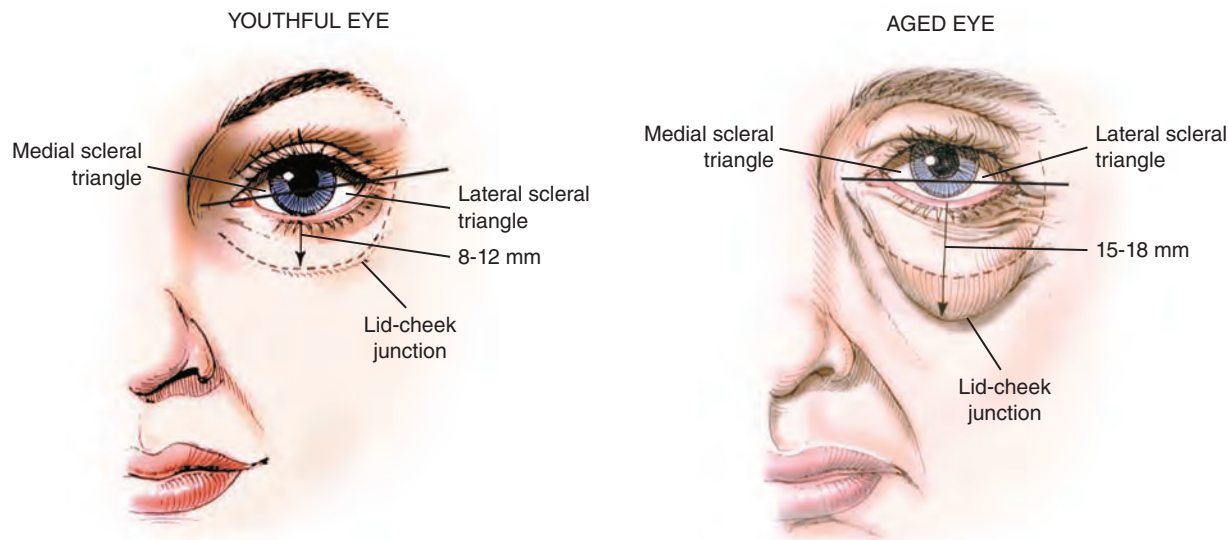


Eye prominence is assessed by means of the Hertel exophthalmometer, which measures the distance between the cornea and the lateral orbital rim.



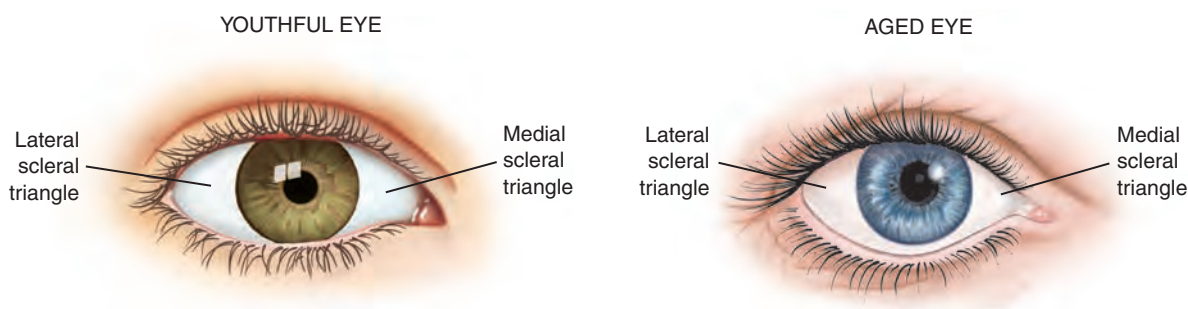
Normal eye prominence, which is seen in 65% of the population, ranges from 15 to 17 mm. Deep-set or anophthalmic eyes measure less than 15 mm, and any measurement of 18 mm or greater indicates a prominent eye. These measurements play a significant role in determining risk, procedure selection, and lid-anchoring techniques.

Canthal Position



The surgeon notes the position of the lateral canthus in relation to the medial canthus. The lateral canthus should normally be higher than the medial canthus. A lateral canthus at the same level or lower than the medial canthus indicates significant lid laxity, requiring horizontal lid shortening (canthoplasty).

Scleral Triangles



The triangle between the cornea and the medial canthus is called the *medial scleral triangle*, and the triangle between the cornea and lateral canthus is called the *lateral scleral triangle*. With increasing lid laxity and age, these triangles, especially the lateral scleral triangle, are lost. Eye shape is judged by the shape and size of the lateral scleral triangle. The tighter the triangle, the more almond-shaped the eye; conversely, the looser the triangle, the rounder the shape of the eye.

Evaluation of skin, muscle, and fat plays a role in selecting the best treatment option. However, of more importance is evaluation of the lid-cheek interface and mid-face aging for lower lid options. For the upper eyelid, the relationship between the upper lid and the brow is an important determining factor.

Evaluation of lid tone, eye prominence, and canthal position plays a pivotal role in determining which lid-anchoring procedure is appropriate to minimize the potential for complications.

Preoperative Planning



27-1 Upper and lower blepharoplasty and midface cheek lift

Treatment Options

A variety of surgical and nonsurgical options are available for treating upper and lower eyelid aging. Fat grafting and injectables offer volume restoration of the upper lid and the lid-cheek junction. Surgical options include transcutaneous and transconjunctival approaches. Procedures range from the simple transconjunctival removal of fat from both upper and lower lids to complex procedures, including transpalpebral procerus corrugator muscle modification and browpexy through the upper eyelid and transpalpebral midface lift through the lower eyelid.

Options for Fat Management

In recent years there has been a tremendous revolution in our thinking and approach to facial rejuvenation. This is especially true in concepts of fat preservation and augmentation, not only in face lifts but even more so in blepharoplasty. Gone is the standard skin, muscle, and fat excision blepharoplasty that I was taught many years ago. Our current choices are to preserve or redistribute the periorbital fat and occasionally remove or even augment the fat. For augmentation, options include autologous fat, autologous dermis, fillers, and even alloplastic materials.

I base my options for fat management on evaluation of the lid-cheek junction and choose a procedure to improve this area.



Although most surgeons continue to rejuvenate the lower lid surgically, injectable fillers are being established as a safe and effective option for lower lid rejuvenation, especially for correction of the tear-trough area.

Options for Fat Management

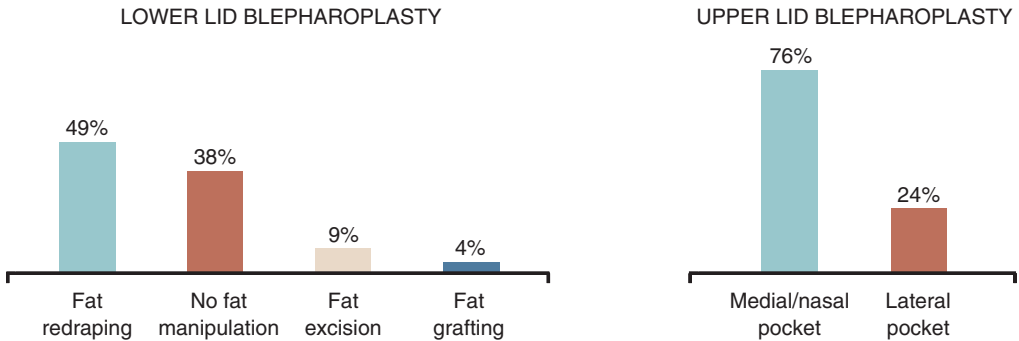
Preserve	Augment
Redistribute	Remove



If the patient has an adequate volume of fat, my preferred technique for improving the lid-cheek junction is a combination of fat redraping and a transpalpebral midface lift with orbicularis muscle flap redraping. If the patient does not have fat herniation or enough fat for redraping, I plan no fat manipulation, I do not open the periorbital septum, and I rely on the transpalpebral midface lift and on orbicularis muscle flap redraping.

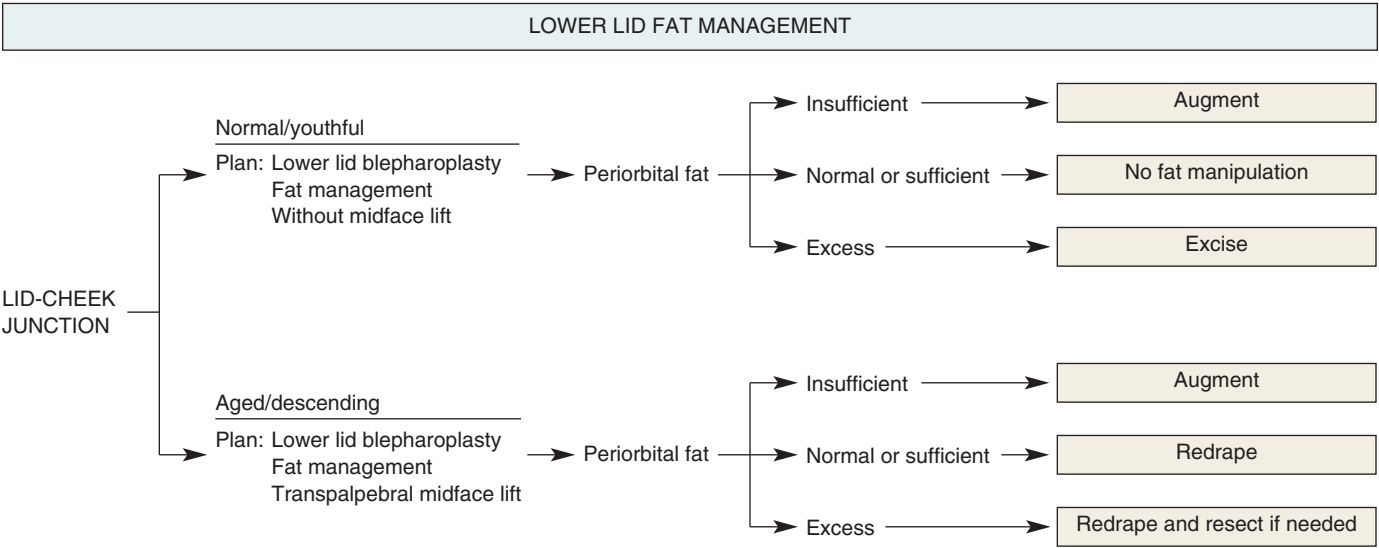


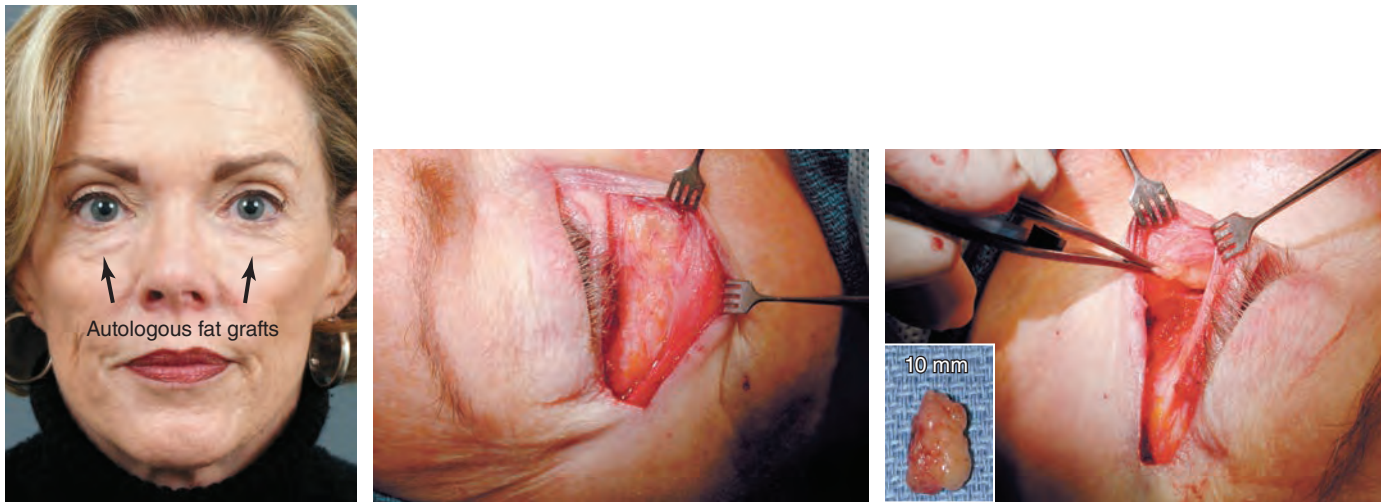
If I think that these approaches are not adequate for correction of the lid-cheek junction, I consider autologous tissue augmentation. I have no experience with alloplastic implants around the orbital rim, and I think that autologous tissue is as effective. Occasionally, I do resect fat from the lower lid, most often from the lateral compartment when the fat bulges out. Both of the patients above have undergone periorbital rejuvenation. The patient at the top of the page had no fat removal from either lower eyelid. The patient immediately above had fat removed only from the lower left eyelid.



A review of a personal series of 100 consecutive blepharoplasties revealed 49% with fat redraping, 38% with no fat manipulation, 9% with fat excision, and 4% with autologous grafting in the lower lid. In the upper eyelid in the same series, I resected fat from the medial nasal pocket in 76% and from the lateral pocket in only 24% of cases. These numbers are indicative of my current practice and the continuing trend toward fat preservation and fat augmentation in the periorbital area.

Resection of the ROOF was very popular several years ago and was part of my approach to the upper eyelid and lateral brow in selected patients. Today, with a better understanding of the aging process and the role of volume, I do not resect the ROOF. Patients with a full subcutaneous pocket deep to the lateral hair-bearing brow who would benefit from ROOF resection are few and far between.





With the current interest in fat preservation and adding volume to the lower eyelid, it is possible that the surgeon may injudiciously inject excessive amounts of autologous fat into the periorbital area, as is demonstrated in this patient. Given the unpredictability of the survival of the grafted fat, this is not an uncommon finding. Transconjunctival and transcutaneous fat removal has proved to be a relatively straightforward and effective procedure for correction of this problem. The injected fat bears little resemblance to the periorbital fat and maintains the appearance and morphologic character of the area from which it was harvested.



The transcutaneous approach was chosen for this patient so that her lid retraction and skin excess could be addressed, along with removal of excess injected fat.



Transconjunctival fat removal is shown in another patient.

Upper Eyelid

Options for upper eyelid rejuvenation are fewer than those for the lower eyelid. Most upper eyelids are approached through a standard skin-muscle incision. Rarely, the transconjunctival approach is an option to resect excess fat in the medial pocket. A skin excision with muscle preservation may sometimes be the best option to preserve orbicularis muscle to maintain volume in the upper eyelid.

Options for Upper Eyelid Rejuvenation

- Transconjunctival fat removal from the medial pocket
- Skin and muscle excision
 - Gateway to the lateral brow
 - Gateway to the glabellar muscles
 - Ptosis repair
- Skin excision with muscle and fat preservation

Options for rejuvenating the upper eyelid include transconjunctival and transcutaneous approaches. The transconjunctival approach has a limited role, confined to excision of fat from the medial or nasal fat pocket. The most versatile approach to the upper lid is excision of skin and muscle (the *open-sky* approach), which allows access to the periorbital fat, ROOF, lateral brow, glabellar muscles, and levator muscle. Recently the skin excision with muscle preservation approach to the upper eyelid has been popularized. With this volume-preserving procedure, the orbicularis is preserved to increase the volume of the upper eyelid. Access deep to the orbicularis is possible by merely dividing the muscle rather than resecting it.

Options for Upper Eyelid Rejuvenation

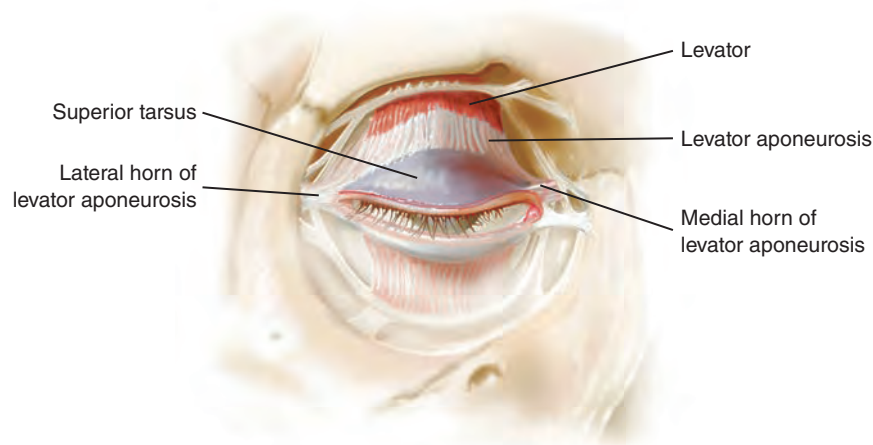
Components	Trans-conjunctival	Skin and Muscle Excision	Skin Excision
Skin	—	++++	++++
Muscle	—	++++	—
Fat	++++ (medial pocket only)	++++	—
Lateral brow	—	++++	—
Glabellar muscles	NA	++++	—
Ptosis repair	NA	++++	—

Degree of effectiveness indicated by the number of pluses.
NA, Not applicable.

Transconjunctival Approach

The transconjunctival approach has limited application for removal of the medial or nasal fat pocket only. I have found this to be a safe, efficacious technique in primary as well as secondary fat removal from the medial pocket. Ideal candidates have a bulging medial fat pocket of the upper eyelid with no excess upper eyelid skin.

The lateral fat pocket, preaponeurotic fat, in the upper eyelid lies anterior to the levator aponeurosis, whereas the medial or nasal fat pocket lies medial to the aponeurosis.



The insertion of the levator aponeurosis into the tarsal plate prevents herniation of the lateral fat pocket; however, the medial horn of the levator aponeurosis is much higher than the lateral horn. This allows herniation of the medial fat and access to the medial fat through the conjunctiva. The incision is made in the conjunctiva medial to the medial border of the tarsal plate.

The advantage of this transconjunctival approach is that it eliminates the need for an incision in the upper eyelid skin. This approach has been free of complications in my hands, and I have not seen any ptosis. The limitation of this approach is that only one aspect of upper eyelid aging—medial fat herniation—is addressed.

Skin-Muscle Excision

Skin-muscle excision is the most versatile approach to the upper eyelid, allowing manipulation and excision of fat from both periorbital fat pockets, excision of ROOF, if indicated, access to the lateral brow, and access to the glabellar muscles. The skin-muscle excision approach also affords exposure of the levator and its aponeurosis for ptosis repair. It is a proven approach with minimal morbidity. Potential problems include inadvertent disruption of the levator aponeurosis, leading to postoperative ptosis, and misplaced scars.

Skin Excision

In keeping with recent trends to preserve and restore volume in facial rejuvenation, a volume-preserving upper lid skin excision has been described (Fagien). If access deep to the orbicularis is needed, the orbicularis is divided rather than resected. It is thought that the small amount of orbicularis that is spared with this approach adds volume to the upper lid.

Lower Eyelid

My approach to the lower eyelid is based on management of fat, skin, muscle, and the lid-cheek junction. Options include the transconjunctival and transcutaneous approaches. A detailed evaluation of the eyelid and periorbital area helps to determine the appropriate selection of surgical technique. A variety of procedures are available to manage the skin laxity and excess, periorbital fat, muscle, and the lid-cheek interface and lid laxity. Some are relatively straightforward with minimal if any morbidity (for example, skin-pinch blepharoplasty and transconjunctival fat removal), whereas others, especially those designed to improve on the lid-cheek junction, are not only complex and technically demanding but also may lead to lid retraction and exposure. Correction of lid laxity and routine lid anchoring at the time of the primary procedure are prerequisites to minimize these potential complications.

The lid-cheek junction can be improved and the lower lid rejuvenated through manipulation of the SMAS with open face-lift procedures, such as the high SMAS technique, SMASectomy, and the extended MACS-lift technique with a skin-pinch blepharoplasty. Although all of these will improve on the lower lid, in my experience the results do not match those of a skin-muscle flap blepharoplasty approach.

Options for Lower Eyelid Rejuvenation

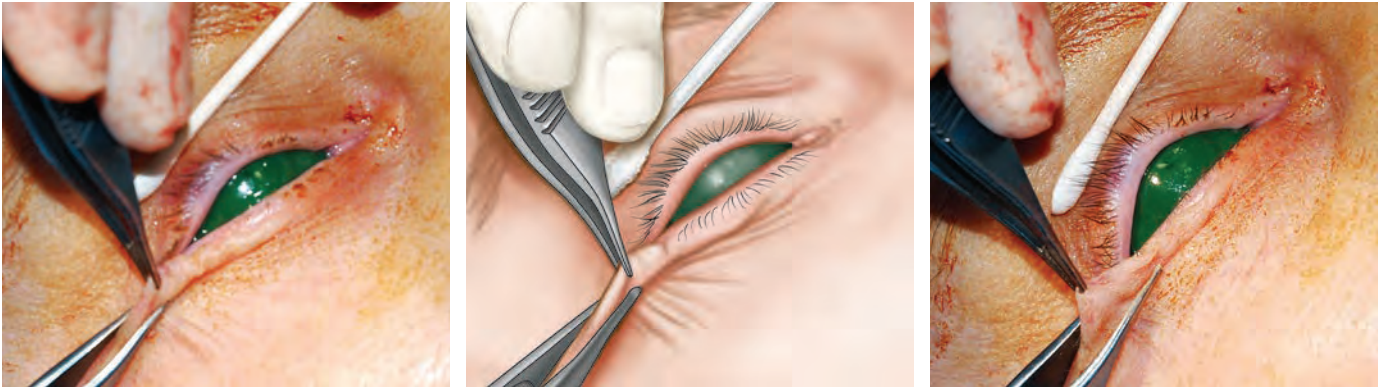
- Fillers
- Pinch blepharoplasty
- Transconjunctival fat removal
- Transconjunctival fat redistribution
- Transcutaneous
 - Skin flap
 - Skin-muscle flap
 - Fat management
 - Orbicularis redraping
- Midface Lift
 - Full open approach
 - Limited or endoscopic approach
- Certain face-lift techniques

Fillers

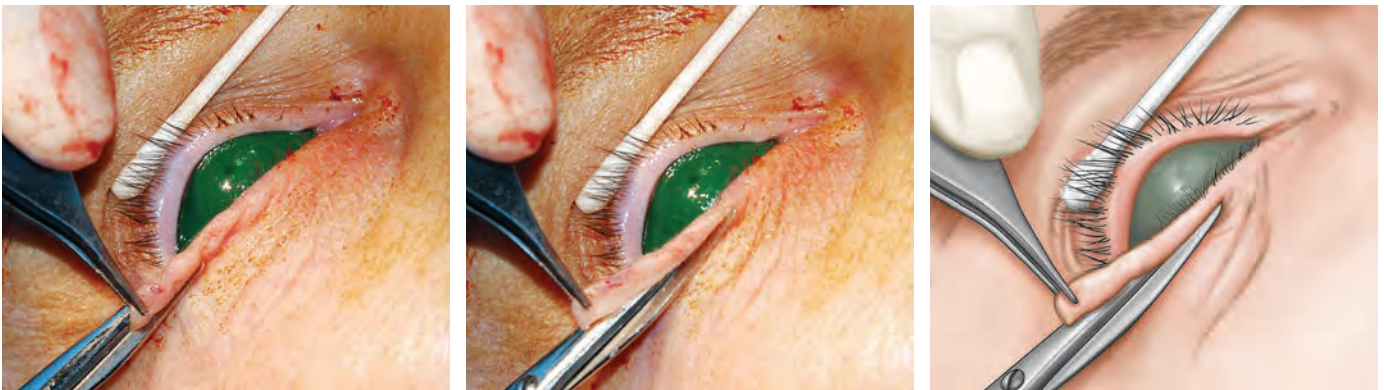
Autologous fat as a filler in the periorbital area is increasing in popularity and effectiveness (see Chapter 13). A variety of fillers, including nonanimal stabilized hyaluronic acid fillers (NASHAs), porcine collagen, and the semipermanent Radiesse are available for volume restoration of the lower lid, especially the nasojugal groove (see Chapter 12).

Pinch Blepharoplasty

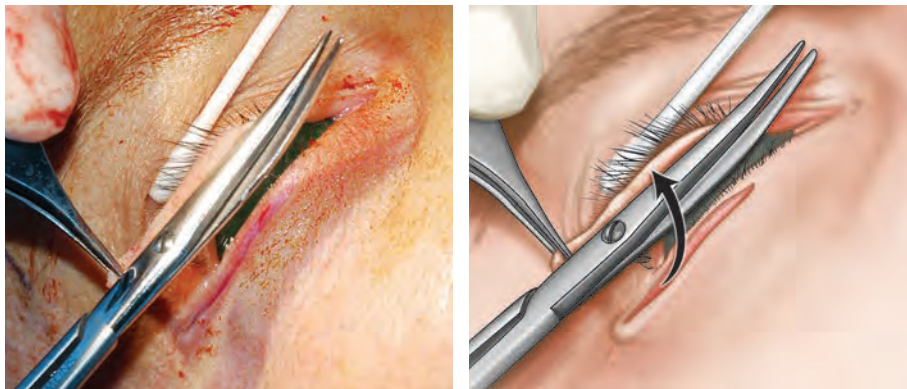
The pinch technique is safe and effective for removal of excess, inelastic eyelid skin without disturbing the underlying orbicularis muscle. Although it has a role as a stand-alone procedure, a pinch blepharoplasty may be combined with transconjunctival fat removal from the lower lid. It may also be used as an adjunct to face-lift procedures such as the extended MACS-lift, which elevates the midface, resulting in excess lower lid skin. Although a canthopexy can be performed with a skin-pinch blepharoplasty, it is not imperative.



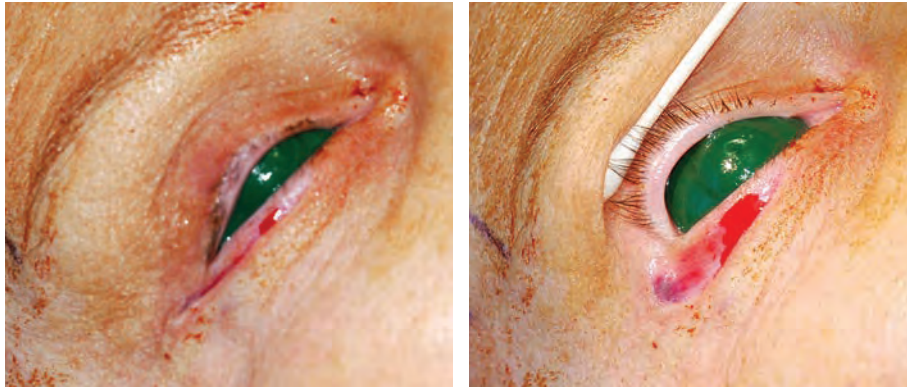
The excess eyelid skin is pinched with one pair of pickups in the left hand while the second pair of pickups in the right hand progressively pinches and squeezes the extra skin, proceeding from lateral to medial.



This “pinched” skin is then trimmed with a pair of scissors.



The skin excision is completed.



Because the skin has been pinched, there is very little bleeding after the skin excision. By spreading the skin, the extent of the resection can be seen, and bleeding points can be cauterized with bipolar cautery.

Transconjunctival Approach

The transconjunctival approach offers two treatment options: preseptal and postseptal. The postseptal approach is the most popular as well as the safest and easiest route to accessing the periorbital fat compartments. This approach only allows fat excision. The incision is made 4 to 5 mm below the tarsal border at the level of the vascular arcade. The conjunctiva and lid retractors are incised together, and the fat pockets are immediately identified and excised as needed.

Options for Lower Eyelid Rejuvenation

Components	Trans-conjunctival Preseptal	Trans-conjunctival Postseptal	Transconjunctival and Laser Resurfacing or Skin Pinch	Skin-Muscle	Skin-Muscle and Orbicularis Flap	Trans-palpebral Midface Lift
Skin	+	+	++	++++	++++	++++
Muscle	+	+	+	++++	++++	++++
Fat	++++	++++	++++	++++	++++	++++
Lid-cheek interface	++++	—	—	—	+++	++++

Degree of effectiveness indicated by the number of pluses.

The preseptal approach affords the opportunity to resect fat as well as the option to redrape the fat; it also provides access to the midface region. The incision is made along the tarsal border through the conjunctiva and lid retractors, then over the peri-orbital septum toward the orbital rim.

These transconjunctival approaches obviously will not allow excision of skin or muscle. Some have advocated approaching the fat and the midface through the transconjunctival approach and adding a simple skin-pinch excision to deal with the excess lower eyelid skin. Laser resurfacing with transconjunctival blepharoplasty is another option. The major advantage of the transconjunctival approach is the fact that no incisions are made in the orbicularis, thus minimizing, if not totally eliminating, the risk of lid retraction. I have found the transconjunctival approach for fat excision to be safe and effective with minimal if any risk of lid retraction. I have also found that it is much more difficult to manipulate fat and to access the midface through a pre-septal transconjunctival approach. I prefer to manipulate the fat and approach the midface through a transcutaneous muscle-skin flap. (See Chapter 33 for more detailed information on transconjunctival blepharoplasty.)

Transcutaneous Approach

The traditional transcutaneous skin-muscle flap is still my preferred approach to the lower eyelid in a patient who requires more than simple fat excision. This approach, especially any incision in the orbicularis, has come under considerable attack and scrutiny over the past few years. Some believe that any incision within the orbicularis will lead to its denervation and result in lid retraction. However, the cause of lid retraction is multifactorial, with orbicularis denervation merely one of the many potential causes.

Causes of Lid Retraction

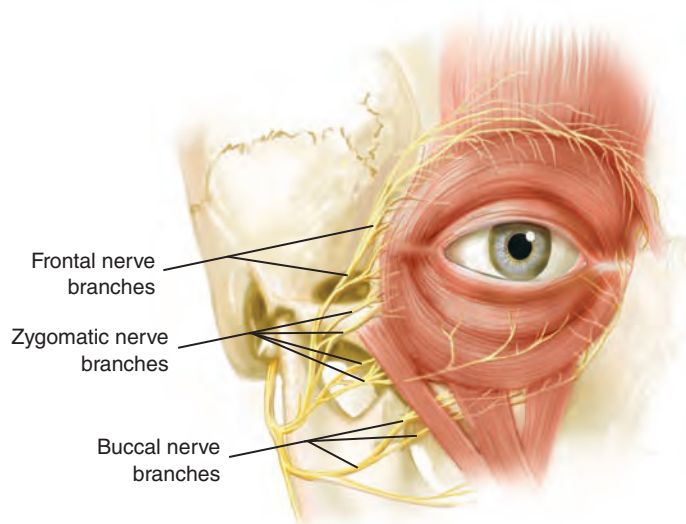
- Anterior lamellar insufficiency
- Middle lamellar scarring
- Lid laxity
- High-risk patient
- Orbicularis muscle excision/denervation

The anterior lamella is composed of skin and the orbicularis muscle. Overresection of skin and muscle will lead to lid retraction. This is easily avoided through judicious skin excision. The middle lamella is composed of the periorbital septum and periorbital fat. Without doubt, scarring of the middle lamella is a major cause of lid retraction, and any procedure requiring manipulation within the middle lamella will increase the risk of lid retraction. This risk is minimized through meticulous dissection and hemostasis in the middle lamella and aggressive treatment of any postoperative bleeding or hematoma.

Unrecognized or untreated lid laxity is also a major cause of lid retraction. The routine application of lid-anchoring techniques in patients undergoing the transcutaneous skin-muscle flap approach and middle lamellar manipulations significantly reduces the risk of lid retraction. Horizontal lid shortening, if indicated, is also my routine. This is particularly appropriate for high-risk patients, including those with prominent or enophthalmic eyes and for anyone undergoing a secondary blepharoplasty. There is no question that true and complete denervation of the orbicularis, especially the pretarsal portion, will lead to lid retraction. Similarly, there is no question that a 5 mm rim of innervated orbicularis should remain on the tarsal plate.

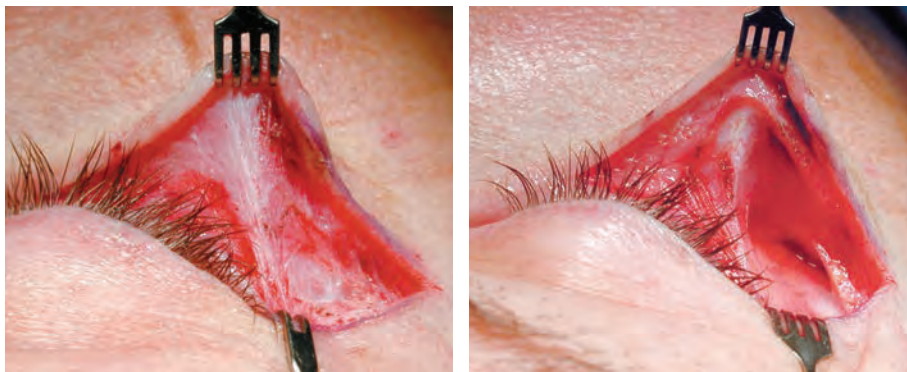
The question of denervation is currently a topic of much debate. The orbicularis is innervated by the zygomatic and buccal branches of the facial nerve. The bulk of the orbicularis muscle, the extracanthal orbicularis, is innervated by the zygomatic branches; classically, these branches run from below upward almost perpendicular to the tarsal plate, and there is no question that division of the orbicularis as in the skin-muscle flap approach, will divide these branches. The extracanthal orbicularis is responsible for squeezing the eyelid, whereas the inner canthal orbicularis (that part of the orbicularis within 5 to 10 mm of the medial canthus) is responsible for eyelid closure, blinking, lower lid tone, and the tear pump.

MOTOR INNERVATION—PERIORBITAL REGION



This extracanthal portion of the muscle is innervated by the buccal branches and is usually preserved with the standard skin-muscle incision unless the incision in the muscle is continued all the way to the medial canthus. Leaving a 5 mm segment of pretarsal muscle on the tarsal plate and limiting the incision in the orbicularis to within 10 to 15 mm of the medial canthus will preserve a functioning, fully innervated portion of the orbicularis with adequate lid tone and closure.

I individualize the extent of the incision in the orbicularis muscle. I approach the lower eyelid through the skin incision and elevate a small skin flap; the orbicularis muscle is then divided separately and elevated as a combined skin-muscle flap. The extent of the incision I make in the orbicularis depends on my plans for the middle lamella.

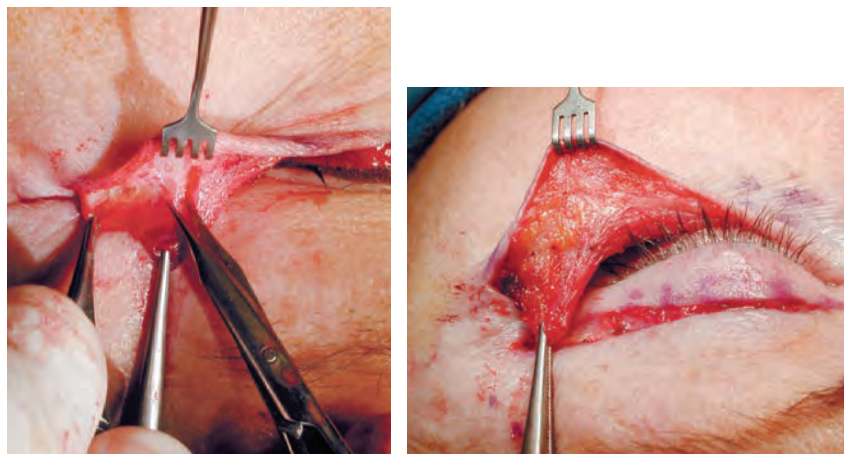


If I do not plan any middle lamellar manipulations, such as fat excision or redraping, I make a *limited-access* incision in the orbicularis starting 10 mm lateral to the lateral canthus and extending up to 10 mm medial to the lateral canthus. This short incision allows access to the entire midface complex. It also enables release of the arcus marginalis all the way to the medial canthus, identification and preservation of the infraorbital nerve, and full subperiosteal dissection of the midface. I prefer to do the dissection with a headlight and a slim retractor, although others have advocated the use of the endoscope.



If fat redraping or dermis fat augmentation is planned, then the orbicularis incision is extended to within 10 to 15 mm of the medial canthus with a *full-access incision*. Both of these incisions allow me to excise as much skin as needed, elevate and fix the midface, redrape the orbicularis, and resect any orbicularis excess. Occasionally, in a patient who has excess periorbital fat, the limited-access incision may be combined with transconjunctival fat removal.

Orbicularis Flap



All of the transcutaneous skin–muscle flap procedures on the lower lid include orbicularis muscle flap redraping. This serves two purposes: functional and aesthetic. The orbicularis is redraped so that it sits snugly against the lower lid tarsus and adds extra support to the lower lid. Redraping with a vertical or combined diagonal and vertical vector will elevate the midface complex, especially the diagonal vector, and will further enhance the youthful appearance of the lower lid.

Transpalpebral Midface Lift

Many approaches are available to rejuvenate the midface area. I prefer this combined approach, because it allows the lower lid and midface to be treated as a single unit. I make a limited-access or full-access incision, depending on the need for middle lamella manipulation. Through either approach, a full subperiosteal dissection and elevation of the midface are performed. I include some subperiosteal dissection below the infraorbital rim on all blepharoplasties in type II, III, and IV patients.

Regional Procedures

Blepharoplasty is one component of periorbital rejuvenation. Often upper lid blepharoplasty is combined with some type of brow or forehead rejuvenation. The lower lid is so intimately involved with the midface complex that I think of the lower lid and cheek as one entity. Therefore, in almost all blepharoplasties for type II, III, and IV patients, I perform a midface lift; the extent, of course, is individualized, depending on the degree of aging and our goals for the patient. These regional procedures reflect the approach to facial rejuvenation, addressing facial zones or the entire face rather than individual components, such as the eyelids, brow, or midface.

Ancillary Procedures

The surgical procedures described will rejuvenate the upper and lower eyelids and improve the relationship of the upper lid and brow, and the lower lid–cheek junction and midface. Frequently, additional ancillary procedures are performed to enhance the result. These include peels, laser resurfacing, alloplastic implants, and fat grafting or fillers as an adjunct.

Laser resurfacing or peeling of sun-damaged, wrinkled skin at the time of blepharoplasty is a safe procedure, because the skin has been elevated as a reliable musculocutaneous flap with a full blood supply.

Fat is the filler material of choice around the eyelids and cheek. Although autologous fat injections are frequently the primary treatment for aging in the periorbital area, they also have a significant role as an adjunct to lower lid blepharoplasty and midface lift. As discussed previously, dermis fat is placed along the orbital rim to enhance the results in patients who have a deficiency in this area. Alloplastic materials, especially cheek implants, may also enhance the results.

Results



This woman in her midforties exhibited type II aging of the lower lid–cheek junction. She also had lid laxity, a round eye, and scleral show bilaterally. She underwent upper and lower lid blepharoplasties with a transpalpebral midface lift and lid anchoring to correct the lid laxity and scleral show. She also had a face and neck lift. Her postoperative result shows correction of the aging changes of the lower lid and correction of the lid laxity and round eye.



This middle-aged woman had type II aging of the lower lids, brow ptosis, grade IV glabellar and forehead lines, and grade III aging of the lower lid–cheek junction and nasolabial folds. She was treated with an endoscopic brow lift, upper and lower lid blepharoplasties with a transpalpebral midface lift, and erbium laser resurfacing of the forehead and glabella. Postoperative views show an improved brow position, lid–cheek junction, midface, and nasolabial folds. The split-face view more dramatically demonstrates the rejuvenative effect of these procedures.



This woman in her late forties had type II aging changes of the lower lids, midface, and jowls. She underwent a short-scar face lift, rhinoplasty, and lower lid blepharoplasty, with fat redistribution and orbicularis redraping. She was very pleased with the improvement in the lower lid-cheek junction, nasolabial folds, and perioral area.

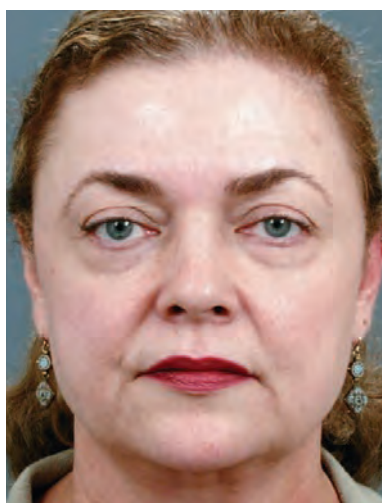


This woman, who is in her sixties, had type III aging of the lower lids, as well as lid laxity, tear-trough deformity, nasojugal grooves, and early development of malar bags. Upper and lower lid blepharoplasties with a transpalpebral midface lift, orbicularis redraping, and canthopexy were performed. She also underwent concomi-

tant erbium laser resurfacing of the periorbital area. The postoperative result shows improvement in the lid-cheek junction, with amelioration of the malar mound and early festoons.



More severe aging changes are evident in this 60-year-old woman, who had type IV aging of the lower eyelids. She had lid laxity; the lateral canthus was significantly lower than the medial canthus. She also had malar mounds and festoons. To address these problems, she underwent lower lid blepharoplasty with a transpalpebral mid-face lift, horizontal lid shortening with cantholysis and canthoplasty, and a face and neck lift. Her postoperative result shows significant improvement in the lower lid-cheek junction, amelioration of the festoons, and improved eyelid position.



This 40-year-old woman had prominent eyes with a Hertel measurement of 23, thus making her a high-risk blepharoplasty patient. She underwent lower lid blepharoplasty with fat redistribution and placement of a primary spacer graft with AlloDerm and canthopexy and a short-scar face lift.



Release of the lower lid retractors is shown (*left*). The primary AlloDerm spacer is placed (*middle*), and the fat is redistributed (*right*).



This split-face view demonstrates the postoperative improvement in the lower lid–cheek junction, with normal lid position.

Long-Term Results



This type II patient is shown 9 years after an endoscopic brow lift, upper and lower blepharoplasty with fat redistribution, orbicularis redraping, and canthopexy.



Preoperative

3 months postoperatively

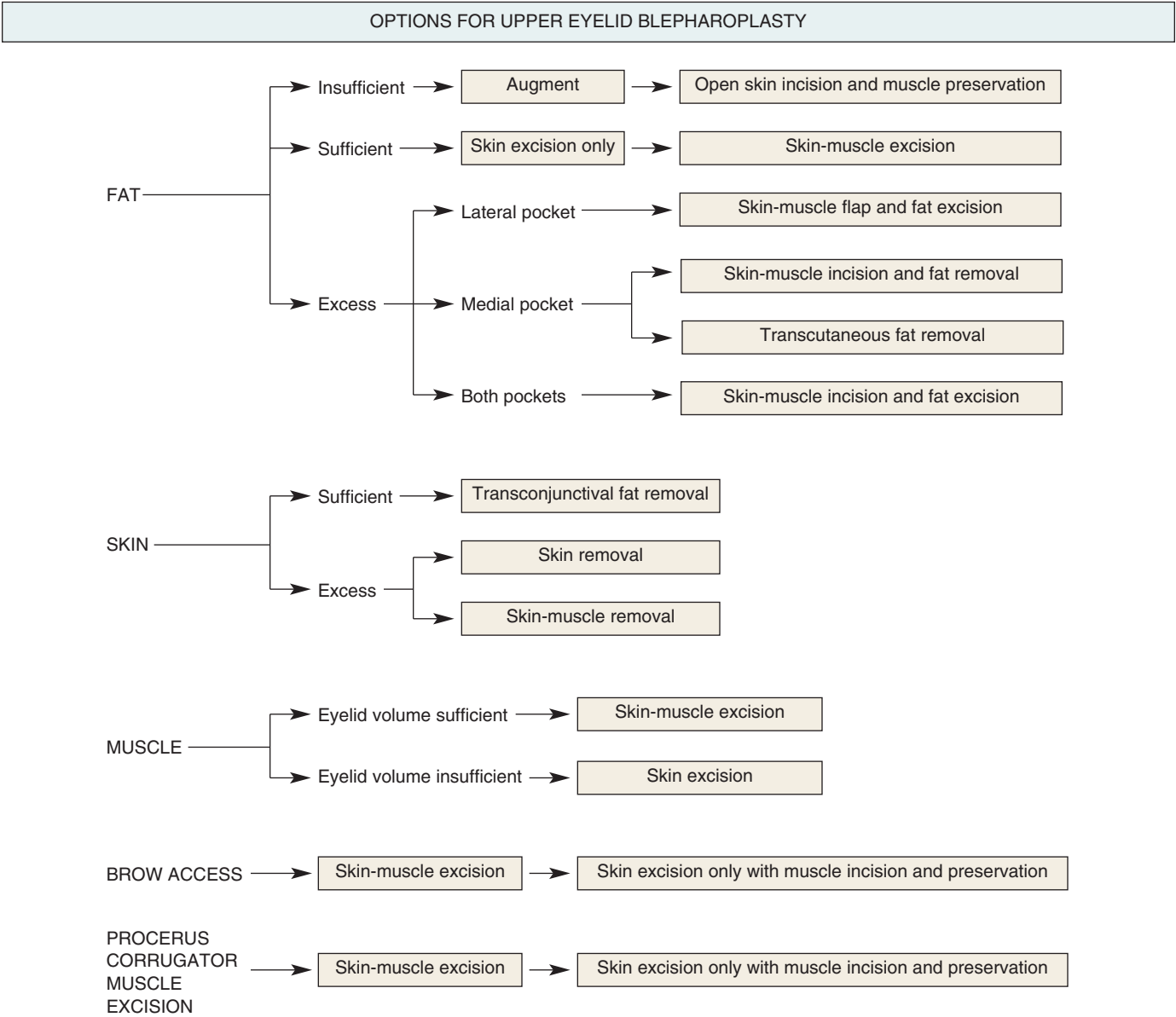
Another type II patient demonstrates a typical result; she is shown 3 months, 5 months, and 5 years after a skin–muscle flap blepharoplasty with fat redistribution, orbicularis redraping, and canthal anchoring.



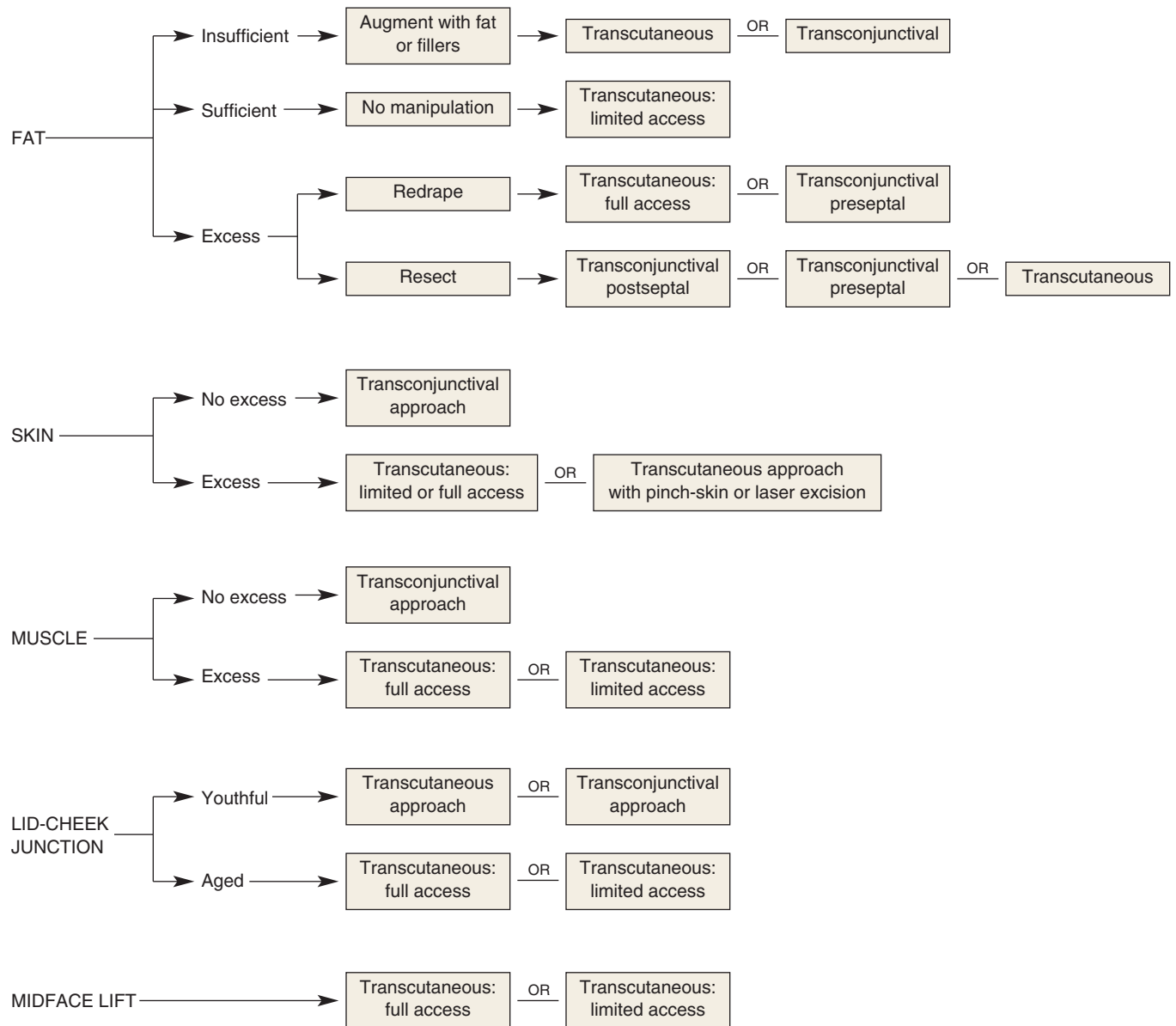
5 months postoperatively

5 years postoperatively

Choosing the Best Option

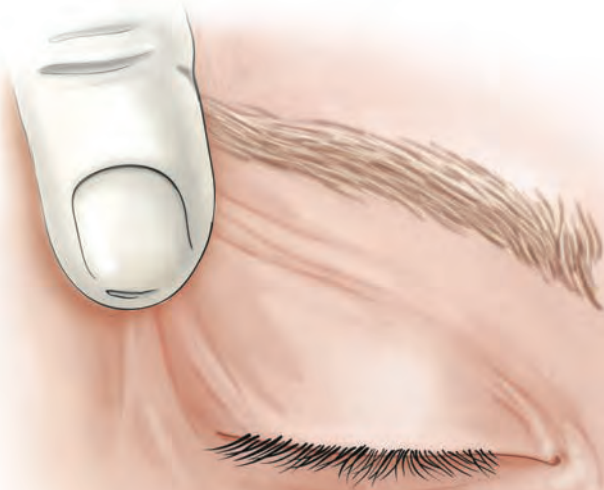


OPTIONS FOR LOWER EYELID BLEPHAROPLASTY



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CHAPTER 28



Upper Eyelid Blepharoplasty

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Blepharoplasty is one of the most commonly performed surgical procedures in the United States. Blepharoplasty in the upper lid is generally less surgically demanding than in the lower lid. However, serious complications such as lagophthalmos and corneal exposure can occur unless the surgeon uses sound judgment. The procedure must be safe, with conservative skin removal, while preserving function and ensuring upper lid closure. The amount of skin left behind in the upper lid is more important than the skin that is removed. Careful assessment of the eyebrow position is essential, because brow ptosis can be a substantial contributing factor to dermatochalasis. It is important to identify risk factors that could increase the potential for complications after blepharoplasty. Once assessment and planning are complete, the blepharoplasty procedure must be performed with precision to achieve the desired goal.

Evolution of Technique

One of the earliest reports of surgery of the eyelids was during the tenth century, when Avicenna (980-1037) noted that excess upper eyelid skin caused visual impairment. Techniques were developed to excise these folds to improve vision. In 1792, in the European literature, Beer first described the excess upper eyelid skin that is now known as *dermatochalasis*. The term *blepharoplasty* was used by Von Graefe in 1818; however, the term was actually applied to reconstructive procedures that were used to correct defects of the upper eyelid caused by excision of carcinoma. Although blepharoplasty was initially used to describe any reconstructive surgical procedure that corrected or shaped the eyelids, the term was later applied to cosmetic procedures, which were developed in the mid-nineteenth century. Descriptions of blepharoplasty techniques were published by a number of authors, including MacKenzie (1830), Alibert (1832), Graf (1836), and Dupuytren (1839), all of whom recommended skin excision only. The presence of pseudoherniation of orbital fat was first described by Sichel (1844), and Bourguet (1929) was the first to propose that fat be removed in addition to skin during blepharoplasty. Bourguet also described two separate fat compartments in the upper eyelid. He was reportedly the first to describe removal of lower eyelid fat through a transconjunctival approach. Joseph (1931) reported on surgical markings for upper and lower eyelid blepharoplasty incisions; these markings are still being used today. Castanares (1951) published one of the initial comprehensive reports of eyelid fat compartments of the upper and lower eyelid. Modern blepharoplasty techniques continued to evolve after World War II through the contributions of many excellent surgeons. Some of the notable surgeons who contributed to the evolution of blepharoplasty include Sheen (1974), who reported the technique of levator fixation for the creation of a supratarsal fold as well as excision of upper lid orbicularis oculi muscle in addition to skin excision, and Baker and Gordon (1977), who refined the technique of upper lid blepharoplasty.

Indications and Contraindications

Candidates for upper blepharoplasty are those with valid physical findings that are amenable to surgical improvement. Typical complaints include excess upper eyelid skin and upper eyelid folds. Candidates should demonstrate complete upper lid closure, as well as normal velocity of closure movement; this is necessary to provide adequate protection of the cornea, thereby preventing exposure. After a normal upper lid blepharoplasty, a small amount of lid closure velocity can occur. Patients who have normal precorneal tear film, ocular motility, Bell's phenomenon, and corneal sensation can usually tolerate this transient event.

Patients with certain preexisting conditions may be at risk of complications after blepharoplasty.



Blepharochalasis, or chronic puffy eyelids, is caused by repeated episodes of extreme eyelid edema, erythema, and thin excess skin resulting from a histamine response and is related to increased levels of immunoglobulin E. This rare condition also seems to be exacerbated during menstrual cycles. Unlike dermatochalasis (excess upper eyelid skin), it is difficult to correct and likely to recur.

Patients with rosacea are predisposed to corneal dryness and possible ulceration from exposure of the cornea after blepharoplasty. Patients with a known history of sarcoidosis should be considered at increased risk for healing complications. Non-caseating granuloma formation in blepharoplasty incisions has been reported; this occurs as a result of sarcoidosis of the surgical scar.

Pemphigus is an autoimmune disorder that leads to chronic inflammatory changes of the conjunctiva and ocular adnexa. Scar contracture of the conjunctival fornix may occur, causing foreshortening and lid malposition. Another periorbital disorder associated with increased risk of complications is benign essential blepharospasm, an involuntary disorder of spastic orbicularis oculi muscle, which often contributes to redundant upper eyelid skin. Blepharoplasty should be avoided, because improve-

ment in symptoms is unlikely. Current management includes a nonoperative approach that involves periorbital injection of the orbicularis oculi muscle with *botulinum* toxin.

Medical Conditions That Could Increase the Risk of Complications

- Blepharochalasis
- Rosacea
- Sarcoidosis
- Pemphigus
- Benign essential blepharospasm
- Graves' disease
- Dry-eye syndrome
- Menopause

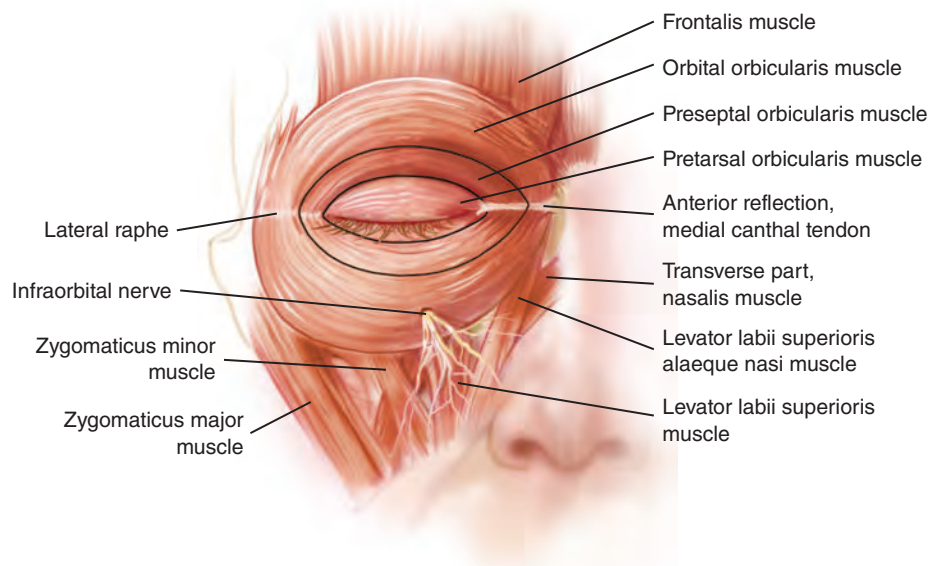
Aesthetic Considerations

Concepts of beauty vary, and there are also significant differences among individuals in upper lid anatomy. When looking at different images of women considered beautiful, we see that beautiful eyelids can differ in regard to the amount of visible skin above the lashes, accentuation of the upper lid, and fullness of the area above the brow. The first step in planning upper lid blepharoplasty is to define specific aesthetic goals for each patient. Patients commonly have their own personal goals, and these should be defined and clarified before surgery. They usually desire a crease-fold relationship similar to their appearance in their youth. Dramatic changes caused by overresection of upper lid tissue can create a hollowed or operated appearance that may be unnatural for the patient.

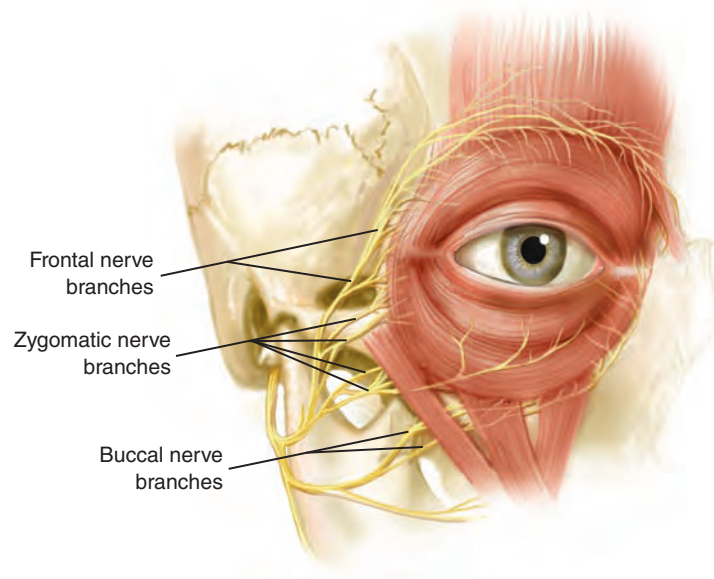
In general, most women want a more visible eyeshadow space with a high upper lid crease and an arched brow. A lower crease, narrower eyeshadow space, and a flatter brow are the standards in men. Commonly, men need brow stabilization during surgery to avoid postoperative brow drop and narrowing of the brow-lash distance after upper lid blepharoplasty.

Pertinent Anatomy

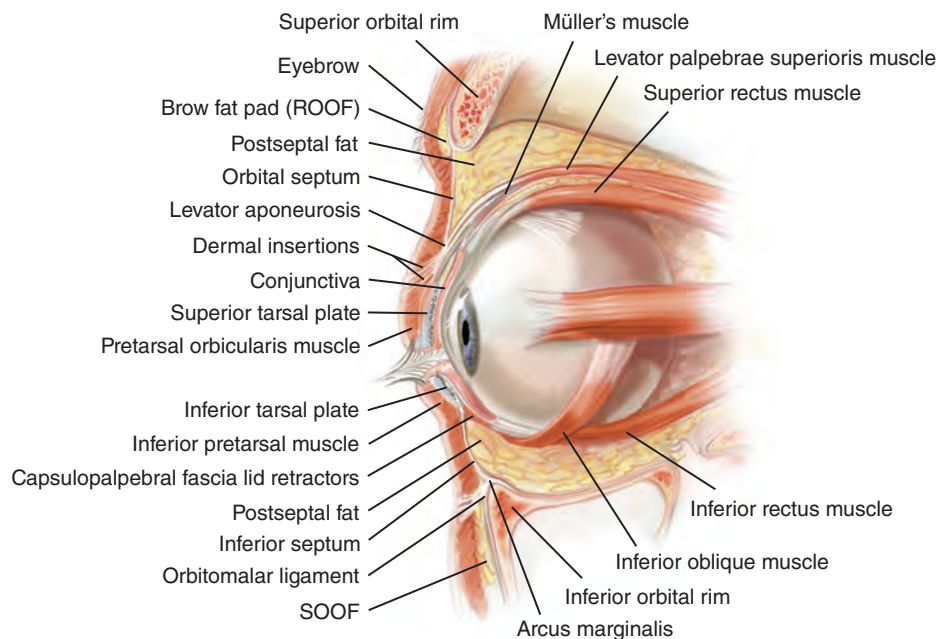
Key landmarks and danger zones to consider when performing blepharoplasty are discussed in detail in Chapter 26.



The muscular anatomy of the periorbital region is shown. The orbicularis muscle is divided into three separate components: the orbital, preseptal, and pretarsal divisions.



The orbicularis muscle is innervated by branches of the facial nerve. Diffuse innervation is supplied by the frontal, zygomatic, and buccal branches. Recent electromyographic studies and cadaver dissections showed evidence of significant innervation of the medial orbicularis muscle of the upper and lower lid from the buccal branch.

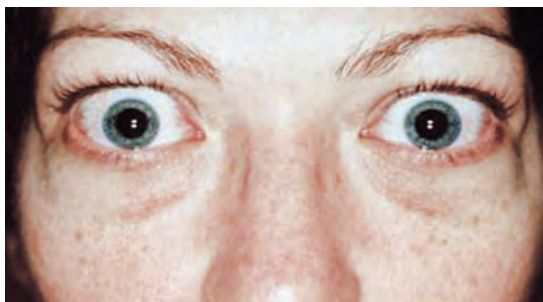


Cross-sectional anatomy demonstrates the anterior and posterior lamella as well as the layers of muscle, fat, and ligaments that contribute to the periorbital contour.

Preoperative Assessment

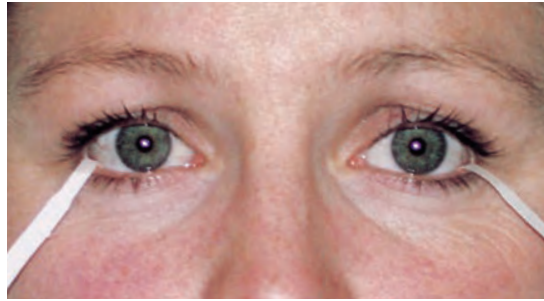
Medical History and Evaluation

The first step in a thorough evaluation includes a history directed toward identification of specific medical conditions that can increase the risk of complications. These conditions include blepharochalasis, rosacea, pemphigus, Graves' disease, and benign essential blepharospasm. Blepharoplasty may be contraindicated in these individuals. If the surgeon decides to proceed with the surgery, the blepharoplasty should be conservative to minimize the risk of corneal dryness or lid malposition.



Patients with puffy eyelids are often seen by the plastic surgeon with undiagnosed hyperthyroid or euthyroid Graves' disease. Preoperative evaluation should take into account the results of laboratory testing, including free T4 levels, and an endocrine

consultation may be appropriate. Ocular manifestations of Graves' disease often include upper and lower lid retraction, increased orbital volume, exophthalmos, and puffy eyelids. Standard blepharoplasty techniques should be modified to correct lid position because of the increased risk of corneal exposure and keratitis.



Patients with an underlying history of dry eyes, which is often associated with intolerance to contact lenses, require preoperative tear film evaluation, including Schirmer's test. Schirmer's test is performed by anesthetizing the conjunctiva in the inferior lateral fornix with tetracaine eyedrops. The excess tear film is blotted with a cotton-tipped applicator, and a Schirmer's strip is placed in the lateral fornix while the patient maintains a forward gaze. Tear production is considered decreased when less than 10 mm of the Schirmer's strip is wet after 5 minutes.

The combination of decreased tear production with increased operative tear film loss from lagophthalmos after blepharoplasty may contribute to significant corneal exposure, including the potential for keratoconjunctivitis or corneal ulceration. Patients with a history of dry eyes who have an abnormal Bell's phenomenon on physical examination are at particular risk for corneal exposure. To minimize complications in this group of patients, blepharoplasty should be approached with caution and performed conservatively. In addition, patients who have had recent LASIK surgery for vision enhancement should not undergo blepharoplasty for at least 6 months to allow adequate corneal sensation to return and to give the corneal incision adequate time to heal, minimizing the risk of superinfection.

In addition to patients with underlying medical conditions, patients with unrealistic expectations may be at risk for dissatisfaction and should be identified before surgery. This group of patients is quite varied and most commonly includes younger patients who demonstrate minimal anatomic findings that are out of proportion to their complaints. Patients who have had previous surgery performed by another surgeon and who are inordinately upset despite minimal imperfections also require careful evaluation and possible psychiatric screening. These patients should be asked to demonstrate the precise nature of their concerns, along with preoperative photographs of their eye appearance. If a valid complaint cannot be substantiated by careful evaluation, surgery should be deferred.

Physical Examination

The physical examination of patients who present for blepharoplasty should proceed sequentially to ensure complete assessment of the periorbital anatomy. Visual acuity is tested with a Snellen eye chart. Bell's phenomenon should be documented. If a patient has dry eyes or a history of dry eyes, a Schirmer's test is performed, and referral to an ophthalmologist should be considered.

Upper Lid

The upper eyelids should be evaluated for excess skin (dermatochalasis), excess orbital fat, eyelid ptosis, levator function, prolapse of the lacrimal glands, excess retroorbicularis oculi fat (ROOF) or brow fat pads, prominent supraorbital rims, and floppy upper lid syndrome. Asymmetrical upper eyelid folds may be caused by upper lid ptosis, brow asymmetry, upper lid retraction, or asymmetrical amounts of excess tissue.

Blepharoptosis is the abnormally low position of the upper eyelid on normal gaze. It is important to differentiate simple dermatochalasis from upper lid ptosis to ensure optimal results. Clinical measures that should be taken are the position of the upper lid margin, the levator function and the lid crease height. The upper lid margins should be symmetrical and should not be lower than 2 mm from the superior corneoscleral limbus. Levator function is assessed by measuring the upper eyelid excursion from extreme downgaze to extreme upgaze and should be more than 10 mm. This should be measured by stabilizing the eyebrow to limit contribution from the compensating frontalis muscle. The normal upper lid crease is 7 to 10 mm above the lid margin and is usually higher in women than in men. In simple dermatochalasis these measurements are normal. The type of blepharoptosis most commonly seen in an aesthetic patient is involutional ptosis, which may be seen in conjunction with dermatochalasis or brow ptosis. In this type, the patient will notice gradual descent of the upper eyelid, an elevated lid crease height, and normal levator function. These patients' ptosis can easily be corrected with tarslevator advancement during the upper blepharoplasty procedure.

Common Causes of Upper Lid Ptosis

- Congenital ptosis
- Involutional ptosis
- Aponeurotic dehiscence
- Myogenic ptosis—myasthenia gravis
- Chronic progressive external ophthalmoplegia
- Neurogenic ptosis—Horner's syndrome
- Mechanical ptosis—tumor, trauma



Patients who are thought to have upper lid ptosis should also be carefully evaluated for a history of congenital ptosis; aponeurotic dehiscence; myogenic ptosis, including myasthenia gravis; chronic progressive external ophthalmoplegia; neurogenic ptosis, including Horner's syndrome; and mechanical ptosis from tumor or trauma.



Patients with minimal unilateral acquired ptosis should undergo the cover test, which is performed by placing an eye patch over the ptotic eyelid for 5 minutes, after which the contralateral eyelid is evaluated. This often reveals an underlying ptosis in the contralateral eyelid, since there is decreased visual input from the ptotic eye. Hering's law of equal innervation states that decreased visual input from one eye with ptosis will result in increased and equal neural output to both eyelids to raise the level of the eyelids, resulting in an equal increase in activity of both levator muscles. The cover test is required to isolate and objectively evaluate the contralateral non-ptotic eyelid.

Preoperative evaluation also includes examination of the superior lateral orbit for prolapse of the lacrimal gland. Excess ROOF requires conservative removal of the brow fat pad lateral to the supraorbital nerve. This may be combined with an internal browpexy of the lateral brow. Extreme fullness of the superolateral orbital rim may be addressed with an osteoplasty using a burr to reduce the bony prominence.



The upper eyelid should be evaluated for floppy eyelid syndrome, which is common in large, burly men. The upper eyelid everts during forced closure; correction requires resection of a portion of the lateral tarsal plate with canthoplasty of the upper lid. Failure to correct this can result in postblepharoplasty closure problems: an overriding upper eyelid, chemosis, or separation from the globe.

Brow

The eyelid must always be considered in conjunction with the eyebrow. The eyebrow should be evaluated for ptosis and symmetry in addition to the aesthetic relationship between the height of the nasal and lateral portions of the brow. In men, the brow should be at the superior orbital rim, whereas in women, the brow should be above the rim, with the arch apex in line with the lateral limbus. Signs of brow ptosis include lateral upper eyelid hooding and a narrowed brow-lash distance. The descent of eyebrow fat and the excess upper lid skin that develops with age may obstruct vision. Compensation by frontalis contraction keeps the eyebrow above the orbital rim, clearing the visual field. Once the upper lid skin is removed, frontalis compensation is no longer necessary, and underlying brow ptosis becomes apparent. Concomitant brow lift or internal brow fixation through the blepharoplasty incision can help to stabilize the eyebrow in the proper position. Lack of brow stability will predispose the patient to descent of the brow after an upper blepharoplasty if the brow laxity is not corrected. Furthermore, patients with underlying unilateral upper lid ptosis may present with eyebrow asymmetry, which is apparent to the patient, even though the ptosis may not be.

Dynamic lines caused by activity of the procerus and corrugator muscles require evaluation and may be treated either nonsurgically with neurotoxin injection or surgically with a brow lift using an endoscopic approach, open approach, or transpalpebral corrugator resection combined with internal browpexy.

Patient Preparation

Preoperative instructions to the patient should include cessation of all medications that increase the risk of bruising and swelling, including aspirin, ibuprofen, and vitamin E. Homeopathic herbs such as *Arnica montana* and bromelain may reduce postoperative edema and ecchymosis, and we have used these routinely for more than 15 years. Patients should be instructed to carefully remove all makeup, particularly mascara residue, and to wash the face the morning of surgery. Blepharoplasty can be performed with the patient under general anesthesia or with intravenous conscious sedation. Patients should be placed in a reverse Trendelenburg position to decrease venous pressure. Surgical preparation includes application of a dilute solution of povidone-iodine to the eyelids and face, carefully avoiding exposure of the conjunctiva, and irrigation of the eyes with balanced saline solution before placement of corneal protectors.

Operative Technique

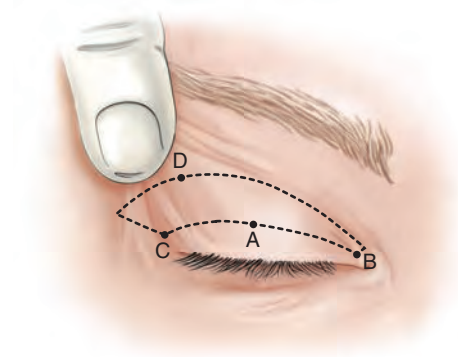
Anesthesia



After adequate intravenous or general anesthesia is obtained, we recommend administration of preoperative antibiotic agents. Local anesthetic consisting of lidocaine 1% with epinephrine 1:100,000 is injected with a 27-gauge needle into the planned area of resection of the upper eyelid. To reduce the risk of eyelid or retrobulbar hematoma, the marginal arcades and the deep orbital structures are carefully avoided. The infiltrate should be allowed to sit for 7 minutes before the incision to allow maximal vasoconstriction.

Markings

The patient's eyelids are marked on the operating table after induction of anesthesia. This permits more precise measurements using loupe magnification and calipers to ensure symmetry of markings on both eyelids. Fine, wooden-tipped applicators are used to mark the incisions with methylene blue.

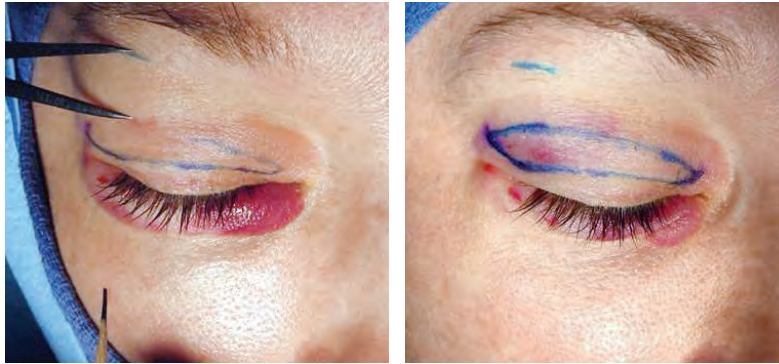


It is possible to determine the amount of skin to be excised by using a forceps to pinch the excess skin and muscle. However, it is not our practice to premark the amount of skin to be removed by bunching. Functionally, the amount of skin that is to be removed from the upper lid is not as important as the amount of skin that is left behind after blepharoplasty. Four points, A through D, are important for the upper blepharoplasty markings.



The inferior excision line is drawn first. The initial mark indicates the upper eyelid crease at the level of the midpupillary line (point A). In women this is usually 10 mm above the lash margin and in men 7 mm above the lash margin. The markings are tapered inferiorly at the medial and lateral lid margins following the gentle curve of the upper lid crease. The lateral and medial marking should be 6 mm above the lash line superior to the respective canthi (points B and C). The medial aspect of the markings should not extend nasal to the caruncle to avoid webbing or epicanthal folds

above the medial canthus. The lateral extension should proceed in a crow's-feet skin line corresponding to the amount of redundant skin but should not extend past the lateral orbital rim to prevent a prominent scar.



The superior marking of the skin incision is started at the level of the lateral limbus (point *D*). At this point at least 10 mm of skin should be preserved between the superior incision and the beginning of the thick eyebrow skin. The superior mark is completed by following a gentle curve paralleling the contour of the lower marking and tapering nasally to reduce the amount of skin and muscle that is removed along the nasal half of the incision. No more than 5 mm of skin should be removed nasally; overresection of skin and muscle is poorly tolerated nasally and often results in lagophthalmos, which can cause corneal dryness. Because the cornea is much more forgiving of lagophthalmos in the temporal half of the upper lid, more aggressive skin removal can be performed laterally. Postoperative lagophthalmos in the nasal half of the upper lid causes more symptoms of corneal exposure. Therefore efforts to correct skin laxity in the nasal upper lid should be more conservative, relying on brow repositioning if possible.



The skin-pinch technique for skin removal is used only in patients who need a touchup after a previous blepharoplasty and in some primary patients who already have a well-defined eyeshadow space and upper lid crease but have small redundant skin folds.

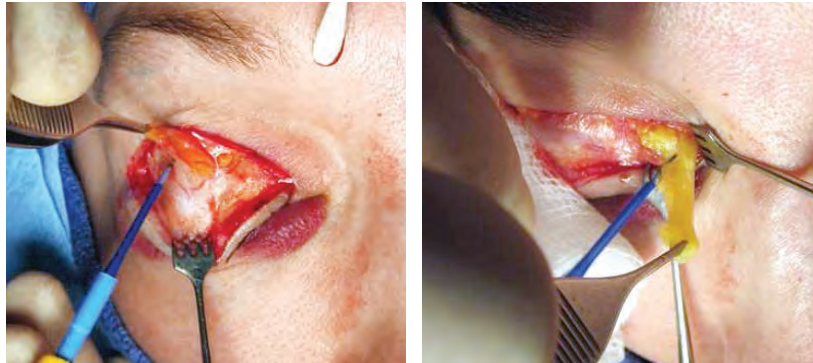
During the process of marking, the surgeon should pay special attention to the presence of asymmetry of the eyebrow and eyelid fold. If the brows are asymmetrical preoperatively, the upper eyelid markings should closely approximate one another, but a concurrent procedure should be planned to correct brow position. However, if the lid folds are asymmetrical, symmetry can be achieved by removing different amounts of skin and muscle from each eyelid.



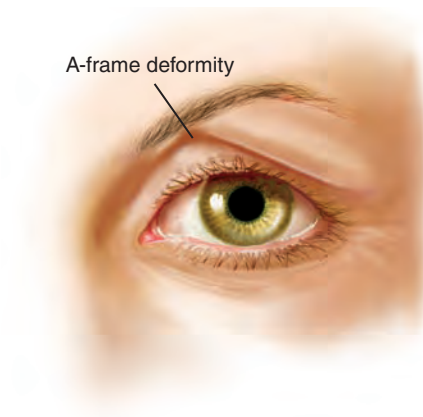
The complete upper eyelid marking is incised with a scalpel through the skin and orbicularis oculi muscle. The upper edge of the incision is completed with needle-tipped cautery, exposing the orbital septum.



The orbital septum is opened with Westcott scissors. This technique provides an *open-sky* approach to the preaponeurotic space and exposes the orbital fat. The septum should be opened along the upper incision to avoid injury to the aponeurosis, which is present posterior to the orbicularis muscle at the lower incision in the lid crease.



Removal of fat from the central and nasal compartment can be performed conservatively, carefully preserving the interpad septum between the central and nasal fat pads.



Overresection of fat in this area will result in an A-frame or peaked-arch deformity of the supratarsal crease. Preservation of fat at the interpad septum will maintain a symmetrical, gentle arch below the new upper lid fold. When fat excision is indicated, it can be performed by direct sculpting with the needle-tipped cautery, which allows greater precision and visualization of the medial palpebral artery. Clamping, resecting, and cauterizing fat should be discouraged, because this can result in uncontrolled bleeding. Inadequate cauterization can result in bleeding from the nasal fat pad. Poor visualization and indiscriminate cauterization within the deep nasal orbit have been reported to contribute to injury to the trochlea and superior oblique muscle. Patients with injury to the superior oblique muscle will exhibit diplopia and head tilt toward the side of the superior oblique injury after blepharoplasty. Preservation of fat should be considered to prevent creation of a hollow, more aged-appearing orbit.



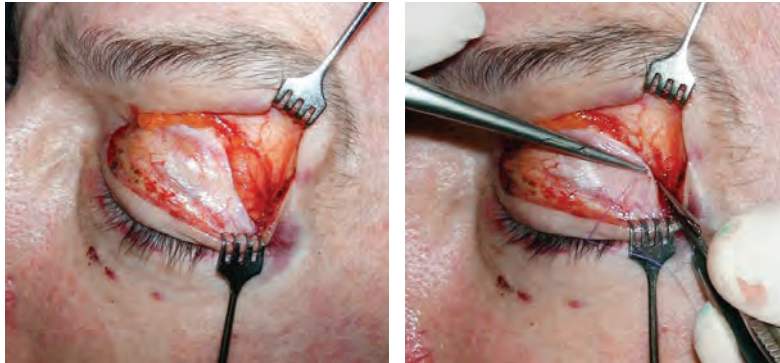
Excess skin, muscle, and septum are resected with scissors beveling away from the levator insertion into the upper lid crease. This open-sky technique takes the same amount of septum and orbicularis as it does skin, which reduces the risk of postoperative lagophthalmos by reducing subcutaneous bulk. If the edges of a large skin resection are closed over large amounts of underlying orbicularis, a relative skin shortage is produced, causing upper lid tightness and decreased lid closure velocity.



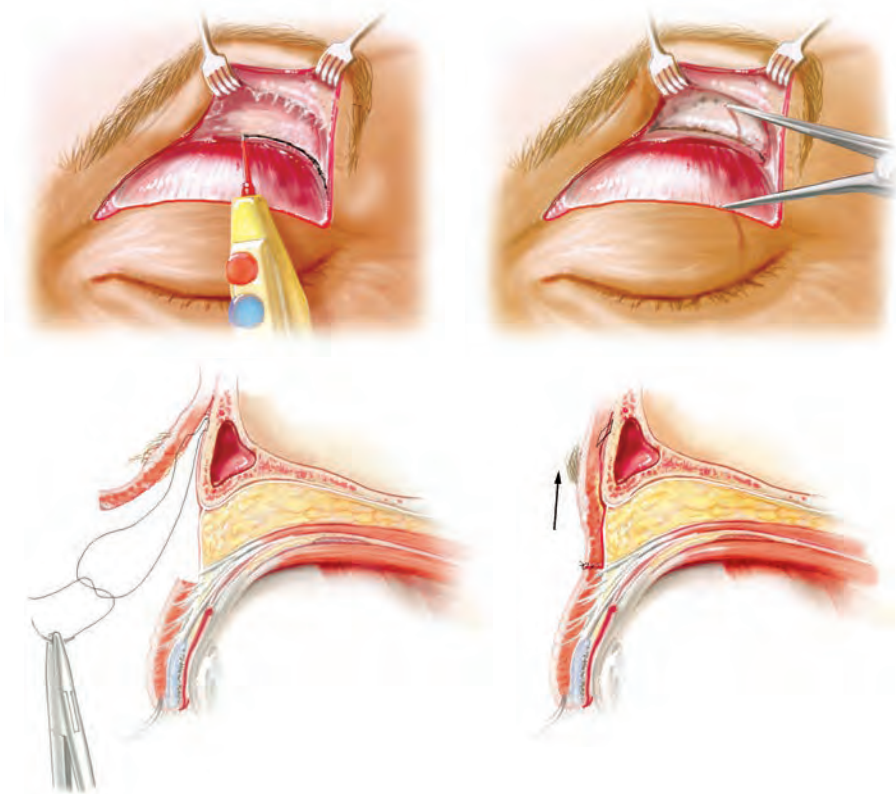
Surgical disinsertion of the levator aponeurosis after upper blepharoplasty is a well-recognized cause of postoperative acquired ptosis. To minimize the potential for this, supratarsal fixation of the pretarsal skin muscle to the levator aponeurosis is performed as a routine part of upper blepharoplasty using a horizontal mattress suture of 6-0 Vicryl at the midpupillary line.



Lateral brow fullness is caused by a prominent bony orbital rim or by excessive brow fat (ROOF). The ROOF should be evaluated, and conservative resection of the brow fat pad can then be performed by retracting the upper lid edge of the blepharoplasty flap, exposing the superior orbital rim and ROOF. The redundant brow fat is marked and resected away from the orbital rim with electrocautery. The underlying periosteum should be left intact to prevent the development of restrictive adhesions.



Ptosis of the orbital lobe of the lacrimal gland may be present and should be corrected with suspension of the lacrimal gland into the lacrimal sac fossa. This is performed by placing the lateral horn on traction and suturing the levator aponeurosis to the arcus marginalis with a 6-0 Vicryl suture just at the level of the lacrimal gland to prevent future lacrimal gland ptosis. The levator aponeurosis needs to be placed on a downward stretch to eliminate the risk of postoperative lagophthalmos. To avoid postoperative dry-eye syndrome, the lacrimal gland should not be resected.



Internal brow fixation through the upper blepharoplasty incision can be performed in patients who have mild laxity and require lateral brow support. After upper blepharoplasty is completed, the superior lateral orbital rim and lateral brow area are exposed by retracting the superior blepharoplasty incision. The orbicularis and ROOF are dissected just superficial to the periosteum along the lateral third of the eyebrow.

The dissection continues upward and laterally for 2 to 3 cm. Dissection cephalic to the orbital rim should be performed bluntly with a cotton-tipped applicator to avoid injury to the perforating zygomaticotemporal vein found in this area. Care should be taken to completely release the lateral zone of fixation at the junction of the temporal line of fusion and supraorbital rim. An internal browpexy is performed using a 4-0 Prolene suture just deep to the dermis at the level of the inferior hair-bearing brow and the underlying periosteum. The brow can be sutured 5 to 10 mm above the orbital rim at the level of the lateral corneoscleral limbus to recreate the peak of the brow. Only mild elevation can be obtained with an internal browpexy, but it provides stabilization of the tail of the brow to prevent brow ptosis after the blepharoplasty, which results in residual skin folds laterally.



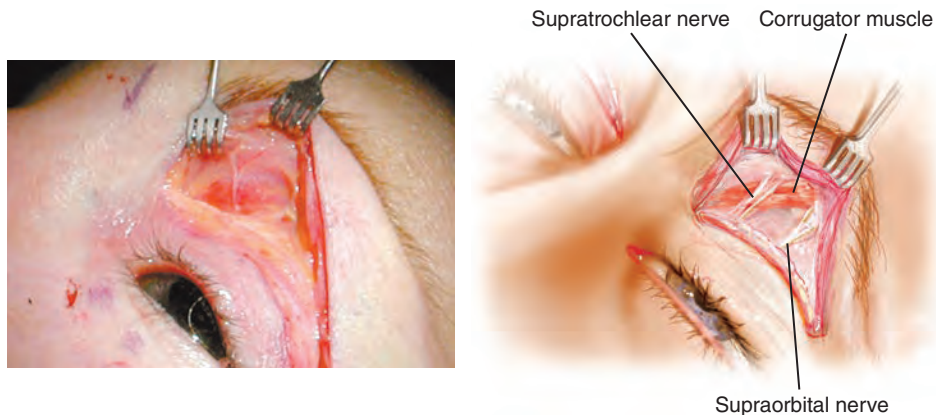
After removal of excess skin, muscle, and fat, the upper lid incision is generously irrigated with normal saline solution to remove any residual liquefied fat that can result in postoperative granuloma formation. The incision is closed with initial sutures placed superior to the lateral canthus with interrupted 6-0 nylon that align the skin and muscle. The incision lateral to the canthus is closed with interrupted 6-0 nylon sutures and the incision medial to the lateral canthus with a running 6-0 nylon. Although an intracuticular closure is commonly used, a running suture that encompasses both skin and muscle reduces tension on the dermis and leaves a better scar. In addition, the interposed muscle prevents formation of adhesions from the dermis to the aponeurosis, thereby minimizing contour irregularity and lagophthalmos.

Ancillary Techniques for Upper Lid Rejuvenation

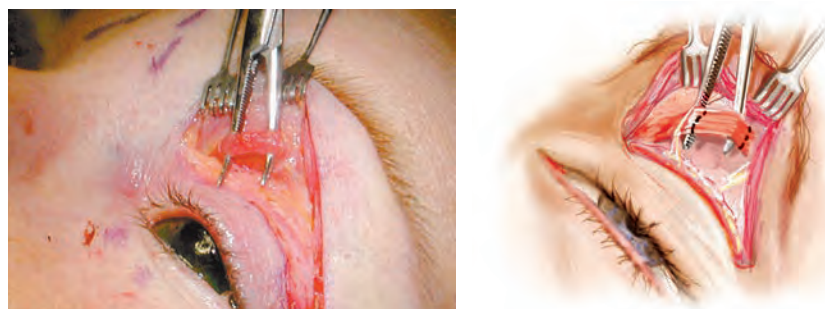
Transblepharoplasty Excision of Corrugator and Procerus Muscles

The upper eyelid, by providing limited access to the forehead, may be thought of as a gateway to the medial and lateral brow. This gateway is limited by the supraorbital and supratrochlear nerves. Modification of the glabellar muscles through the

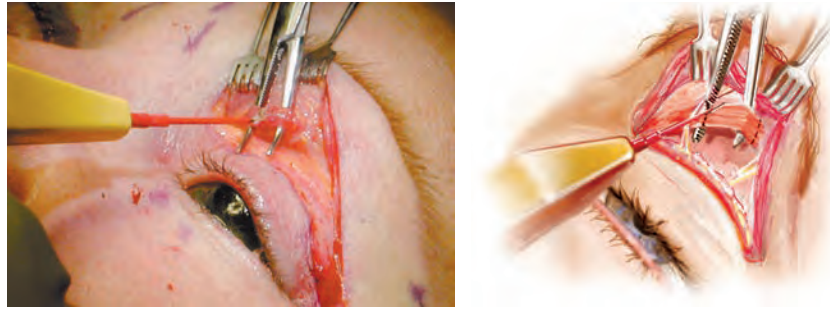
upper eyelid incision is effective in improving glabellar lines with minimal medial brow elevation. The ideal candidates for this procedure are patients who are undergoing an upper blepharoplasty, have glabellar frown lines, minimal or no brow ptosis, and no excess skin above the nasal radix.



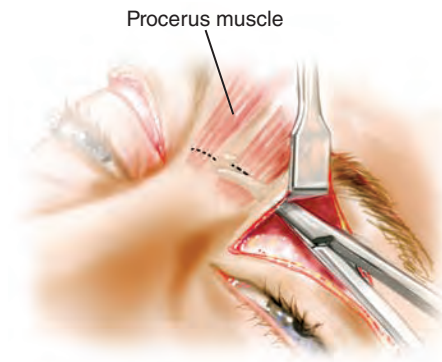
After the upper lid blepharoplasty has been completed, the assistant retracts the superior blepharoplasty incision, helping to expose the glabellar area. Dissection is performed deep to the orbicularis toward the corrugator muscles with spreading scissors or a cutting needle Bovie. As the superior orbital rim is approached, one can identify the diagonal muscle fibers of the corrugator. Care should be taken to identify and preserve the supraorbital and supratrochlear nerve branches, which are visible at this stage. The supraorbital nerve is the larger and more lateral, and the supratrochlear branches are smaller, medial, and usually intertwined with the corrugator muscle.



Once the corrugator is identified, a small mosquito clamp is used to dissect it and bring it forward.



With the muscle isolated, coagulating current is used to resect a segment of the corrugator muscle, producing a central gap. Injuries to the trochlea or superior oblique muscle tendon are rare and are easily avoided by limiting any dissection behind the origin of the corrugator.



The procerus muscle can also be divided through the upper blepharoplasty incision. Patients with transverse glabellar or dorsal nasal skin lines from procerus muscle activity benefit from this procedure. The orbicularis is elevated, and then a pair of scissors are pushed blindly toward the nasal radix, cutting the fibers under the skin.

Postoperative swelling after these procedures is more prolonged than with standard blepharoplasty. Head elevation and ice packs help with the swelling. The use of diuretics and a short course of methylprednisolone (Medrol Dosepak) can be considered in some patients.

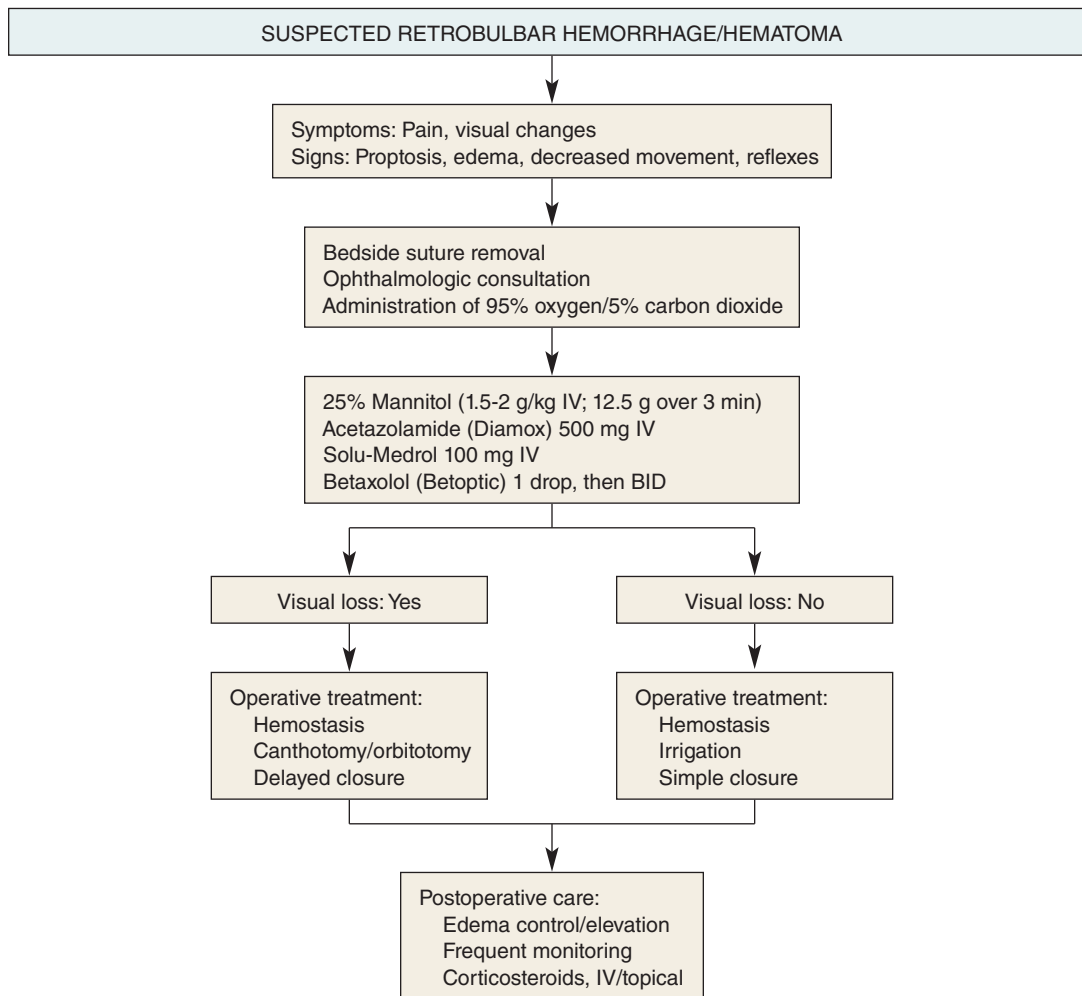
Postoperative Care

The patient's head should remain elevated to reduce edema and ophthalmic pressure. Ice packs or cold compresses are applied to the eyelids for 48 hours. The eyes should remain lubricated at all times with saline drops during the day and lubricating ointment at night. Lagophthalmos can be caused by periorbital edema; it resolves spontaneously in 1 to 2 weeks. In these cases the eyedrops and ointment are essential to prevent corneal exposure and abrasions. Before discharge the patient's vision should be evaluated and documented. Any signs of corneal irritation or decreased visual acuity require careful ophthalmologic evaluation including slit-lamp examination with the use of fluorescein eyedrops to evaluate the cornea. Patients are asked to avoid the use of eyelid makeup on the suture lines and contact lenses for 2 weeks after blepharoplasty. The sutures are removed 5 days postoperatively.

Complications

Vision Loss

Permanent vision loss is the most feared complication after blepharoplasty. If this occurs, it is usually caused by retrobulbar hemorrhage. In an epidemiologic study of more than 250,000 blepharoplasties, the incidence of retrobulbar hemorrhage was 1 in 2000, with a 1 in 10,000 risk of permanent visual loss associated with it. Acute retrobulbar hemorrhage may compress neurovascular structures, leading to ischemia of the retina, central artery, and optic nerve. Most hemorrhages occur within the first 24 hours after surgery (96%), and of these, more than half occur within the first 6 hours postoperatively. The patient can present with severe pain and pressure and visual changes that include hemianopsia, scotomas, or amaurosis fugax. Physical examination will reveal a tense and proptotic eye and loss of pupillary reflexes with diminished or absent extraocular movements. Urgent treatment should be implemented, because 90 to 120 minutes of ischemia can lead to irreversible blindness. An ophthalmic consultation should be obtained immediately. If intraocular pressure is elevated, topical and systemic glaucoma medications such as mannitol and acetazolamide (Diamox) are started. Systemic corticosteroids are needed to address significant edema. The patient should be taken back to the operating room. The sutures are removed and the surgical wound is reexplored to check for bleeding. If the condition remains unresponsive, lateral canthotomy and cantholysis are performed to relieve pressure. If these measures fail, a CT scan without contrast is warranted to rule out a posterior hematoma. In these cases bony decompression may relieve orbital apex compression. The algorithm on p. 884 outlines the means for assessing and treating retrobulbar hematomas.



Steps to Reduce the Risk of Retrobulbar Hemorrhage

- Maintain normal blood pressure.
- Inject anesthetic with care.
- Manipulate orbital fat gently during dissection.
- Ensure meticulous hemostasis.
- Place the patient in a head-up position postoperatively.
- Provide pain control measures.
- Instruct the patient to avoid strenuous activity.

Vision loss from perforation of the globe during the blepharoplasty can be prevented with the use of corneal protectors. Diplopia may result from impaired ocular motility. In upper lid surgery it can be from edema or stretching of the vertical recti and superior oblique muscles. Conservative management is recommended since the diplopia will often resolve in the first few months as the edema and inflammation subside.

Hematoma

When a hematoma is seen intraoperatively, the wound should be explored, evacuation performed, and proper hemostasis obtained. Small superficial postoperative hematomas are treated conservatively with ice compresses and rarely need to be drained by reopening the wound. If they persist, they can be evacuated with needle aspiration or stab wound drainage after spontaneous clot dissolution 7 to 10 days later. Large, expanding hematomas seen after surgery require immediate surgical exploration and evacuation. Residual areas of organized clotting can result in nodular irregularities or scarring of the middle lamella.

Lagophthalmos

Lagophthalmos may result from excessive skin resection or edema. It can lead to patient discomfort from exposed keratopathy and is worse in those with a preexisting dry-eye condition. Lagophthalmos after blepharoplasty is usually temporary and can be managed conservatively with patient reassurance, light massage, taping, and application of lubricants day and night. If conservative therapy fails, surgical options include skin grafting, and release of orbital-septal adhesions. When placing a full-thickness skin graft in the upper lid, it must not distort the upper lid crease. It is placed in the pretarsal area not extending above the crease (over the eyeshadow space).

Dry-Eye Syndrome

Dry-eye syndrome is not an uncommon sequela after blepharoplasty. Even minimal widening of the palpebral fissure with blepharoplasty can produce keratopathy in patients with low tear production. Patients in their fifties or sixties (when tear production is diminished), women receiving estrogen replacement therapy, patients who cannot tolerate contact lenses, or those with a history of increased sensitivity and dry-eye irritation are especially at risk for dry-eye syndrome. Performing Schirmer's test is important in the preoperative evaluation of these patients. Patients with a significant decrease of tear production with an absent Bell's phenomenon are not suitable candidates for aesthetic blepharoplasty. Initial treatment consists of ocular lubrication with artificial tears and ophthalmic ointment. Failure of this treatment should prompt ophthalmologic examination and consideration of punctal occlusion or additional antiinflammatory eyedrops such as topical cyclosporine.

Blepharoptosis

Eyelid ptosis can be a common finding several hours after the procedure as a result of the effects of local anesthesia on the levator muscle. Persistent ptosis can be caused by edema or injury to the levator. Mild cases may resolve spontaneously and can be managed expectantly for at least 3 months before surgery is considered. Severe ptosis with poor levator function requires reexploration and levator repair. If injury to the levator is noticed at the time of surgery, it should be sutured back to the tarsus.

Overresection of Fat

Conservative blepharoplasty is the rule today, since overzealous fat resection can lead to an unaesthetic, hollow, skeletonized appearance. Options for correction of a sunken upper lid include fat transposition or grafting and the use of synthetic fillers.

Infection

Infection is very rare after blepharoplasty because it is a highly vascularized area. If infection occurs, it can be treated with antibiotics and drainage if necessary.

Results

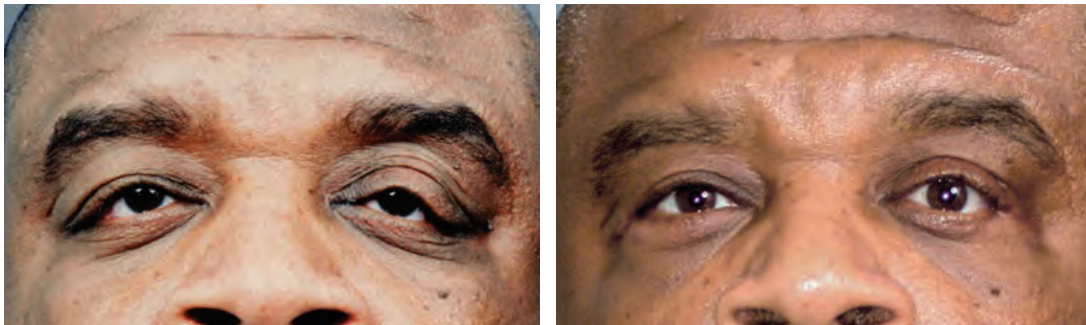
The following cases have been selected to represent a variety and continuum of patients who demonstrate age-related changes of the eyelids and periorbital region.



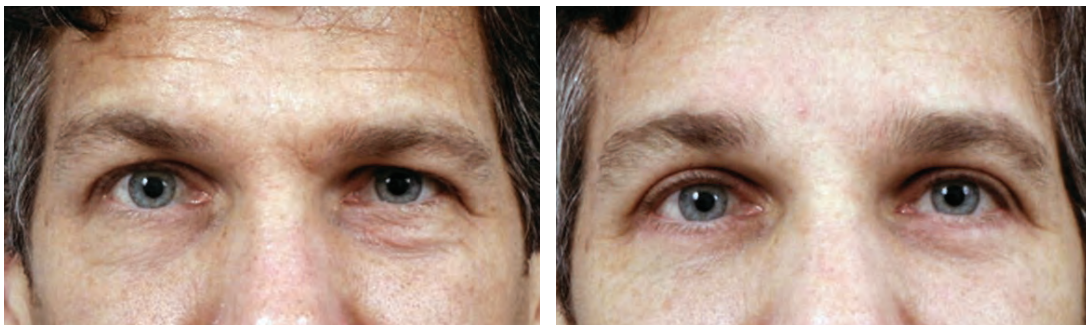
Patients with a heavy upper eyelid fold who did not have a visible significant pre-tarsal space, even in youth, should undergo conservative resection to avoid a change in the shape of the upper eyelid by creating a deep upper lid sulcus.



In men, removal of skin and muscle from the upper eyelid should be conservative to preserve a low crease and avoid feminization of the upper eyelid.



Floppy upper eyelid syndrome is common in large, burly men. This patient underwent upper and lower blepharoplasties with canthoplasty of the upper and lower eyelids.



This patient had brow asymmetry and ptosis on the left side, with compensatory frontalis activity. He is shown 6 months after bilateral upper and lower blepharoplasties and an endoscopic brow lift.

Concluding Thoughts

The upper lid and brow region is a very important determinant of facial aesthetics and plays a vital role in facial rejuvenation. Although upper blepharoplasty is less complex than lower blepharoplasty, judicious preoperative assessment and operative technique are essential to avoid possible complications such as lagophthalmos, A-frame deformity, a shrunk-lid appearance, or eyelid ptosis. High-risk patients have a lower tolerance to the anatomic and biomechanical changes that follow a blepharoplasty; such individuals must be identified before the procedure. The technique described in this chapter represents the basic approach to upper lid blepharoplasty. The surgical outcomes have been carefully evaluated and are associated with a low rate of complications and a high rate of patient satisfaction. The key principles for upper blepharoplasty include conservative removal of skin, muscle, and fat to avoid a hollow upper lid sulcus or postoperative lagophthalmos. Adherence to these basic principles significantly contributes to achieving the overall goal, which is excellence in blepharoplasty results.

Clinical Caveats

Upper lid blepharoplasty, although technically less challenging than lower lid blepharoplasty, requires familiarity with periorbital anatomy.

Individual goals in upper lid blepharoplasty vary and must be determined on an individual basis.

Upper lid functionality is more important than aesthetics and should always be maintained after upper lid blepharoplasty.

High-risk patients can be recognized preoperatively with systematic clinical evaluation.

Avoid placing the upper blepharoplasty incision more than 8 to 10 mm above the lid margin.

Fat preservation and conservative resection of skin and muscle during upper blepharoplasty should be performed to reduce the appearance of a hollow orbit.

The amount of skin that is left behind in the upper lid is more important than the skin that is removed.

Supratarsal fixation of the pretarsal skin and muscle to the levator aponeurosis should be a routine part of upper blepharoplasty to minimize the development of postblepharoplasty ptosis.

Procedures like eyelid ptosis correction, lacrimal gland suspension, lateral brow-pexy, and corrugator and procerus excision can be performed through the upper blepharoplasty incision.

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This chapter focuses on the most common and the most devastating complications after upper lid blepharoplasty.

McCord CD, Codner MA, Nahai F. Upper lid blepharoplasty. In McCord CD Jr, Codner MA, eds. Eyelid and Periorbital Surgery. St Louis: Quality Medical Publishing, 2008.

This chapter is a thorough updated review on upper eyelid blepharoplasty. It discusses aesthetic considerations, preoperative evaluation, and operative technique. Ancillary procedures that are sometimes performed with upper blepharoplasty like transblepharoplasty excision of corrugator and procerus muscles are also discussed.

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The author discusses the refinement of his technique to eliminate postoperative morbidity.

Trussler AP, Rohrich RJ. MOC-PS CME article: blepharoplasty. Plast Reconstr Surg 121(1 Suppl): S1-S10, 2008.

Retrobulbar hematoma is the most feared complication after blepharoplasty. This article provides a practical management algorithm on the topic. It also discusses prevention and causes of postoperative blindness after eyelid surgery.

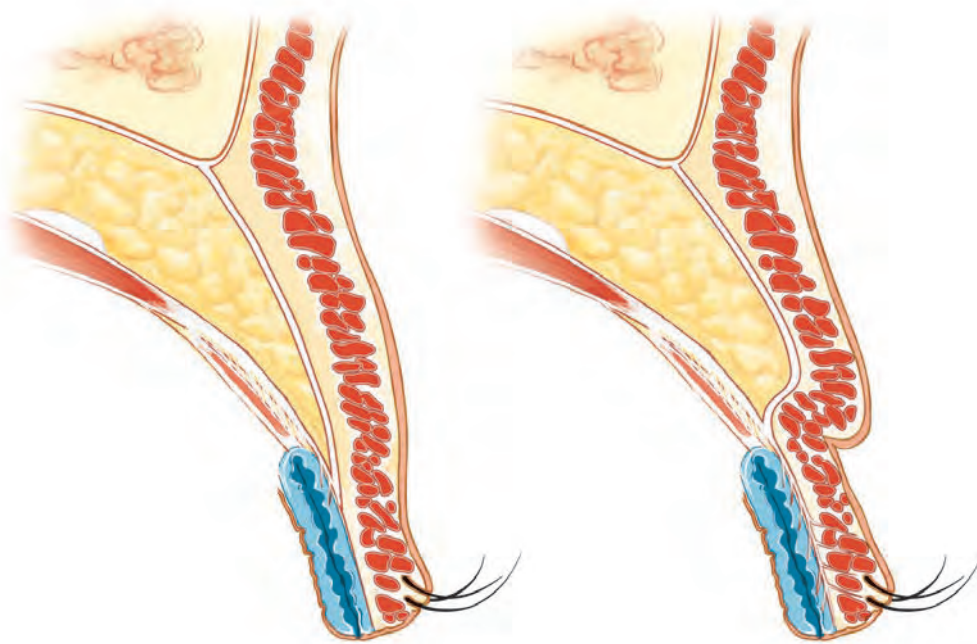
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CHAPTER 29



Upper Blepharoplasty in the Asian Patient

WILLIAM P. CHEN

Double eyelid surgery refers to the aesthetic procedure of creating an upper eyelid crease in an Asian patient who does not have a crease. It has evolved over the last century from using buried suture ligatures into a more anatomically based form of cosmetic blepharoplasty. In Asian countries, it is one of the most frequently performed aesthetic surgeries. I coined the term *Asian blepharoplasty* in 1987 while attempting to define the skills and pitfalls necessary for performing primary and revisional surgery in Asians.

The suture ligation methods are thought to be less invasive and easier to learn, but they require tremendous practice to be adept. The external incision methods are easier to adapt by surgeons who have been exposed to the usual training in blepharoplasty. I think that the suture ligation method yields a relatively static crease, whereas the incisional approach with crease construction yields a more dynamic crease that mimics a natural crease on upgaze and downgaze.

In this chapter I will concentrate on the external incision method, because it yields more predictable results.

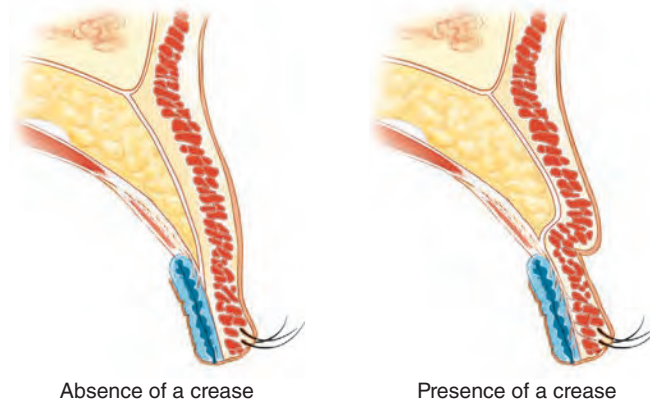
Indications and Contraindications

Bearing in mind that Asian blepharoplasty is a form of aesthetic surgery, suitable candidates include individuals who believe that adding a natural-appearing crease to their eyelid fissure will enhance the shape and proportion of their eyelids. This should certainly be performed within the anatomic parameters appropriate to Asians and appropriate to the individual's facial dimensions. Contraindications are the same as those which apply to any prospective blepharoplasty patients, including individuals who have unrealistic expectations of the changes that such a procedure can produce. Those who may not psychologically tolerate the significant change in look of the eyelid fissure should not undergo such an aesthetic alteration. A patient must be 16 years of age or older before I perform this operation, since there is still a very slight probability that a crease may be secondarily acquired around this age.

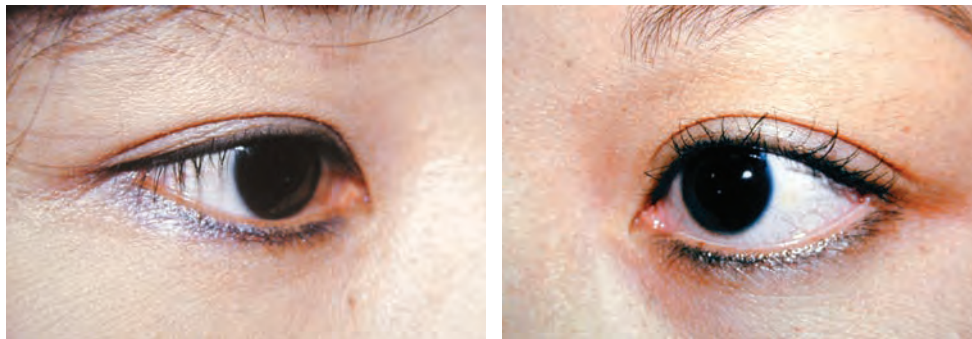
Anatomy of the Asian Eyelid, Incidence of the Crease, and Crease Shape

On average within a family, there is approximately a 50% prevalence of an upper eyelid crease, and this seems to generalize to Asian populations who are of Han background (Chinese, Koreans, and Japanese). There are geographic variations in incidence of the crease, ranging from 25% to 80% or more, but the overall incidence

of 50% seems to hold true in my clinical experience. The vertical height of the upper tarsus is typically between 6.5 and 7.5 mm, and on rare occasions 8.0 to 8.5 mm. This is in contrast to the average dimension in non-Asians of 9.0 to 10.5 mm vertical height.



The current consensus on the distinguishing features of a creased upper eyelid versus one without a crease in Asians seems to be the presence or absence of terminal interdigitations of levator aponeurotic fibers into the pretarsal orbicularis oculi fibers and intermuscular septa, located in an area just slightly below or along the superior tarsal border. The images above show an Asian upper eyelid in an open position without any crease indentation (*left*) and with the presence of a crease (*right*).



Asians who have a natural crease tend to manifest either a nasally tapered crease (*left*) or a parallel crease (*right*). The nasally tapered crease is low-set and runs parallel across the ciliary margin over the central and lateral portion of the upper lid, while over the medial portion it converges inward toward the medial canthus, often blending into a small ethnic medial canthal fold. The parallel crease runs parallel across the ciliary border; over the medial portion, it simply runs independent of and above any residual medial canthal fold.

Both these crease shapes are different from the semilunar crease typically seen in non-Asians. The non-Asian upper eyelid typically shows a semilunar crease line on the skin on downgaze, although this may manifest with either a parallel shape or semilunar shape when viewed straight on.

Preoperative Assessment

It is common to see patients with asymmetry of the two upper lids as well as its crease, asymmetry of fat and soft tissues (skin and orbicularis oculi muscle), asymmetry in shape and height, and possibly latent ptosis.

A detailed history should be taken, outlining the goals of the procedure from the patient's viewpoint, and an eye examination is done to document the various factors mentioned previously. I note the shape of the face, its size, the position of the brow, and its separation from the upper lid margin. These observations are combined into a recommendation for the patient.

A surgically constructed crease that does not fold in well can result from borderline levator contractility with no true anatomic ptosis. Patients are shown representative before-and-after photos and photos of patients in various stages of the healing process so their expectations will be realistic. Photos are taken in primary as well as revisional cases.

Preoperative Planning and Anesthesia

Preoperative sedation and anesthetic include a combination of 10 mg of diazepam (Valium) and 1 tablet of hydrocodone/acetaminophen (Vicodin) (or 1000 mg of acetaminophen) given orally an hour before the procedure. The local anesthetic is 2% lidocaine with a 1:100,000 dilution of epinephrine. A 30-gauge needle is used, and the volume injected is seldom more than 1 ml for each upper eyelid. A controlled flow of room air is supplied through a nasal cannula. An intravenous line is inserted in case further sedation is necessary.

Operative Technique

The surgical steps are as follows:

1. Marking the desired eyelid crease
2. Skin incision
3. Transection through the orbicularis oculi along the upper edge of the skin incision
4. Approaching and opening the orbital septum
5. Handling the fat pads
6. Excision and debulking of the preaponeurotic platform
7. Resetting of tissue planes
8. Anastomosis of the levator aponeurosis to the skin: lid crease sutures and wound closure



29-1 Upper
blepharoplasty in
the Asian patient

Marking the Desired Eyelid Crease



Marking involves precise measurement of the vertical height of the central portion of the everted upper eyelid tarsus. This image shows the measurement of central height of the tarsal plate on the right upper lid with a corneal protector in place. Typically the central tarsal height is between 6.5 and 7.5 mm, with an occasional patient manifesting 8.0 to 8.5 mm. The crease height is determined; typically 7 mm is chosen based on patients' stated preference during their initial consultations. A higher or lower crease will be no more than 0.5 mm on either side of this average. This central crease height is marked on the skin side and will determine the overall height of the crease, whether one is planning a nasally tapered crease or a parallel crease. The nasally tapered crease is chosen in more than two thirds of my patients and is easier to mark and execute in my hands. The crease shape is simply merged toward the medial canthus when approaching nasally. For a parallel crease shape design, the surgeon should try to stay parallel to the lash line while approaching the medial canthus. A segment of redundant skin and soft tissue is included in the line of excision—typically a strip of skin measuring about 2 mm centrally, 2.5 mm laterally, and 1 mm medially. Most of the tissue swelling from the local anesthetic's infiltration should have subsided by this point of the initial marking.

Skin Incision



The skin is incised with a No. 15 surgical blade along the upper and lower lines of marked skin. The photo shows the subcutaneous incisions made along the upper and lower lines of skin marking. A dry 4 × 4 dressing is used to stabilize the skin layer during this step. The blade tip cuts through the skin full thickness and stops just when the fascial tissue overlying the orbicularis oculi is reached. The entire length of the incision often requires several positioning and repositioning steps; this demands utmost precision.

Transection Through the Orbicularis Oculi Along the Upper Edge of the Skin Incision



I use a Colorado tip needle on a monopolar cautery (Bovie) with a low setting on the cutting mode to make the transection through the orbicularis oculi muscle. The tip is intentionally beveled upward along the orbicularis so that the orbital septum is reached along a higher level than that of the superior tarsal border. Once transection through the preseptal orbicularis oculi has been completed, as shown above for the right upper lid, a portion of the orbital septum is open and the preaponeurotic fat pads can be seen. With this maneuver, the cautery tip is likely to reach the preaponeurotic (postseptal) fat pad rather than injure the levator aponeurosis, and it allows identification of the preaponeurotic space. This step of beveled transection

through the preseptal orbicularis oculi constitutes my *first vector*. The orbicularis typically is the most vascular layer, and it is worthwhile to be meticulous in controlling any bleeding here with bipolar cautery.

Approaching and Opening the Orbital Septum



Preseptal fat is often seen commixed with orbicularis fibers plus fascial tissues and can misdirect the surgeon into thinking that it is the deeper preaponeurotic fat, which is distinctly globular, fluctuant, and easily prolapses through small rents in the orbital septum as one reaches it. The septum is opened horizontally with blunt spring scissors; the surgeon must make certain to slant the septal cut upward to avoid cutting blood vessels in the fat pads, not slanting downward toward vessels of the aponeurosis or the aponeurosis itself. As shown, after the septum is opened, the preaponeurotic space and levator aponeurosis can easily be seen.

Handling the Fat Pads



Partial excision of the preaponeurotic fat pad

After the septum is opened horizontally, the fragment of tissues bounded by the upper skin incision and transorbicularis *first vector* can be rotated away from the underlying levator to form a myocutaneous strip. A tissue retractor is applied on the myocutaneous strip to explore the preaponeurotic space. Within the space one may observe fluctuant preaponeurotic fat, or amorphous, bound-down fatty strands, or

smaller “islands” of fat. Depending on the preoperative evaluation of the sulcus and the brow relationship to the upper lid margin, the surgeon may choose to do one of the following:

1. Reposition all preaponeurotic fat.
2. Partially excise some preaponeurotic fat along the superior tarsal border, creating a clearance along the preaponeurotic platform.
3. When fat strands or islets of fat are observed, dissect this off and allow it to retract upward to fill in the sulcus. This maneuver appears to greatly facilitate the glide mechanism (glide plane) of the levator relative to the anterior skin lamella, allowing an eyelid crease to indent dynamically against a passively relaxed preseptal skin-muscle layer (the eyelid fold).

Excision and Debulking the Preaponeurotic Platform



The myocutaneous strip of tissue redundancy (2 mm of skin plus a slightly larger fragment of preseptal orbicularis oculi just above the upper tarsus) can be excised along the superior tarsal border using a Bovie cautery tip. This transection through the lower edge of the orbicularis strip is called the *second vector* and completes the trapezoidal debulking of the preaponeurotic platform. If there is some residual fullness along the lower edge of the skin incision, I may trim off some inferior orbicularis fibers so that it will be less likely to interfere with the crease construction. The excision of an orbicularis strip along the inferior edge of the pretarsal skin is shown above.

In summary, with skin incision and only two additional steps (the first vector through the orbicularis and septum; the second vector through the orbicularis), one can complete a beveled excision of these layers—skin and orbicularis oculi as a trapezoidal fragment, and a fragment of orbital septum overlying the distal 4 to 5 mm of the levator aponeurosis. Bleeding is controlled along the two planes that involved transection through the vascular orbicularis.

Resetting the Tissue Plane

Resetting the tissue plane is an important step in primary as well as revisional Asian blepharoplasty. After the redundant skin and muscle have been appropriately trimmed and the preaponeurotic fat reduced or repositioned, it is essential to reset the tissue planes by properly positioning the anterior skin-muscle layer in relation to the underlying aponeurosis. The surgical drapes are loosened to facilitate this resetting. This maneuver avoids creating lagophthalmos or secondary ptosis. The original operative field may have been isolated using surgical drapes, towels, and adhesive drapes; therefore the surgeon may inadvertently attach the skin edges at a higher point along the aponeurosis rather than just along the superior tarsal border. This results in an overly high crease and secondary ptosis; the frontalis muscles then become overactive, and the eyebrows are unnaturally arched. In revisional cases, this resetting allows some skin recruitment and brings in additional soft tissues to partially fill in any prominent sulcus from fat excision associated with previous aggressive blepharoplasty.

Wound Closure and Crease Construction



The crease shape and height is controlled through accurate design as well as meticulous application of crease-forming sutures; I prefer the soft texture of 6-0 silk sutures for this purpose. They are applied from the lower skin edge, through the aponeurosis along the superior tarsal border, through the upper skin edge, and then are tied down, as shown above. Six to nine interrupted sutures are typically used. The rest of the wound can be closed with 7-0 Prolene, nylon, or silk.

During wound closure, the crease height is repeatedly measured and compared with the contralateral side to verify symmetry; adjustment is always made toward the lower measurement of the two sides. It is not unusual to find that when one is finishing up on the second side, the crease height on the first side (which has been covered with ice or saline sponges) may measure half a millimeter lower. I do not use any buried crease-fixation suture, even in revisional cases.

Postoperative Care

Topical antibiotic-steroid ointment may be applied for 1 week. The eyelids are rested during the first 24 hours, with application of cold compresses. Sutures are usually removed 1 week after the procedure.

Problems and Complications

Problems associated with Asian eyelid crease procedures often involve asymmetry of the eyelid crease height, incomplete crease formation, or late obliteration of the crease. The reasons may include poor execution, poor knowledge, inadequate debulking of the soft tissues, marking the crease too high or low, or inadequate crease indentation. Factors that are somewhat beyond the practitioner's control include poor levator function that was not noted during clinical examination, a bleeding tendency, an allergy to medications, or infection.

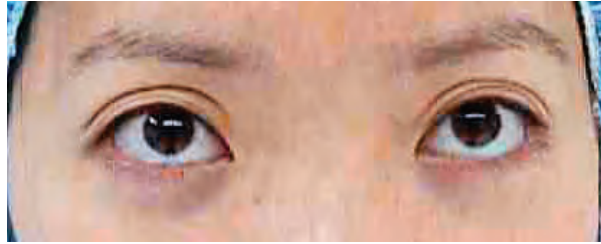
Results



This 25-year-old Asian woman underwent primary Asian blepharoplasty. She is seen 2 months postoperatively.



This 35-year-old woman wanted a low-set parallel crease. She is seen 2 months postoperatively.



This 30-year-old woman had undergone a crease procedure elsewhere. Her preoperative findings included an excessively high crease, a prominent sulcus, and crease fold redundancy.



A beveled approach in a revisional upper blepharoplasty was done, with lysis of the adhesions through the orbicularis oculi and fibrous scar.



The postoperative view at 2 months (*right*) shows improvement in the sulcus and an overall lowering of the crease height. Skin shortage medially prevented a more ambitious correction; however, this can be remedied in the future when skin in this area develops more laxity.

Concluding Thoughts

Accurate definition of the crease height and shape determines the visible component of the procedure, as well as outcome and measurable success rate. A layered and selective debulking of the eyelid tissues makes the completion of these essential steps more reliable and efficient. Less hemorrhage and injury of tissues are encountered. It establishes the proper orientation and spatial geometry of the semirigid pretarsal skin and tarsus (or posterior lamella, vectored by the levator muscle) relative to the more passive preseptal and periorbital orbicularis (anterior lamella) when the eyelids are opened. Repositioning the preaponeurotic fat and resetting of the eyelid skin and forehead structures relative to the posterior lamella are critical steps in preventing complications. These measures allow the proper height and crease shape to be achieved as planned. It helps to soften the deepened sulcus appearance seen in revisional cases. Exact anastomosis of the levator aponeurosis to the lid crease incision along the superior tarsal border provides a higher probability for a successful outcome. Proper execution of these steps allows one to create a natural-looking eyelid crease without the use of permanent or buried static sutures.

The special niche of Asian eyelid crease procedures should progress from creating an eyelid crease that appears static (with the crease very apparent on downgaze) to a physiologically natural and dynamic crease (where it partially disappears on downgaze). I hope that surgeons who perform these procedures can appreciate these subtle goals to create a fluid crease for these special patients.

Clinical Caveats

Accurate definition of the crease height and shape determines the visible component of the procedure, as well as outcome and a measurable success rate.

A layered and selective debulking of the eyelid tissues makes the completion of these essential steps more efficient and reliable.

Repositioning the preaponeurotic fat and resetting of the eyelid skin and forehead structures relative to the posterior lamella are critical steps in preventing complications.

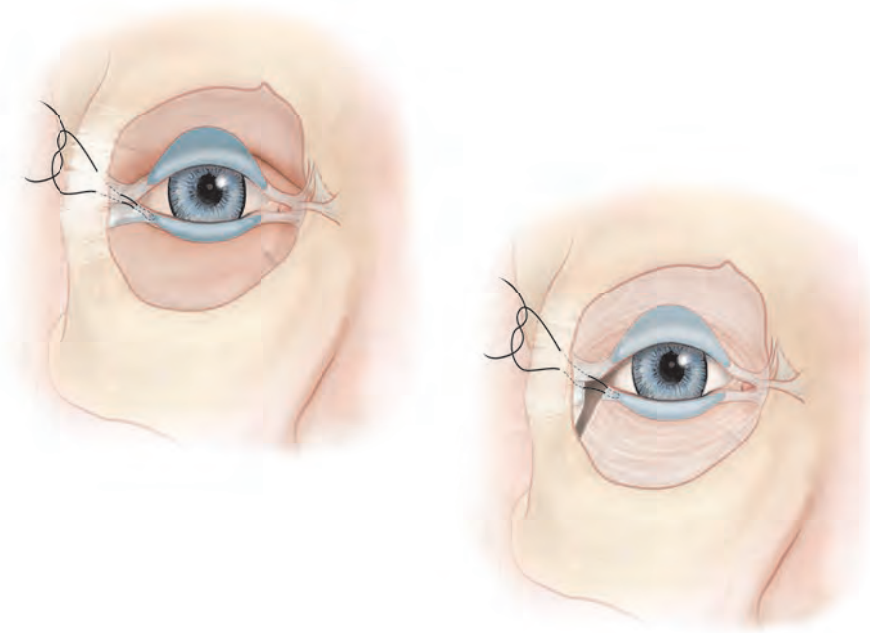
Exact anastomosis of the levator aponeurosis to lid crease incision along the superior tarsal border provides a higher probability for a successful outcome.

Suggested Readings

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CHAPTER 30



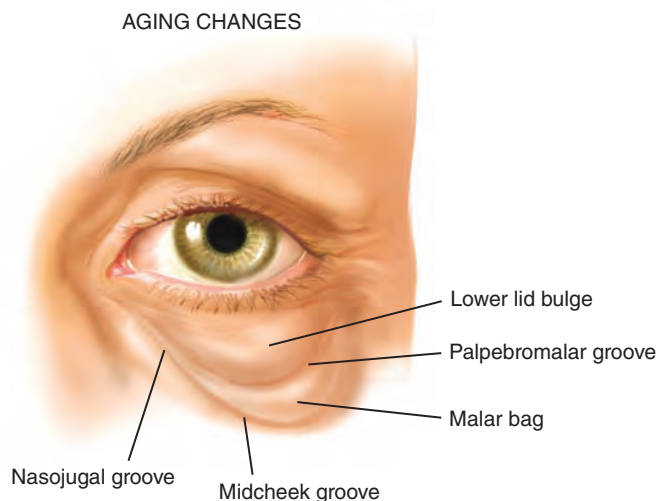
Lower Eyelid Blepharoplasty

MARK A. CODNER, JUAN DIEGO MEJIA

Despite the frequency with which lower blepharoplasty is performed, the procedure remains a complex, challenging, and technically demanding one that should not be considered routine. Minimizing complications and maximizing postoperative results depend on careful preoperative planning and meticulous intraoperative technique. In addition to evaluating the eyelids, the surgeon must carefully assess the periorbital anatomy, including the midface, because midfacial aging can have a profound effect on the appearance of the lower lid. The lower lid and midface compose an aesthetic unit that is best treated together, and the standard lower lid approach provides an easy entry for midface rejuvenation. However, it is important to individualize the operative plan to address individual patient needs.

It is essential to identify risk factors and concomitant medical conditions that could contribute to postoperative complications. Excellent blepharoplasty results can be achieved through the combination of careful preoperative assessment and meticulous surgical technique using an anatomic approach to the aesthetic correction of aging changes of the eyelids and periorbital region. Traditional blepharoplasty techniques placed little emphasis on lower lid support or the correction of acquired anatomic changes of the surrounding periorbital region. Newer techniques emphasize lower lid support, such as routine canthopexy or canthoplasty, as well as transpalpebral elevation of the midface and fat preservation and repositioning. In our patients, routine canthal anchoring has been the key to achieving good, predictable results and avoiding complications.

Indications



Candidates for lower blepharoplasty are individuals with valid complaints in conjunction with physical findings that are amenable to surgical improvement. Typical complaints include a tired look, puffy lower eyelids, malar bags, wrinkled skin, an

accentuated lid-cheek junction, and a deep nasojugal groove. Patients must understand the importance of treating the lower lid–midface as an aesthetic unit. In most cases, treatment of one area without the other will produce unsatisfactory results.

Preoperative Assessment

Medical History and Evaluation

The first step in a thorough evaluation includes taking a history to identify specific conditions, including inflammatory eyelid disorders, Graves' disease, benign essential blepharospasm, and dry-eye syndrome. All of these increase the risk of complications after blepharoplasty and should be screened before surgery. These conditions are discussed in Chapter 28.

Medical Conditions That Might Increase the Risk of Complications

Blepharochalasis	Benign essential blepharospasm
Rosacea	Dry-eye syndrome
Pemphigus	Sarcoidosis
Graves' disease	Menopause

Physical Examination

To produce a result that will be aesthetically pleasing to the patient, the surgeon must take time to understand his or her complaints and concerns, and these should be confirmed by the physical examination. For example, patients complaining of lower eyelid bags may actually have midfacial aging or malar bags, which would not be improved with standard lower blepharoplasty techniques. Therefore the surgeon must be diligent in evaluating both the patient's complaints and the underlying anatomic findings to improve the aesthetic appearance of the periorbital region and provide the best possible outcome. The physical examination should proceed sequentially to ensure complete assessment of the periorbital anatomy. A Snellen eye chart is used to document preoperative visual acuity in all patients before blepharoplasty.

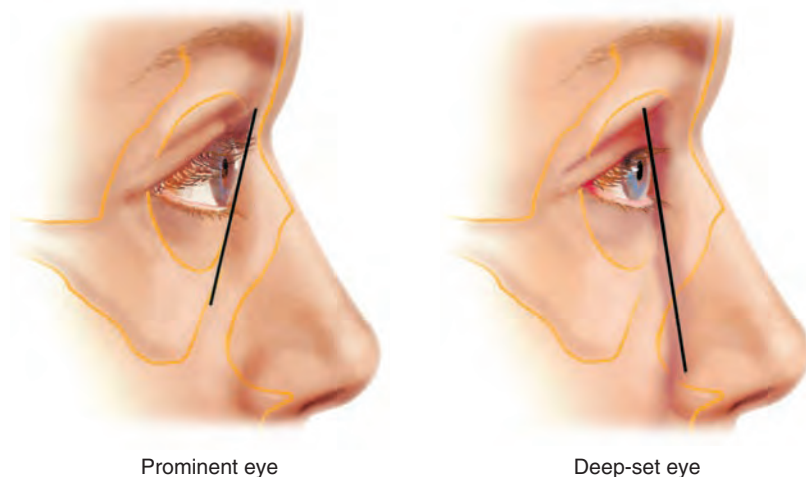
Eye Protection Mechanisms



Patients should be evaluated for the presence of Bell's phenomenon, since the combination of dry eyes with a poor Bell's phenomenon may lead to significant postoperative corneal dryness (*left*).

These patients should be further evaluated with Schirmer's test. The conjunctiva is anesthetized in the inferior lateral fornix with tetracaine eyedrops. Then the excess tear film is blotted with a cotton-tipped applicator, and a Schirmer's strip is placed in the lateral fornix while the patient maintains a forward gaze (*right*). Decreased tear production is present when less than 10 mm of the Schirmer's strip is wet after 5 minutes.

Eye Prominence



Prominent eye

Deep-set eye

The globe should be examined to evaluate its position relative to the bony orbit. Patients with prominent eyes have a negative vector, which is visible on the lateral view of the orbit when the anterior aspect of the globe is anterior to the underlying soft tissue of the infraorbital rim. Patients with deep-set eyes have a positive vector, where the globe is posterior to the infraorbital rim and overlying soft tissues.

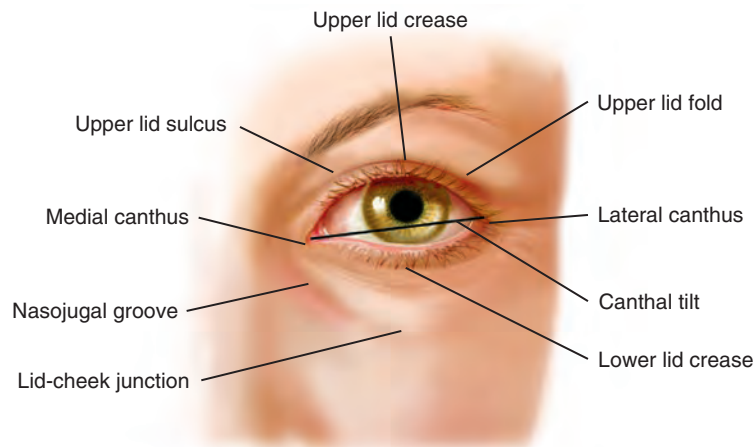


A more detailed analysis can be performed with a Hertel exophthalmometer, which measures the position of the globe relative to the lateral orbital rim. Normal globe prominence is in the range of 16 to 18 mm; patients with enophthalmos have measurements less than 16 mm, and those with exophthalmos have measurements greater than 18 mm. Patients with deep-set eyes or prominent eyes are at increased risk for complications, and the degree of prominence influences the level at which the lateral canthus will be anchored during lateral canthoplasty.

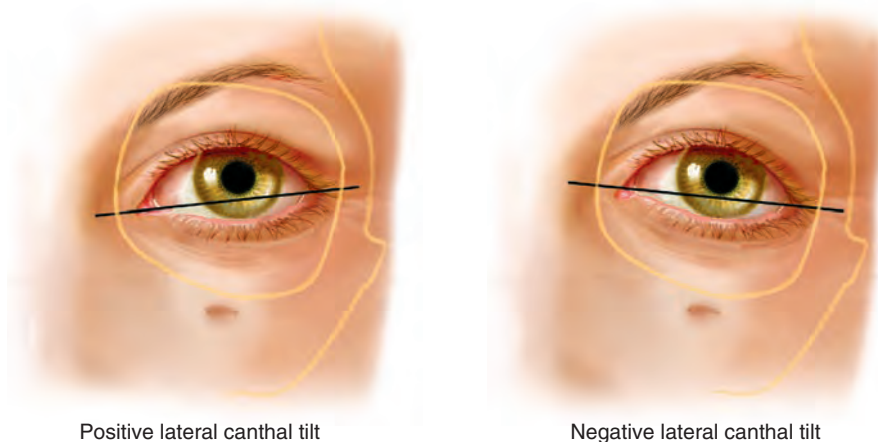
In patients with a standard eye position (16 to 18 mm), the lateral canthal fixation should be in line with the inferior edge of the pupil to produce a normal eye fissure. Patients with prominent eyes (19 mm or more) exhibit a tendency for downward migration of the eyelid margin with lateral tightening, which will produce postoperative scleral show. Canthal anchoring in a standard position will “clothesline” the lid margin underneath the eye. In patients with mild prominence, supraplacement of the lateral canthal tendon is needed at the level of the midpupil. However, canthal anchoring in a higher position will impair upper lid closure. Therefore, with increasingly prominent eyes (as in patients with Graves’ disease), canthal anchoring should not surpass the midpupillary line; other techniques are needed, such as recession of the inferior retractors, insertion of primary spacers, or crisscross anchoring of the upper and lower lids. Patients with deep-set eyes (15 mm or less) need lower and deeper lateral canthal anchoring, because a standard canthal position can cause upward clotheslining of the lower lid, narrowing the eye fissure and reducing the size of the lateral scleral triangle.

Lower Lid Evaluation

The lower eyelid should be evaluated for lateral canthal descent, lower lid laxity, and the presence of scleral show, as well as excess skin and muscle, orbital fat, and malar bags. The presence of scleral show should be a red flag to the surgeon; this is often caused by a combination of a prominent eye, lower lid laxity, and poor infraorbital support. Adjunctive procedures should be considered, such as lateral canthal support, a possible midface lift, or orbital rim augmentation.



The eyelid should be evaluated for both shape and function. The lateral canthal position is normally 2 mm superior to the medial canthal position, and an imaginary line should be drawn from the medial to the lateral canthus indicating the canthal tilt.

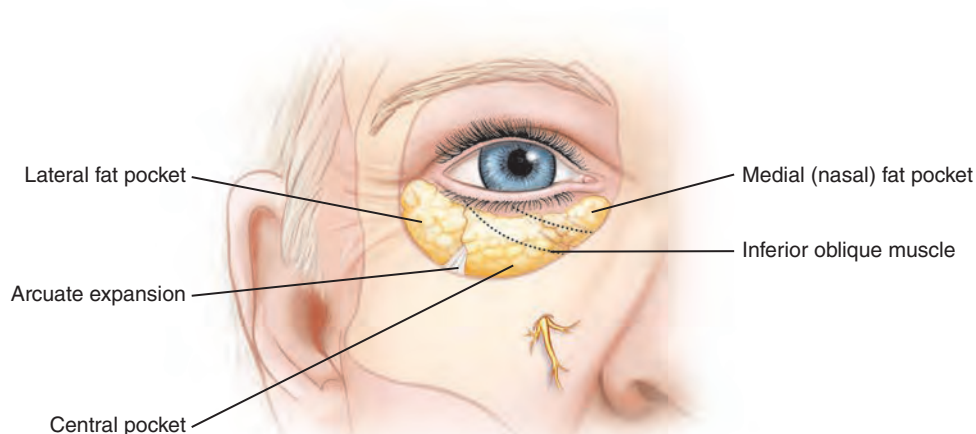


A positive lateral canthal tilt is present when the lateral canthus is superior to the medial canthus; a negative lateral canthal tilt is present when the lateral canthus is inferior to the horizontal position of the medial canthus. A negative canthal tilt may indicate descent of the lateral canthus from disinsertion, laxity, or the presence of a prominent eye. These last patients are at increased risk for lid malposition and require lateral canthal support during blepharoplasty procedures.



The lid snapback test may indicate the presence of lower lid laxity; however, this is a fairly subjective test, and conclusions drawn from it may be inaccurate (*left*). More precise evaluation can be obtained by lid distraction. Anterior lid distraction should be less than 3 mm from the globe. Anything greater indicates lid laxity and postoperative risk for scleral show, ectropion, or corneal exposure. Appropriate lateral canthal anchoring can help reduce the risk in these cases (*right*).

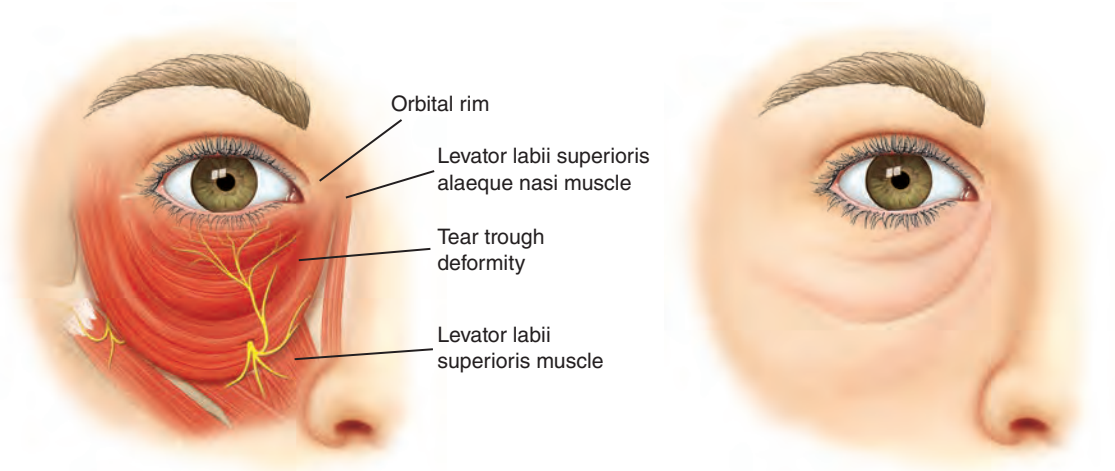
Herniated Fat Pads



Usual areas of fat herniation and protuberance

Progressive weakening of the overlying septum as individuals age has been an accepted theory for the protrusion of the fat pads. Descent of the midface with aging also contributes to the unmasking of the lower eyelid bags as the interface between the lid and cheek becomes more apparent, leading to a “double-bubble” appearance. The lower lid has medial, central, and lateral fat prominences. The volume of these fat pads varies among patients. The surgeon should mark and document the most prominent fat pads preoperatively, because this can be difficult to do when the patient is on the operating table. The lateral fat pad is the most commonly overlooked pad in lower lid blepharoplasty, yet it generally contains the greatest volume and contributes most significantly to the lower lid bags. The options for managing the fat of the lower lid depend mostly on the amount of fat and on the characteristics of the lid-cheek junction. With this in mind, the fat pads can be preserved, removed, redistributed, or even augmented with autologous fat grafting.

Tear-Trough Deformity



The tear trough is a midfacial hollow that begins at the inner canthus and travels obliquely toward the lid-cheek junction. The orbitomalar ligament, along with the origin of the levator labii superioris and levator labii alaeque nasi muscles, contributes to its formation. Release of the orbitomalar ligament in the preperiosteal plane and fat transpositioning or grafting are effective for adding volume and improving this concavity.

Skin Pigmentation

Sometimes dark circles around the eyes are shadows produced by the convexity of the herniated fat, and these can be improved with blepharoplasty. However, many patients have pigmentation of the skin that will remain even after surgery, and it is important that the patient be told this. Use of hydroquinone may be effective to lighten dark circles caused by hyperpigmentation.

Midface

Aging changes in the midface are characterized by descent of the tissues, exposing the inferior orbital rim and allowing the postseptal fat to become more visible. Recognition of these changes is essential as the surgeon chooses the proper procedure. Transconjunctival fat removal alone without correction of vertical midface descent in these patients will lead to a skeletonized appearance of the lid-cheek junction. Patients with mild midface descent can benefit from extended blepharoplasty with release of the orbitomalar ligament with fat repositioning to produce a smoother lid-cheek junction. Those with more advanced aging changes and midface descent require a lower lid blepharoplasty combined with a midface lift.

Malar Eminence

Fat should be removed conservatively in patients with prominent cheekbones, because excessive resection will create a sunken lower lid appearance, accentuate the malar eminence, and disturb the balance of the lid-cheek junction. Patients with a lack of projection of the malar eminence are at greater risk for lower lid malposition after blepharoplasty. These patients can present with preexisting scleral show and prominent eyes. Canthal anchoring and lower lid release procedures are especially important in these cases to decrease the risk of complications.

Patient Education

All of the potential risks of surgery should be discussed with patients before blepharoplasty surgery. Common complications may include swelling, ecchymosis, chemosis, and lagophthalmos. Other possible complications include infection, hematoma, hypertrophic scarring, dry eye, epiphora, asymmetry, lid malposition, ectropion, entropion, and the rare risk of vision loss. Informed consent should include a detailed preoperative discussion of these risks with the patient.

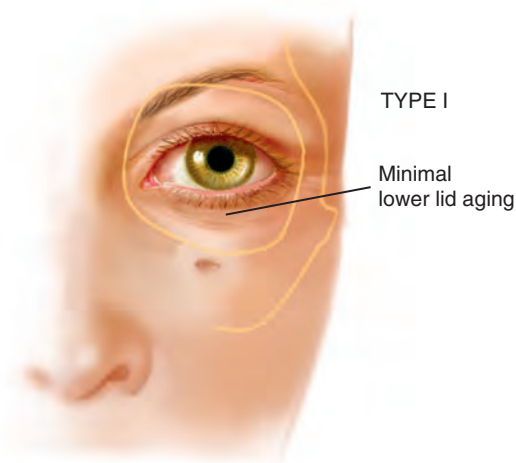
Preoperative Planning

Classification of Periorbital Aging

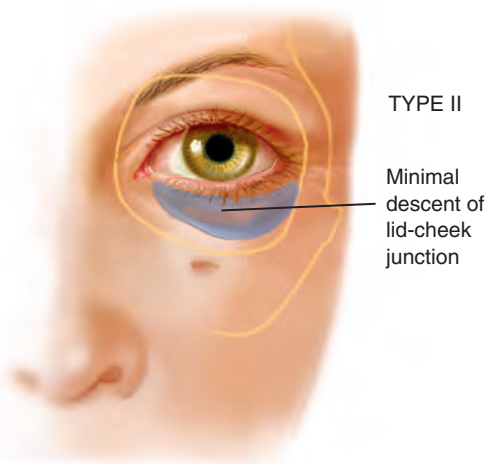
A classification system of periorbital aging may aid in selecting the appropriate surgical procedure for correction. The classification is based on the anatomic findings associated with aging of the eyelids as well as midface descent, including the presence of tear-trough deformity, nasolabial folds, and bags under the lower lids. This classification system focuses on the relationship between the lower lid and the midface using an anatomic approach to develop a specific surgical plan.

Classification of Periorbital Aging

Type	Age-Related Changes	Appropriate Procedure
I	Excess fat, no skin excess	Transconjunctival blepharoplasty
II	Excess skin, muscle, and fat Changes above intraorbital rim Minimal lower lid laxity	Transcutaneous blepharoplasty Preperiosteal cheek lift Lateral canthopexy
III	Excess skin, muscle, and fat Descent of malar fat pad	Transcutaneous blepharoplasty Subperiosteal cheek lift
IV	Malar bags Significant lower lid laxity	Subperiosteal cheek lift Lateral canthoplasty

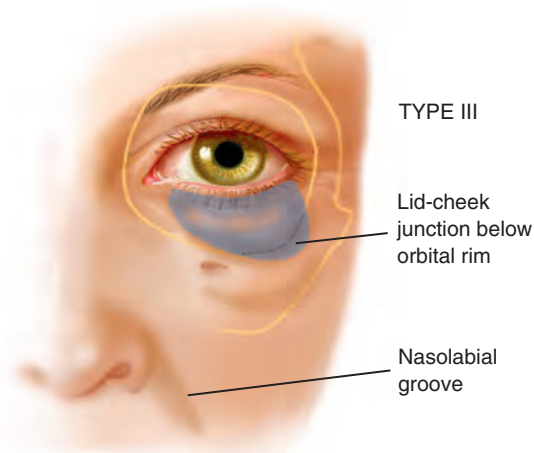


Type I patients demonstrate the earliest changes of periorbital aging, with findings confined to the lower eyelid. The presence of dermatochalasis includes acquired age-related excess folds of skin and muscle, along with apparent fat excess. However, the volume of orbital fat remains relatively unchanged from youth to middle age and is even resistant to volume loss in cachectic patients. In contrast, facial fat, including the malar fat pad and jowl, undergoes redistribution with age; that is, deflation and descent. The perception of increased orbital fat volume is often affected by the presence of edema. In type I patients, the focus is to improve the appearance of the eyelids by means of upper and lower blepharoplasty, including fat resection by a transconjunctival or transcutaneous approach and possible skin resection or resurfacing. Alternative procedures are also appropriate, including resetting or tightening the orbital septum and repositioning and retaining intraorbital fat.

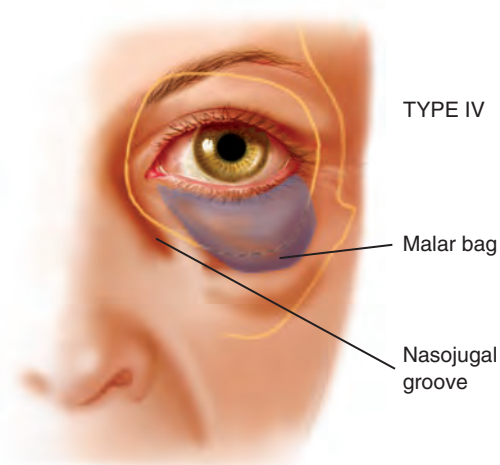


Type II patients have a combination of lower lid aging and early evidence of midfacial descent. As the malar fat pad descends, the lid-cheek junction is more evident, with the inferior orbital rim becoming visible through attenuated soft tissue. Midfacial descent is often associated with loss of upper malar fullness, which contributes

significantly to the loss of lower lid support. These patients require augmentation of the infraorbital rim, either through arcus marginalis release and fat repositioning or elevation of the suborbicularis oculi fat (SOOF) to camouflage the infraorbital rim. Modified superficial midface-lift techniques with dissection in the supraperiosteal plane may be considered.



Type III patients display more advanced midfacial aging, with further descent of the lid-cheek junction and deepening of the nasolabial folds. Descent of the malar fat pad contributes to the formation of the nasolabial fold and requires elevation, either with a subperiosteal midface lift or combined face-lift procedures that elevate the malar fat pad.



Type IV patients have extensive midfacial aging changes, including malar bags, and often demonstrate lower lid malposition with lid laxity. Subperiosteal dissection is required, with release of the orbitomalar ligament, orbital retaining ligaments, and the subzygomatic space to elevate the midface, along with lateral canthal support to correct lower lid laxity.

Patient Preparation

Preoperatively the patient is instructed to stop taking all medications that increase the risk of bruising and swelling, including aspirin, ibuprofen, and vitamin E. Homeopathic herbs such as *Arnica montana* and bromelain may reduce postoperative edema and ecchymosis and have been used routinely for surgery patients for more than 15 years. Patients are instructed to carefully remove all makeup, particularly mascara residue, and to wash the face the morning of surgery. Lower blepharoplasty can be performed with a general anesthetic or with intravenous conscious sedation.

The patient should be placed in a reverse Trendelenburg position to decrease venous pressure. Surgical preparation includes application of a dilute povidone-iodine (Betadine) solution to the eyelids and face, taking care to avoid exposure of the conjunctiva; the eyes are irrigated with balanced saline solution before corneal protectors are placed.

Operative Technique

Anesthesia

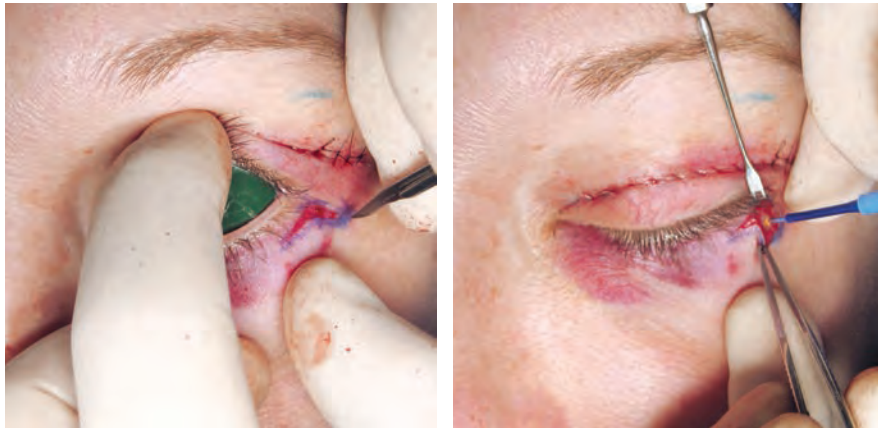
Adequate intravenous or general anesthesia is obtained; preoperative antibiotic administration is recommended. Local anesthetic, consisting of lidocaine 1% with epinephrine 1:100,000, is injected with a 27-gauge needle into the lateral canthus, lower eyelid, and inferior orbital rim, avoiding the marginal arcades and the deep orbital structures to reduce the risk of eyelid or retrobulbar hematoma.

Markings

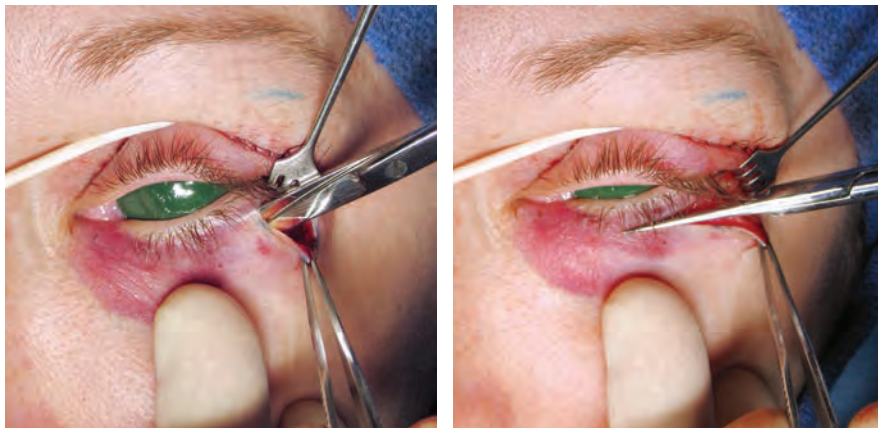
The lower lid incision is initially marked with a single point at the level of the lateral canthus. Markings should extend approximately 6 to 10 mm inferolaterally in a prominent crow's-feet skin line. Approximately 10 mm of skin should be preserved between the lateral extension of the upper and lower blepharoplasty incisions. Postoperative webbing or distortion can occur if these incisions are placed too close together. The remainder of the marking parallels the lid margin approximately 1 mm below the eyelashes.



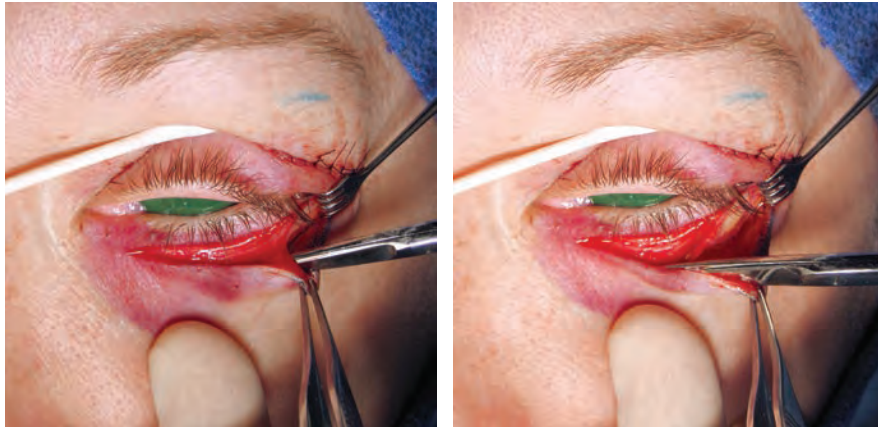
Lower Lid Blepharoplasty



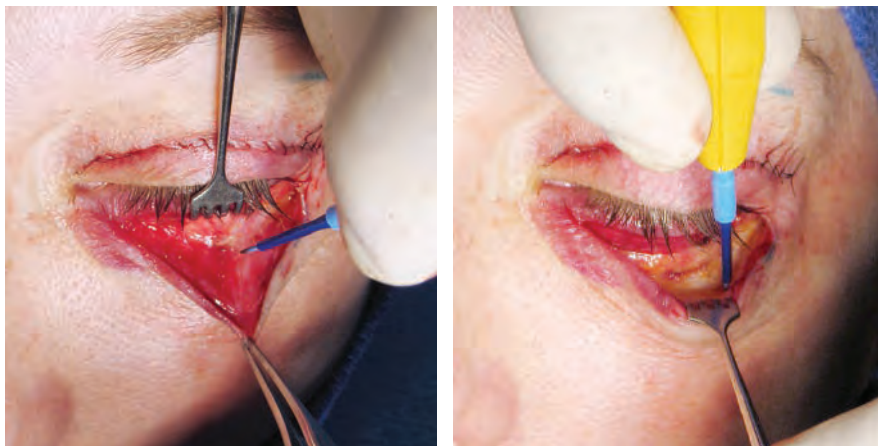
The lower lid skin is incised with a scalpel lateral to the canthus, exposing the underlying orbicularis oculi muscle, which is then divided with electrocautery into the submuscular space.



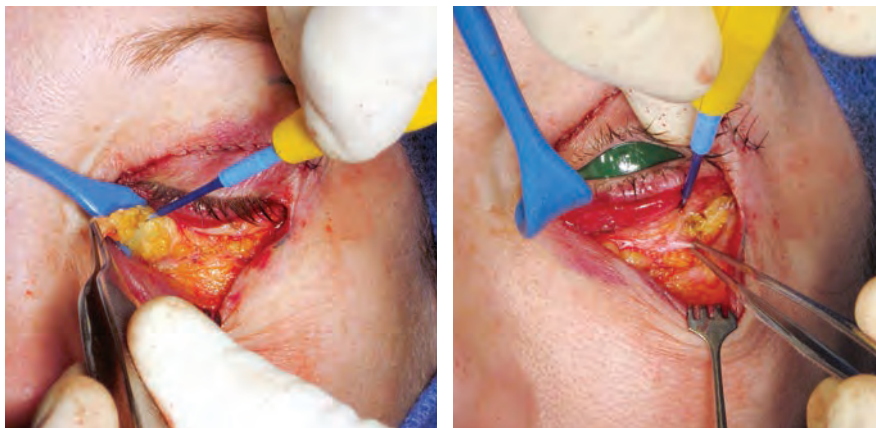
With the lower lid on stretch, scissors are used to dissect a subcutaneous tunnel over the pretarsal muscle just below the lashes, and with the same instrument the skin is incised, stopping 4 mm inferior to the punctum.



Through the lateral incision, the scissors are used once again to dissect a submuscular tunnel, and a second parallel incision is made through the orbicularis, preserving a 5 mm strip of pretarsal orbicularis muscle. Electromyographic analysis has revealed normal function to the pretarsal muscle strip with minimal risk of denervation. The skin-muscle flap is then dissected anterior to the septum with a Bovie cutting needle to the level of the infraorbital rim. Dissection continues past the infraorbital rim just superficial to the periosteum, releasing the orbitomalar ligament to improve the appearance of the lid-cheek junction.

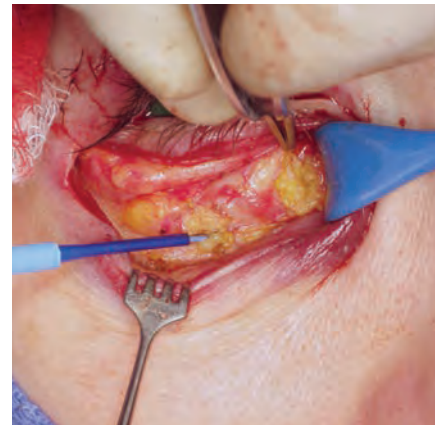


Submuscular dissection continues over the septum down to the orbital rim. The orbitomalar ligament is divided along the entire infraorbital rim. A tear-trough deformity requires release of the medial origins of the orbicularis oculi, levator labii superioris, and levator alaeque nasi muscles from the inferior orbital rim. Once the orbitomalar ligament is released, the SOOF becomes visible, and dissection superficial to the periosteum is continued approximately 10 mm below the orbital rim, preserving the zygomaticofacial and zygomaticotemporal nerves. Release of the orbitomalar ligament allows elevation of the SOOF with the skin-muscle flap. Elevation of the SOOF with orbicularis muscle redraping camouflages the inferior orbital rim, giving the lid-cheek junction a smoother appearance.



Fat can be removed conservatively with the Bovie from all three lower lid compartments, and the orbital septum is resected along with excess fat (*left*). Removal of the septum may reduce the risk of subsequent septal scar formation. If fat resection is planned, the arcuate expansion of Lockwood's ligament between the central and lateral fat pad should be preserved for additional support to prevent further herniation of periorbital fat. When fat transposition is the objective, Lockwood's ligament should be divided to allow adequate release and redraping of the fat pads.

Care should be taken to avoid injury to the inferior oblique muscle between the nasal and central fat pads. The inferior oblique muscle is reportedly the most common extraocular muscle injured during blepharoplasty, usually from indiscriminate cauterization. The lateral fat pocket should be reevaluated after lateral canthopexy, because lateral tension will cause additional herniation.

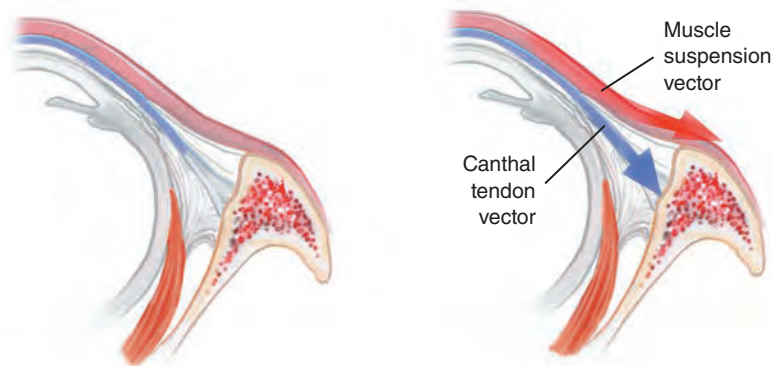


Alternative procedures might also be considered: arcus marginalis release, septal reset, or septal tightening. Septal reset, as described by Hamra, involves suturing the septum orbitale over the inferior orbital rim to produce a youthful convex contour to the lower eyelid–cheek complex. Septal tightening, described by de la Plaza and Mendelson, encompasses suture tightening of the septum after partial resection or septal plication without resection. These procedures are designed to improve the pseudoherniation of the orbital fat through the septum. As in an upper blepharoplasty, the lower lid should be irrigated with normal saline solution after resection of the orbital fat pads.

Lateral Canthal Support

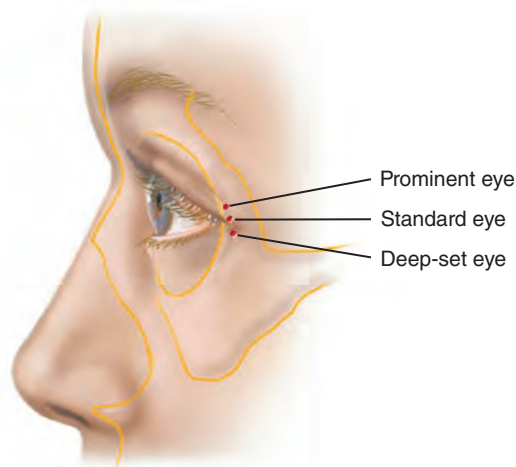


The degree of lower lid laxity should be evaluated intraoperatively by placing anterior traction on the lower eyelid away from the globe and measuring the amount of lid distraction with calipers. Lid distraction of 1 to 2 mm indicates minimal lid laxity; 3 to 6 mm indicates moderate laxity; more than 6 mm indicates significant lid laxity.

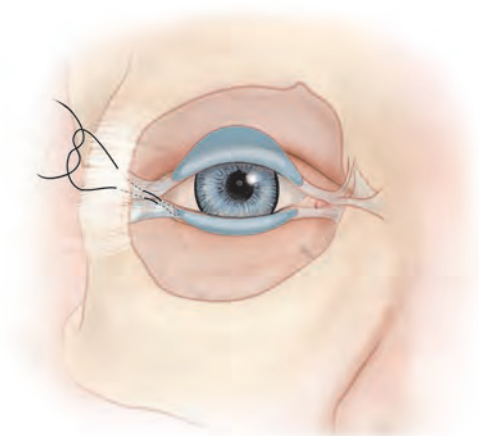


Routine lateral canthal anchoring is performed as part of all of our lower blepharoplasties. A lateral canthopexy is indicated in patients with minimal or moderate lid laxity. When lid distraction is more than 6 mm from the globe or when persistent intraoperative lid laxity is seen after a routine canthopexy, horizontal shortening of the lid is performed with a lateral canthotomy and canthoplasty. Regardless of the type of anchoring used (canthopexy or canthoplasty), the internal vector of fixation is essential. The canthus should be anchored inside the orbital rim to enable the lid to conform to the globe.

The vertical position at which the lateral canthal fixation suture will be placed depends on the degree of eye prominence, the amount of lower lid laxity, and the preoperative shape of the lower eyelid. The preoperative shape of the lower eyelid must be carefully maintained, avoiding overcorrection or alteration of the preoperative canthal position. In patients who have normal eye prominence, the position of the lateral canthal suture is most commonly at the inferior edge of the pupil.



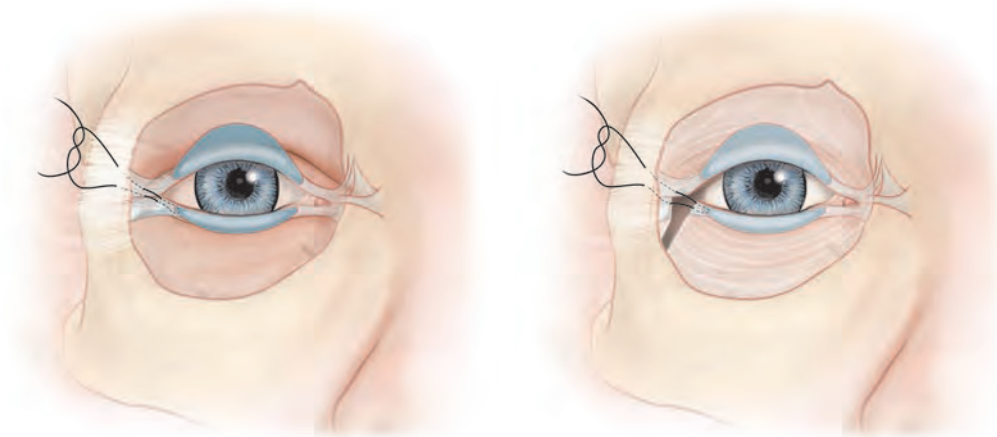
However, patients with prominent eyes require supraplacement of the canthal support suture at the level of the midpupillary line, with overcorrection and minimal tightening to avoid downward clotheslining of the lower lid below the inferior limbus, which can cause scleral show. The release of the inferior retinaculum and lower lid retractors facilitates the supraplacement of the canthus. The downward force of the prominent globe on the lower lid will cause descent of the lid margin after lateral canthal anchoring; however, this force does not exist in patients who have deep-set eyes. Patients with deep-set eyes require more inferior and posterior placement of the canthal suture to avoid upward clotheslining, with care to avoid overcorrection.



The objective of lateral canthopexy is to suture the tarsal plate and lateral retinaculum to the periosteum of the lateral orbital rim, thereby tightening the lower lid tarsoligamentous sling. Through the blepharoplasty incision, a horizontal mattress suture of 4-0 Mersilene is used to incorporate the tarsal plate and lateral retinaculum. To prevent dehiscence of the Mersilene through the tarsus, an interlocking 6-0 Vicryl suture is placed around the 4-0 Mersilene. The Mersilene suture is then placed inside the lateral orbital rim periosteum from deep to superficial, which allows the lateral canthus and lower lid to be tightened posteriorly and superiorly to maintain the position of the lower lid margin against the globe.



A single tie is placed on the lateral canthal suture to set the correct tension as the lower lid assumes its desired position. Before completing the knot, lower lid laxity is once again evaluated with a pair of fine pickups. At this point, the lower lid should have a normal distraction of 1 to 2 mm, and it should allow some upper and lower displacement without restriction. If this is the case, the canthopexy knot is completed. When the lid is too tight and does not permit displacement above the lower limbus with the pickups, the knot should be loosened.



Patients who have significant lid laxity with lid distraction greater than 6 mm, or those with persistent intraoperative lid laxity after canthopexy, require lateral canthotomy and canthoplasty. Lateral canthoplasty is performed after canthotomy of the inferior limb of the lateral canthal tendon, followed by cantholysis, which allows mobilization of the lower lid. Before the lid is transposed over the lateral orbital rim, 2 to 3 mm of full-thickness horizontal lid shortening is performed to correct significant lid laxity. A 4-0 Mersilene suture is used for lateral canthoplasty and is placed

through the edge of the tarsal plate from inferior to superior, ensuring vertical alignment while controlling lash rotation. The mattress suture is then placed along the posterior aspect of the lateral orbital rim periosteum at the appropriate level according to eye prominence and is tied in a surgeon's knot. The desired amount of tension created by the lateral canthoplasty should allow 1 to 2 mm of lid distraction away from the globe, and the lid should be easily mobilized over the cornea. Over-tightening of the lateral canthoplasty should be avoided to minimize lid malposition. The lateral commissure is then reconstructed with a 6-0 plain catgut suture placed in the gray line to prevent postoperative lateral canthal webbing. To re-create a normal-appearing lateral commissure, the suture is placed in the posterior aspect of the upper lid gray line and the anterior aspect of the lower lid gray line to allow the upper lid to slightly overlap the lower lid in a normal anatomic relationship.



After lateral canthal support is achieved, the skin-muscle flap is redraped in a superior lateral vector. A triangle of excess skin and muscle is resected according to the amount that overlaps the lateral extent of the lower blepharoplasty incision.

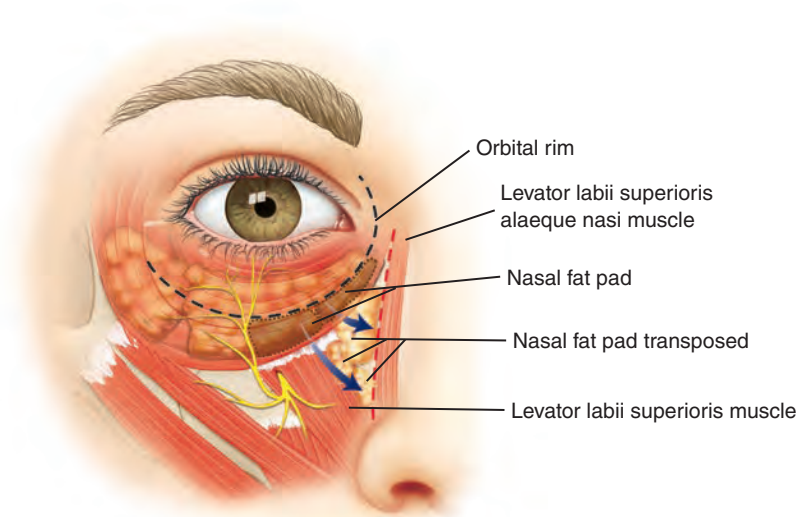
The orbicularis muscle flap is then resuspended to the lateral orbital rim at the level of the lateral canthus using a 4-0 Vicryl suture, which is placed as a three-point quilting suture from the incised edges of skin and muscle to the periosteum along the inner aspect of the lateral orbital rim to recreate the normal concavity associated with the lateral orbital raphe. Similarly, interrupted absorbable sutures are placed in the lateral cut edge of the orbicularis flap to the lateral orbital rim periosteum and temporalis fascia to resuspend the orbicularis under appropriate tension. Resuspension of the orbicularis provides additional lower lid support as well as elevation of the SOOF over the inferior orbital rim, anatomically blending the lid-cheek junction and giving it a smoother look.



Minimal skin and muscle are resected parallel to the lower lid margin to minimize the risk of lid malposition. A small strip of orbicularis is removed from the skin muscle flap to avoid a redundant layer overlying the preserved pretarsal orbicularis. Tension-free closure is then performed in the skin muscle edges with a 6-0 fast-absorbing catgut suture.

Adjunctive Techniques

Treatment of the Tear Trough Deformity



The tear trough hollow can be corrected during a standard lower blepharoplasty. When releasing the orbitomalar ligament along the infraorbital rim, the surgeon performs additional preperiosteal dissection and release of the tear trough. This dissection is performed with low-power electrocautery and should be limited to prevent injury to the buccal branch of the facial nerve, which is located medial to the tear trough at the level of the angular artery. If the levator labii superioris alaeque

nasi muscle twitches with the electrocautery, this may be a sign of overdissection near the buccal branch. After release of the tear trough, the nasal fat pad is transposed and secured with a 6-0 Vicryl suture into the periosteum. It is important to remember that aggressive transposition of the nasal and central pads can impair inferior oblique function and result in diplopia. Fat grafting from excised orbital fat can also be used to fill this space.

Postoperative Care



At the end of the procedure, a 6-0 nylon suture can be placed as a temporary tarsorrhaphy along the gray line lateral to the limbus. Another option is to place a temporary Frost suture in the lower lid margin lateral to the lateral limbus and either suturing to the eyebrow or suspending to a Steri-Strip above the eyebrow. These techniques will reduce corneal exposure in the immediate postoperative period and minimize chemosis. These sutures are removed at the first postoperative visit 5 to 7 days after surgery.

Postoperatively the patient's head should remain elevated to reduce edema and ophthalmic pressure. An ice pack or cold compresses should be applied to the eyelids for 48 hours. The eyes should remain lubricated at all times with saline drops during the day and lubricating ointment at night. Lagophthalmos can be caused by periorbital edema; if this occurs, it resolves spontaneously in 1 to 2 weeks. In these cases eye drops and ointment are essential to prevent corneal abrasions and exposure problems. Before discharge the patient's vision should be evaluated and documented. Any signs of corneal irritation or decreased visual acuity require careful ophthalmologic evaluation, including slit-lamp examination with the use of fluorescein eyedrops to evaluate the cornea. Patients are asked to avoid the use of contact lenses and any eyelid makeup on the suture lines for 2 weeks after blepharoplasty.

Persistent postoperative chemosis can be treated with liberal application of ophthalmic ointments and steroid eyedrops. Use of these eyedrops should be limited to 2 weeks to avoid the risks associated with prolonged treatment. Severe chemosis that herniates through the palpebral fissure requires more aggressive management with liberal use of ophthalmic ointment, topical steroids, patching the eye closed for 24 to 48 hours, conjunctivotomy, or tarsorrhaphy.

Mild lid malposition may contribute to lagophthalmos and corneal exposure, which may require bandage contact lenses to protect the cornea and conservative massage of the lower lid margin until the patient has passed the critical 6-week postoperative period, which corresponds with the peak inflammatory phase of healing. Lower lid ectropion or persistent lid malposition after a 6 week period of conservative management may require surgical intervention including placement of a posterior lamella spacer graft and lateral canthoplasty.

Outcomes

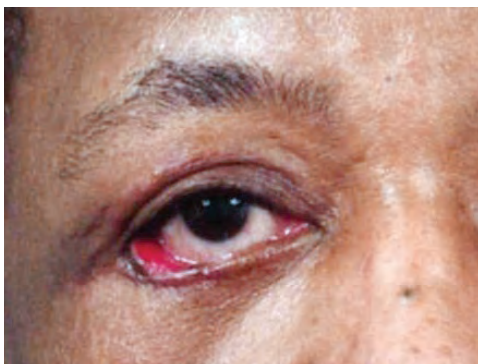
Lower blepharoplasty can no longer be considered a routine operation. Surgical techniques have evolved and are today significantly more sophisticated than in previous decades. Careful preoperative evaluation is the initial step toward creating a specific and comprehensive treatment plan for each patient based on individual findings and desired outcome. Patients who have medical or anatomic characteristics known to be factors predictive of poor outcome should be considered high-risk patients who require alternative procedures to minimize complications. Once assessment and planning are complete, blepharoplasty procedures should be performed with precision. Emphasis is placed on maintaining the preoperative shape of the palpebral fissure with particular attention to maintaining lower eyelid position. Lateral canthal support, most commonly with lateral canthopexy, represents a very important step in the technique to maintain lid shape and reduce the risk of lower lid malposition or postoperative round-eye syndrome. The tradeoff, which should be discussed with the patient before surgery, is that the lower lid may appear tight, and this could last 2 to 3 weeks after surgery. The natural S-shaped curve of the lower lid and the palpebral aperture are preserved after healing is complete.

Complications associated with lateral canthoplasty have been minor and primarily include canthal angle webbing or asymmetry that requires surgical revision. The risk of frank ectropion is significantly minimized with the use of lateral canthal support. In addition to minimizing the risk of complications, maximizing the aesthetic result is directly related to management of both periorbital fat compartments, the orbicularis muscle, and SOOF. Elevation of the skin muscle flap and release of the orbito-

malar ligament mobilize the SOOF, which is elevated with the orbicularis muscle. Using the orbicularis muscle as a sling with secure lateral orbital fixation is the key to maximizing the aesthetic appearance of the infraorbital region. This can be performed safely based on the anatomy of the lower eyelid. The posterior lamella (tarsoligamentous sling) has a separate point of periosteal fixation from the anterior lamella (skin-muscle flap). These basic principles, founded on anatomy, are the two key points in maximizing surgical outcome after lower blepharoplasty. Adherence to these basic principles significantly contributes to achieving the overall goal.

Complications

Lower Lid Malposition



Lower lid malposition is the most common surgical complication after transcutaneous lower lid blepharoplasty and includes lid retraction, scleral show, and ectropion. The incidence of this complication varies from 5% to 30% in the literature. Lower lid malposition not only detracts from the aesthetic results but can also lead to functional problems such as exposure keratopathy. The most common etiologic factor is vertical deficiency of the anterior or posterior lamella in patients with pre-existing tarsoligamentous laxity. Care should be taken to avoid excessive skin and muscle resection. Patients associated with increased risk include those with lower lid laxity, prominent eyes, negative vector, negative canthal tilt, and preoperative scleral show. To avoid this complication, some have suggested less-invasive approaches to the lower lid, such as the transconjunctival lower blepharoplasty. Although more conservative, this technique does not eliminate the risk of lower lid malposition. In addition, most patients who consult for lower lid rejuvenation need removal of excess skin and muscle, which is a limitation of the transconjunctival approach. The treatment of postoperative mild lower lid malposition is conservative, with postoperative massage, the use of tape to hold the lower lid in position, and eye lubrica-

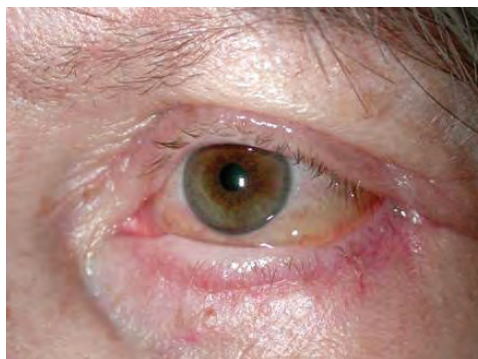
tion. If conservative treatment fails to improve the position of the lower lid after 6 weeks, surgical revision with canthopexy or canthoplasty with or without the use of spacers is recommended. Drill hole canthal anchoring is often needed, because there might be a lack of adequate periosteum for suture fixation. Severe postoperative lower lid malposition causing functional problems or corneal exposure requires immediate correction to avoid exposure keratopathy.

The addition of routine lateral canthal anchoring provides an anatomic solution for decreasing the risk of lower lid malposition after transcutaneous blepharoplasty. In a review of our 10-year experience with routine lateral canthal support in 264 primary cosmetic transcutaneous lower lid blepharoplasties, we reported ectropion in 0.8%, lower lid retraction requiring revision in 2.7%, and mild lower lid retraction (1 mm or less) that resolved with massage in 6.1%. Patients who needed revision were treated with secondary canthoplasty; three patients required posterior lamella spacer grafts.

Causes of Postblepharoplasty Lower Lid Malposition

Lower lid laxity	Middle lamellar scarring
High risk patients	Posterior lamellar scarring
Excessive skin removal	Damage to pretarsal orbicularis muscle
Excessive muscle removal	Untreated hematoma

Chemosis

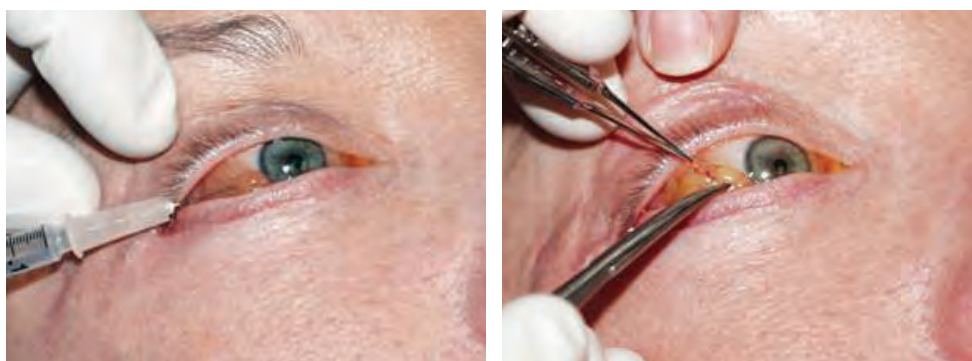


Chemosis is the most common nonsurgical complication after lower blepharoplasty, occurring in up to 12% of patients undergoing the procedure. It is a transudative edema of the bulbar or fornical conjunctiva and is characterized by visible swelling of the conjunctiva.

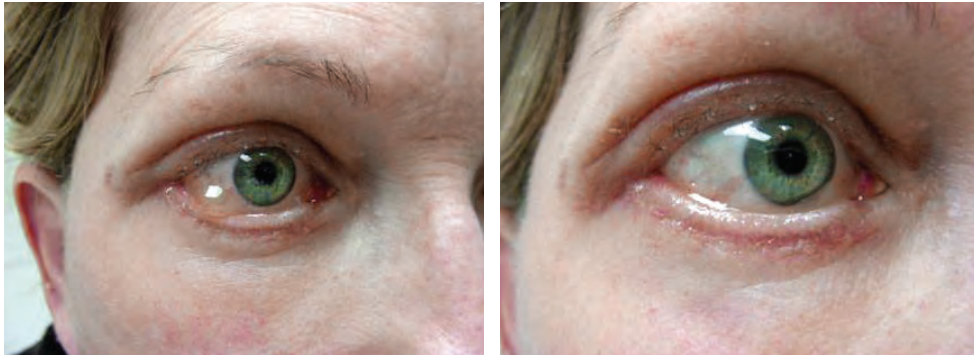
Patients may experience epiphora, irritation, foreign body sensation, and mild visual alteration. In a lower blepharoplasty, the causes include conjunctival desiccation from exposure, regional edema, and lymphatic stasis resulting from local trauma. Chemosis usually presents in the first postoperative week. The median duration is approximately 4 weeks and can range from 1 week to 3 months.

Prevention is the most important treatment in chemosis management, and it starts in the operating room. The use of lubricated corneal protectors, preventing prolonged eye exposure and dryness with frequent moisturizing of the eyes, and minimizing trauma can all help reduce its incidence. If significant chemosis is seen intraoperatively, it can be treated with an immediate conjunctivotomy with a pair of small scissors. A temporary tarsorrhaphy suture can be placed lateral to the lateral limbus to reduce postoperative chemosis.

Postoperative treatment of chemosis starts by keeping the eyes lubricated with wetting drops and ophthalmic lubricants. Ophthalmic steroid drops (tobramycin/dexamethasone [Tobradex; Alcon]) are also helpful. If the irritation does not resolve, an eye patch to the affected eye with the use of an ACE bandage at night can be used. In more severe cases (lasting more than 2 weeks), especially if lagophthalmos is present, a conjunctivotomy or tarsorrhaphy should be considered.



This patient presented with postoperative chemosis that prolapsed through the eyelids during closure, causing lagophthalmos. A conjunctivotomy of the prolapsed conjunctiva with the patient under local anesthesia was performed in an office setting.



This patient, seen before and immediately after a conjunctivotomy with the use of a local anesthetic in the office, shows an almost complete resolution of her chemosis.

Visual Changes

Visual changes such as diplopia are generally temporary and can be attributed to edema. The most common extraocular muscle damaged in lower blepharoplasty is the inferior oblique muscle, which is located between the nasal and central fat pads and can be inadvertently injured during fat manipulation. Conservative treatment is recommended; normal vision is usually regained when the muscle edema subsides. Vision loss can also occur; it is discussed in Chapter 28.

Other Complications

Epiphora is usually a transient problem that can resolve spontaneously in days; it is most commonly caused by edema distorting the lacrimal canaliculi. If persistent, punctal eversion can be corrected by excising and closing an ellipse of conjunctiva below the canaliculus, producing inversion. The same effect can be obtained by applying cautery below the lacrimal canaliculus on the conjunctival side to produce contraction and inversion of the punctum.

Corneal abrasions can be prevented by constant corneal lubrication, the use of ocular protectors, and avoiding prolonged exposure of the cornea. Dry-eye syndrome, infection, and hematoma may occur; these are discussed in Chapter 28.

Results

The following cases represent a variety and continuum of patients who demonstrate age-related changes of the eyelids and periorbital region.



This patient, with early signs of aging confined to the upper and lower eyelid with excess skin, muscle, and fat, is shown before and after upper and lower blepharoplasty.



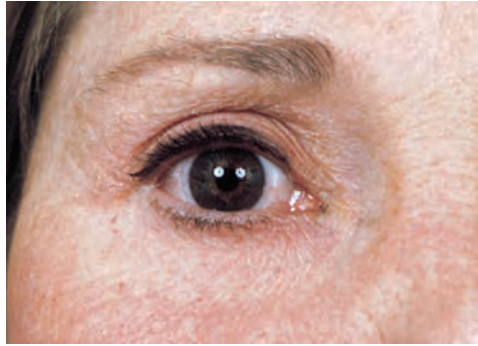
This woman, with a tear-trough deformity of the lower eyelid, shows improvement after release of the orbitomalar ligament, orbicularis, and levator labii superioris, along with fat transposition into the tear trough.



This patient had prominent eyes, with a Hertel measurement greater than 18 mm; she is shown after a blepharoplasty with canthopexy to support the lower eyelid, thus minimizing the risk of lower lid malposition.



This woman underwent lateral canthopexy and lateral canthoplasty; her lower lid shape and lateral canthal position were maintained.



This closeup view of the lateral canthus after lateral canthopexy and lateral canthoplasty demonstrates the natural appearance of the lateral palpebral aperture and commissure.



This woman, with significant signs of midfacial aging, is shown after upper and lower blepharoplasty combined with subperiosteal midface elevation.



This patient underwent bilateral lower blepharoplasty. Her tear trough deformity was corrected by orbitomalar ligament release and repositioning of the nasal and central fat pads.

Concluding Thoughts

As concepts of aging evolve and new techniques are developed, operative approaches to blepharoplasty continue to be refined, thereby producing a more natural, youthful eyelid appearance. The stigmata of surgery can be minimized, along with the risk of complications, by proper preoperative assessment and meticulous surgical technique. Appreciation of the underlying anatomy, along with the indications and limitations of techniques used to correct the anatomic changes that occur with aging, form the basis of a sound surgical approach that ensures favorable results.

Clinical Caveats

Preoperative evaluation should include the lower lids and midface.

This technique for lower blepharoplasty is an anatomically based procedure that requires familiarity with periorbital anatomy.

Preoperative recognition of high-risk patients is essential; this can be achieved with systematic clinical evaluation.

Patients at high risk for lower lid malposition include those with prominent and deep-set eyes, lower lid laxity, a negative canthal tilt, and a negative vector.

Modifications of the surgical technique are performed based on the extent of the age-related changes present in the eyelids and periorbital region.

Lower blepharoplasty using a skin-muscle flap can be safely performed with minimal risk of denervation of the pretarsal orbicularis muscle.

Release of the orbitomalar ligament is an important part of lower lid blepharoplasty to resuspend the orbicularis and elevate the SOOF to achieve a smoother transition of the lid-cheek junction.

Routine lateral canthal anchoring is required to minimize the risk of postblepharoplasty lid malposition.

Modest lower lid laxity with less than 6 mm of lid distraction is managed with lateral canthopexy.

Significant lower lid laxity of 6 mm or more of lid distraction is managed with lateral canthoplasty.

Lower lid malposition is the most common surgical complication after lower lid blepharoplasty. Chemosis is the most common nonsurgical complication after lower lid blepharoplasty.

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Knize DM. The superficial lateral canthal tendon: anatomic study and clinical application to lateral canthopexy. *Plast Reconstr Surg* 109:1149-1157; discussion 1158-1163, 2002. *Most patients who undergo facial cosmetic surgery procedures that could cause lower eyelid retraction or ectropion should have an additional surgical procedure to support the lower eyelid and lateral canthus. Suspending the lateral canthus by surgically altering the lateral canthal tendon is a proven technique that can provide support for the lower eyelid, but a technique of this complexity may be unnecessary for most patients. The authors investigated the attachments of the lateral canthus to the lateral orbital rim and found that the most commonly appreciated attachment between the eyelids and the lateral orbital rim is the lateral canthal tendon (the lateral canthal raphe). However, the lateral canthus also is attached to the orbital rim at a more superficial level through the septum orbitale. This superficial fascial plane may be modified and used as a structure to stabilize or suspend the lateral canthus. This structure is defined in this article as the "superficial lateral canthal tendon."*

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CHAPTER 31



Transconjunctival Blepharoplasty

FOAD NAHAI

Evolution of Technique

In an effort to minimize the risks associated with the open or transcutaneous skin-muscle approach to blepharoplasty, there has been renewed interest in the transconjunctival approach. Originally described by Bourguet in 1928, the transconjunctival approach was reintroduced in 1973 by Tessier for removal of fat from the lower eyelid and treatment of congenital deformities and trauma. This approach was later popularized for the removal of lower lid fat by Baylis et al, by McCord and Moses in the oculoplastic literature in the 1980s, and by Zarem and Resnick in the plastic surgery literature in the early 1990s. These surgeons emphasized the safety of this technique and the significant reduction in complications it offered, with almost complete elimination of lid retraction and its consequences. My personal experience, reported in 1995 and again in 2010, confirmed the safety and efficacy of this approach for removal of fat from the lower eyelid. Over time, interest in transconjunctival blepharoplasty waned as the focus shifted to amelioration of aging of the lid-cheek junction with an emphasis on fat redraping and the transpalpebral approach to mid-face elevation. Today, however, the transconjunctival approach is again attracting attention and gaining in popularity, not only for fat removal from the lower eyelid but also for fat redraping, fat redistribution, and a transconjunctival gateway to the mid-face. In 1999 we described the transconjunctival approach to the medial or nasal fat pocket of the upper eyelid.

Advantages

In addition to the obvious benefit of significantly decreasing complications, the other advantage to this technique is that there is no visible scar. Lid retraction and its consequences—exposure, round eye, scleral show, and ectropion—have all but been eliminated with this approach. Baylis et al reported no lid retraction, as did Zarem and Resnick. A personal review of 300 consecutive blepharoplasties between March 1992 and March 1996 (portions of which were published in 1995) included 120 transconjunctival blepharoplasties and 180 transcutaneous blepharoplasties. The overall complication rate for the transconjunctival group was 5% and for the transcutaneous group 13%. In the transconjunctival group there was no lid retraction, and in the transcutaneous group 3.3% had lid retraction. The revision rate for the transcutaneous group was 2.2%, and for the transconjunctival group it was 1.6%. The complication rates were similar in primary and secondary blepharoplasties.

Transconjunctival and Transcutaneous Blepharoplasties: A Personal Series of 300 Patients (March 1992–March 1996)

	Transconjunctival	Transcutaneous
Primary blepharoplasty	101 (84%)	145 (80%)
Secondary blepharoplasty	19 (16%)	35 (20%)
Mean follow-up	3 yr	3 yr
Range	2-4 yr	2-4 yr

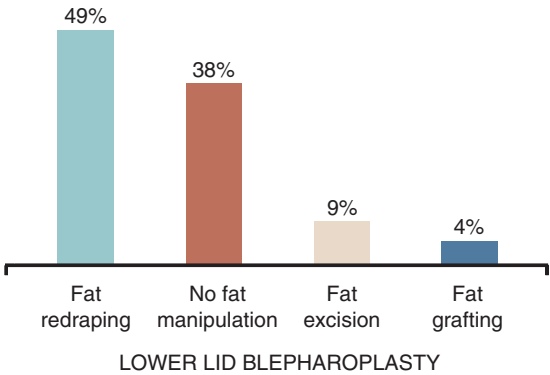
Transconjunctival and Transcutaneous Blepharoplasties: Complications (March 1992–March 1996)

Complication	Transconjunctival (N = 120)	Transcutaneous (N = 180)
Surgical revision	2 (1.6%)	4 (2.2%)
Exposure	0	8 (4.4%)
Subconjunctival hematoma	2 (1.6%)	4 (2.2%)
Infection	0	2 (1.1%)
Granuloma	2 (1.6%)	0
Scleral show/ectropion	0	6 (3.3%)
Overall	6 (5%)	24 (13%)

Disadvantages

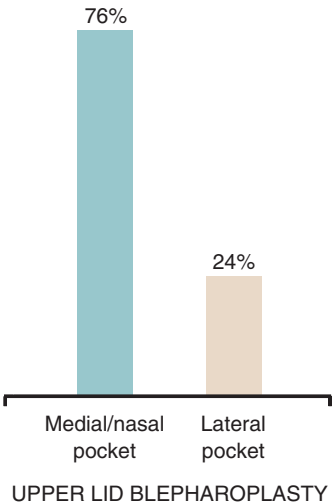
Resection of excess skin and muscle is not possible through this approach, although the addition of a pinch excision adds a viable option for dealing with the excess skin. Access for redraping and redistribution of periorbital fat and access to the midface are possible through this approach, but it is not as straightforward as the open approach. In the upper eyelid, only the nasal fat pocket can be approached through the conjunctiva, which limits its role to removal of fat from that pocket only.

Management of Fat in the Eyelids



Over the years there has been considerable change in our management of periorbital fat. Gone are the days of the skin-muscle-fat excision blepharoplasty. It was through this evolution of fat management around the eye in the late 1990s that transconjunctival fat removal became less popular in general, and I chose it with significantly less frequency in my practice. My current management of lower lid fat is presented in the graphs and includes the following:

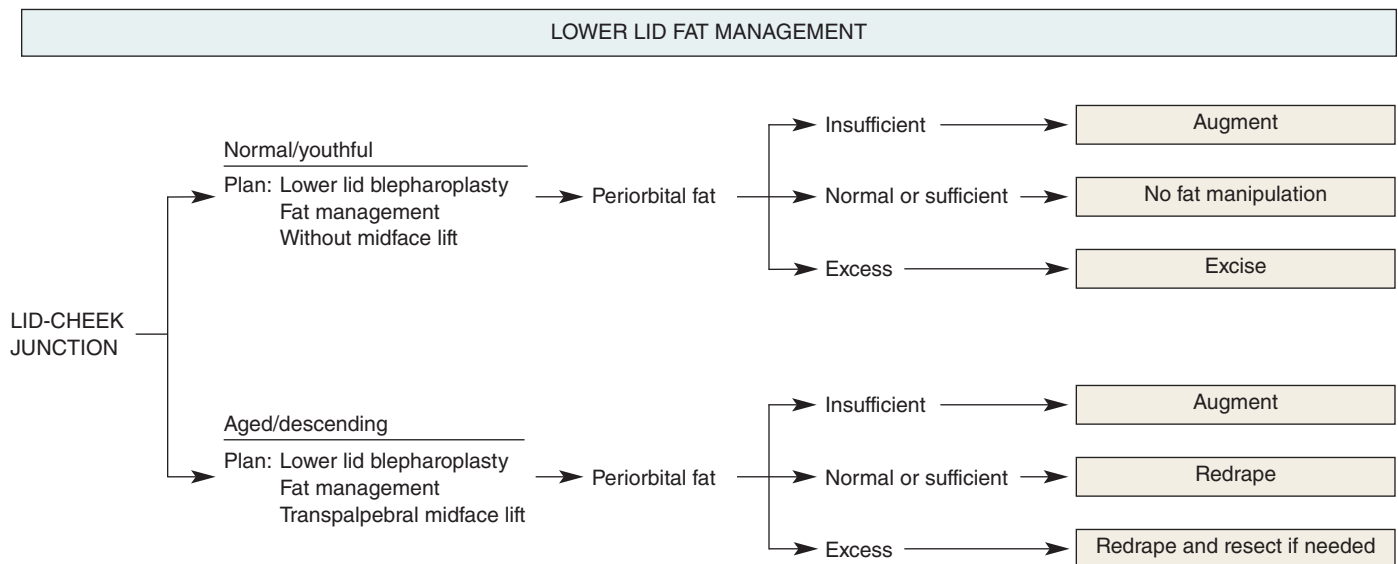
- Redraping
- Preservation
- Excision
- Augmentation



Even in the upper eyelid, I am preserving fat rather than resecting, especially in the lateral pocket.

Indications

Fat management, especially in the lower eyelid, is now customized to each individual. I base my options for fat management on the amount of fat present and an evaluation of the lid-cheek junction. If the patient has little if any aging of the lid-cheek junction with true excess fat, I prefer resection of fat. If the patient has no excess fat, the fat pocket is not opened. If the patient has aging of the lid-cheek junction and sufficient fat for redraping, redraping or redistribution of that fat is the procedure of choice. In patients who require improvement of the lid-cheek junction and do not have an adequate volume of lower lid fat, augmentation with autologous fat or a dermis graft is necessary.



For individuals with excess lower lid fat and little or no lid-cheek junction change, the postseptal transconjunctival approach is an ideal operation with safe, easy fat removal from all compartments. It is also a good operation for patients with excess fat and fine skin wrinkling and in those with apparent excess skin in whom fat removal will result in redraping of the excess skin into an acceptable contour with elimination of the skin laxity. Laser resurfacing and peels have been advocated for skin tightening after transconjunctival fat removal to deal with the excess skin; however, I have found that skin excision is best for handling the excess skin. The combination of transconjunctival fat removal and skin excision through *skin-pinch blepharoplasty* is a suitable alternative to the transcutaneous skin-muscle flap blepharoplasty in selected patients. For candidates for redraping or redistribution or augmentation of the periorbital fat, the preseptal transconjunctival approach allows access to the periorbital fat, retroorbicularis oculi fat, and midface. This approach does not afford the same easy access and visualization of the transcutaneous approach.

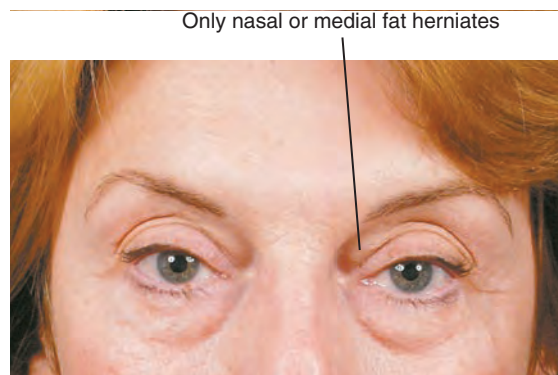
Preoperative Assessment

A complete medical history is taken. We ask about hypertension and medications that affect bleeding. A careful ophthalmologic history is then obtained. The patient is asked about any history of eye problems or operations, specifically inquiring about glaucoma and Lasik procedures, symptoms of dry-eye syndrome or irritation, whether he or she wears glasses or contact lenses, and any family history of eye problems, especially glaucoma.

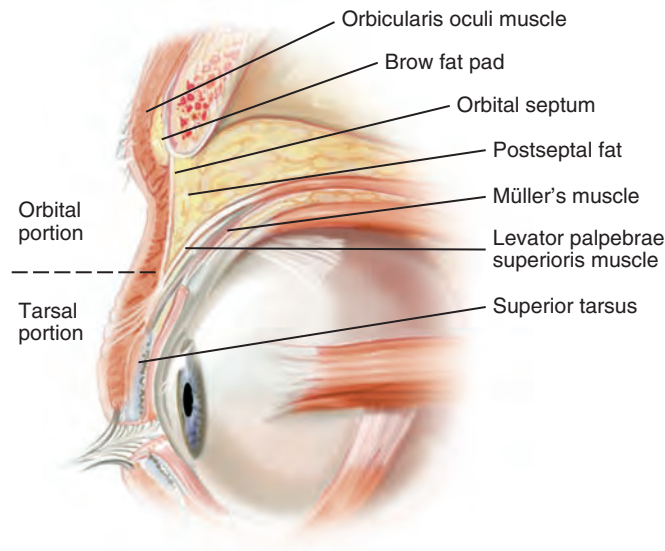
The examination includes an evaluation of the lower lid skin, muscle, fat, and lid-cheek junction. Lid tone should be assessed with the pinch and traction tests. Schirmer's test is done on a selective basis, as indicated. Although I routinely measure every patient's eyes with the Hertel ophthalmometer, it may not be as vital to do so for patients undergoing transconjunctival procedures.

Upper Eyelid

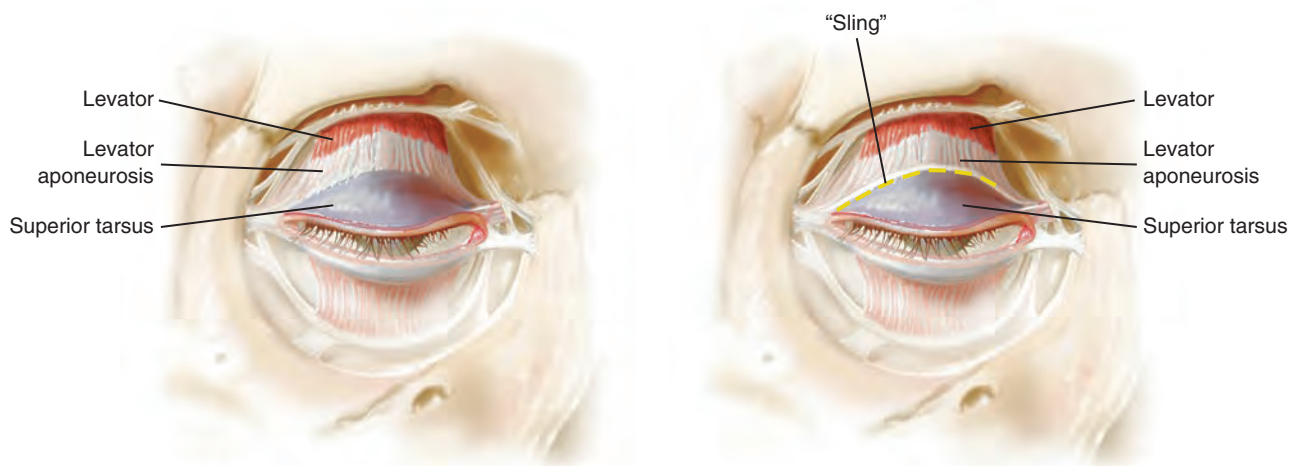
Pertinent Anatomy



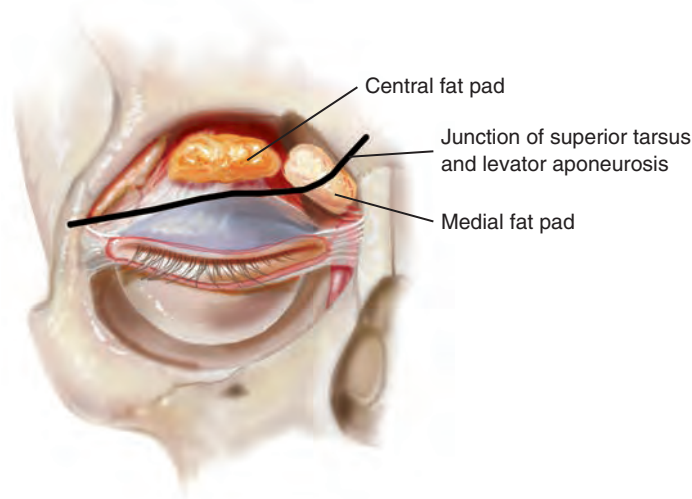
The only fat compartment to herniate in the upper eyelid is the medial compartment. The other compartment is retained anatomically, does not herniate, and cannot be exposed through the conjunctiva.



We consider the upper eyelid to be divided into tarsal and orbital portions at the level of the supratarsal fold, which is located 3 to 5 mm above the upper border of the tarsal plate in whites and much lower in Asians. It is formed by the fusion of the levator aponeurosis, orbital septum, and fascia on the deep surface of the orbicularis oculi muscle. This fused layer acts as a sling and holds up the periorbital fat so that the excess fat drapes over the fold rather than herniating below it.



This sling is lower laterally and much higher nasally, thus allowing herniation of the nasal fat pocket below it. The other structure of importance here is the levator aponeurosis. The lateral horn of the levator is much lower than its medial horn. These two factors combined allow transconjunctival access to the nasal or medial fat pocket without risk of injuring or involving the levator aponeurosis.



The medial or nasal fat lies medial to the levator aponeurosis and below its medial horn. The lateral temporal or central upper eyelid fat pocket lies anterior to the levator aponeurosis and is inaccessible through the transconjunctival approach. The medial or nasal fat is usually pale yellow or white. It contains more sensory filaments, branches of the supratrochlear nerve, and more blood vessels, branches of the superior ophthalmic artery. The fat of the lateral central or temple compartment is much more yellow in color and has sensory fibers and vascular branches of the supraorbital nerve and artery.

Transconjunctival Approaches

Only the nasal fat pocket can be approached through the medial conjunctiva below the medial horn of the levator aponeurosis through the so-called bare area described by Guerra et al.

Preoperative Planning

The transconjunctival approach is suitable for a primary and secondary procedure for removal of excess medial upper eyelid fat. The best candidates for this procedure have excess fat limited to the nasal pocket with little or no true skin excess. In my experience, most of these patients have undergone previous blepharoplasties, with remaining excess fat in the medial or nasal pocket.

Markings

With gentle pressure on the globe, I look for the maximum bulging of the medial fat pocket and place a small mark on the skin.

Operative Technique

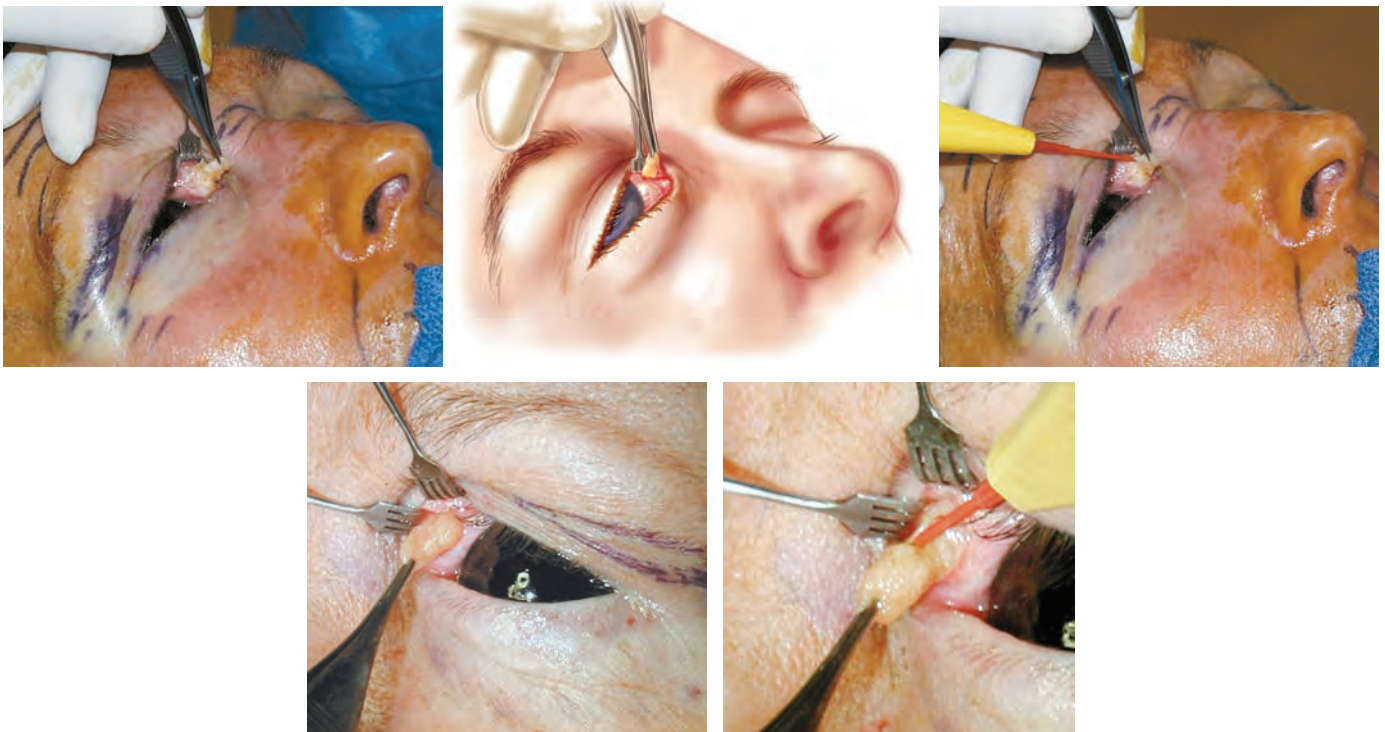
Anesthesia

Local anesthesia is my choice if fat removal is the only procedure to be performed. If it is combined with other facial rejuvenation procedures, I prefer general anesthesia. Before injection of the local anesthetic, 1 to 2 drops of topical tetracaine anesthetic are placed on the eye. The local anesthetic, 0.5% lidocaine with epinephrine, 1:200,000, is infiltrated transcutaneously and through the conjunctiva. If the patient is under general anesthesia, the lidocaine-epinephrine mixture is injected for its vasoconstrictor effect, but the tetracaine is not necessary.

Incision

A corneal protector is placed over the eye. The medialmost part of the upper eyelid is retracted; I prefer to use a Blair retractor. The “bare area” is immediately exposed and an incision made in the conjunctiva with Colorado tip needle electrocautery. This incision is kept in the medialmost part of the upper eyelid and should not extend laterally beyond the bare area, where it may injure the levator aponeurosis and risk postoperative ptosis. Once the incision is made, I take a pair of fine blunt-tipped scissors and spread the blades. The nasal fat pocket immediately comes into view.

Fat Excision



The medial fat pocket is then easily teased and delivered through the incision, where it is trimmed with the electrocautery. The endpoint is reached when there is no bulging medially in the upper eyelid with gentle pressure on the globe.

Closure

The conjunctival incision is always left open.

Postoperative Care

The patient's head is elevated, and ice packs are placed on the eyelids.

Results

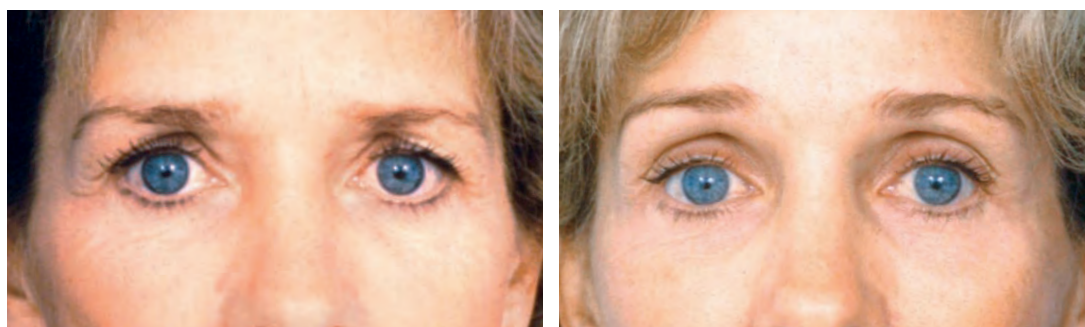
The transconjunctival approach for removal of fat in the upper eyelid has been free of complications in our hands, specifically no eyelid ptosis. There have been no revisions, and patients have been consistently pleased.



This middle-aged woman underwent an endoscopic brow lift, transconjunctival removal of fat from the upper eyelids, a lower lid blepharoplasty with transpalpebral midface lift and neck lift, and laser resurfacing of the forehead. She is seen 12 months postoperatively. No skin was removed from the upper eyelids; the improvement seen in the upper lids resulted from the endoscopic brow lift and excision of fat from the medial fat pocket.



This 50-year-old woman underwent an endoscopic brow lift, transconjunctival removal of fat from the upper eyelids, lower lid blepharoplasty, and a face and neck lift. She is shown 3 years after surgery. No skin was removed from the upper eyelids. The medial upper lid improvement that resulted from transconjunctival fat removal is most evident in the split-face view.



This woman in her early fifties had had a previous coronal brow lift. She underwent an endoscopic brow lift with transconjunctival removal of fat from the nasal pocket of the upper eyelids. The upper eyelids are improved as a result of the transconjunctival removal of fat from the nasal pocket and the endoscopic brow lift. There was no skin excision from the upper eyelids.

Lower Eyelids

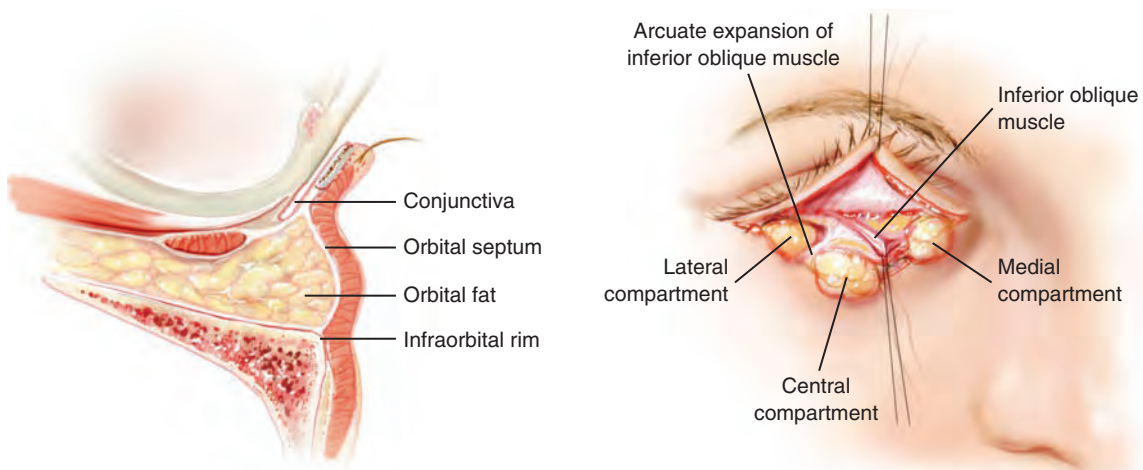
Pertinent Anatomy

An understanding of the anatomic relationships between the fat pockets and other lid structures is the key to this approach. It should be remembered that the outer lamella of the lower eyelid is composed of the skin and orbicularis muscle. The middle lamella is the orbital septum, and deep to it is the periorbital fat; the posterior lamella behind the orbital fat is made up of the lower lid retractors (capsulopalpebral fascia) and conjunctiva.

Orbital Fat Pads



The orbital fat pads are bounded anteriorly by the orbital septum. The septum is attached inferiorly to the arcus marginalis and fuses superiorly with the lower lid retractors. The orbicularis muscle and skin are anterior to the septum. The orbital fat pads are bounded superiorly and posteriorly by the lower lid retractors. The lower lid retractors arise from the terminal muscle fibers and tendons of the inferior rectus muscle. They fuse with the orbital septum 5 mm below the inferior tarsus and insert on the tarsal plate. The posterior lower lid retractors are applied very close, in fact quite adherently, to the lower lid conjunctiva.

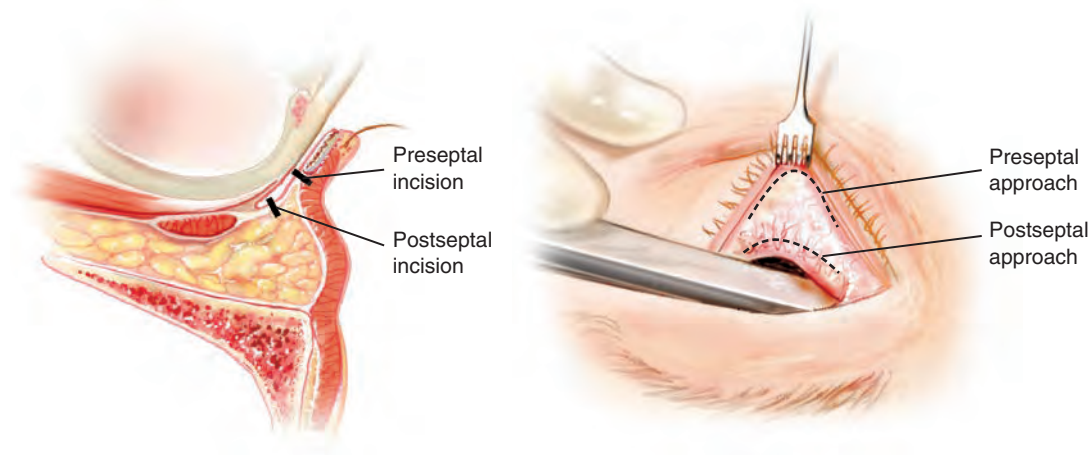


The inferior oblique muscle lies within the orbital fat and is the only eye muscle at risk during blepharoplasty. The muscle originates along the anterior medial orbital floor, passing posteriorly and laterally beneath the globe separating the medial and central fat pockets.

The Compartments

The central compartment is separated from the lateral compartment by the arcuate expansion of the inferior oblique muscle, which inserts into the orbital rim anterolaterally. The inferior oblique muscle separates the central and medial fat compartments.

Transconjunctival Approaches



Transconjunctival approaches to the lower eyelid are either preseptal or postseptal. Each approach has its own advantages and limitations. The postseptal approach only allows fat removal. The preseptal approach allows access for fat removal and redistribution, along with access to the midface and orbital rim.

Transconjunctival Approaches

The preseptal approach allows:

- Fat removal
- Fat redistribution
- Access to midface

The preseptal incision is placed:

- Below the tarsal border
- At the level of the upper arcade

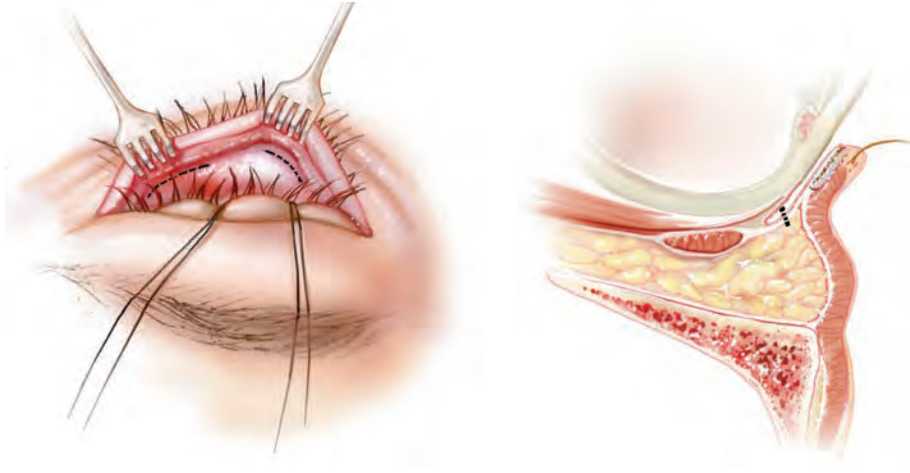
The postseptal approach allows:

- Fat removal only

The postseptal incision is placed:

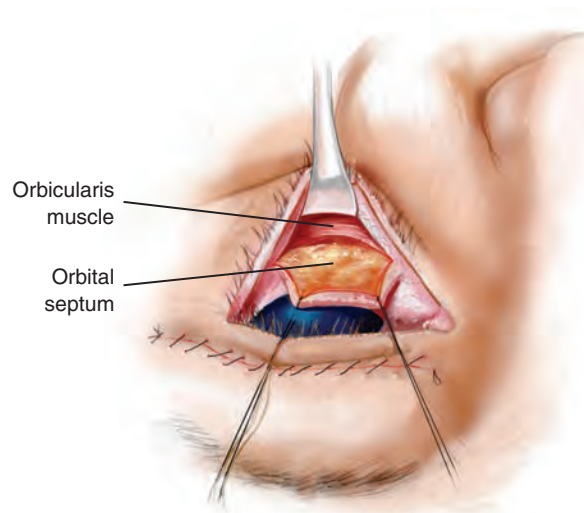
- In the fornix 4 to 5 mm below the tarsal border
- At the level of the lower arcade

Postseptal Approach



Transconjunctival blepharoplasty by the postseptal approach permits access to the orbital fat through an incision in the conjunctiva and lid retractors/capsulopalpebral fascia without any disruption or involvement of the skin, muscle, or orbital septum. The incision is usually made in the conjunctiva of the inferior fornix, 4 or 5 mm below the tarsal border at the level of the lower conjunctival vascular arcade.

Preseptal Approach



The preseptal approach permits access to the fat pads through the orbital septum and allows access to the orbital rim, retroorbicularis fat (ROOF), and the midface without any involvement of the orbicularis muscle or skin. The incision is made along the lower tarsal border, 1 or 2 mm below the lid margin. This incision extends through the conjunctiva lid retractors and capsulopalpebral fascia. The space behind the orbicularis is then entered, and the dissection is continued deep to the orbicularis but anterior to the orbital septum. This dissection is continued down to the orbital rim, and the arcus marginalis is easily released, affording access to the midface. Access to the fat requires resection or incision of the orbital septum.

Preoperative Planning

The best candidates for transconjunctival fat removal or redraping are those with excess fat and little if any real skin excess. The combination of transconjunctival fat removal and skin-pinch excision is a suitable procedure in some patients. Fat redraping is appropriate for patients with aging of the lid-cheek junction with little or no real skin excess.

Markings

With gentle pressure on the globe, the skin is marked directly over each bulging compartment. If fat redraping is planned, the nasojugal groove and lid-cheek junction are marked.

Operative Technique

The ideal candidate for the postseptal approach is a patient with bulging lower lid fat compartments with no real excess skin. The ideal candidate for the preseptal approach has aging of the lid-cheek junction with no real skin excess.

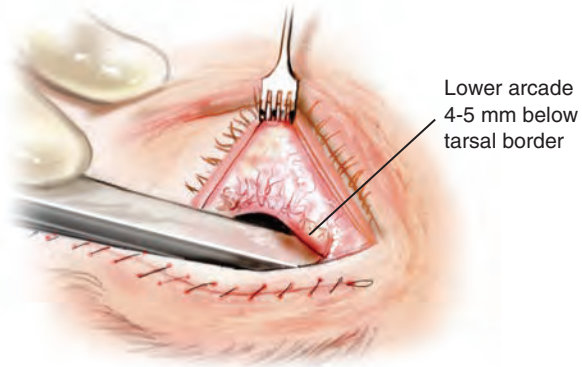
Anesthesia

The choice of local versus general anesthetic is the same as described previously for the upper eyelid.

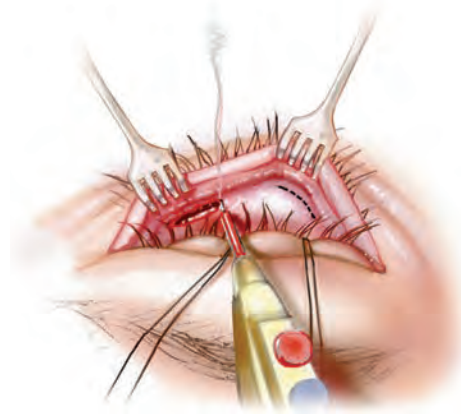
Postseptal Approach: Incisions



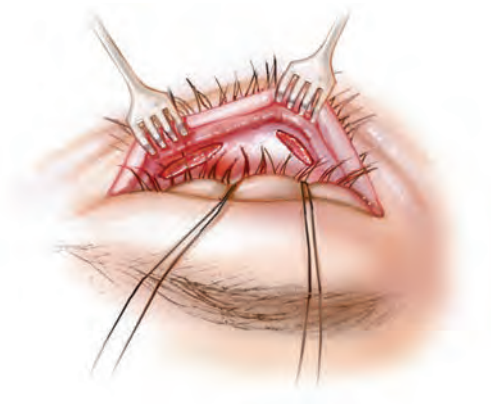
The globe is protected with a corneal protector. Stay sutures of 5-0 Prolene are placed medially and laterally through the conjunctiva of the inferior fornix. These two sutures are then pulled upward, facilitating the dissection and also affording extra protection to the globe. A Blair retractor or traction sutures are then placed in the lower lid margin.

Lower Arcade

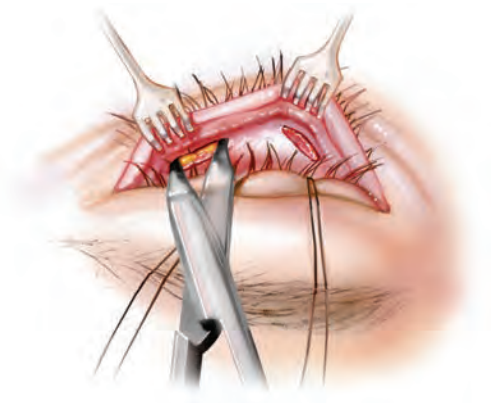
The incisions are made with the electrocautery, 4 to 5 mm below the lid margin at the level of the lower arcade.



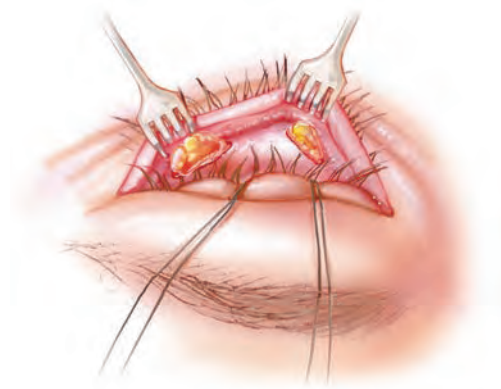
I prefer to make two separate conjunctival incisions: one medially over the medial fat compartment and the second laterally over the central and lateral compartments. These two incisions leave an intervening bridge of conjunctiva over the inferior oblique muscle in an effort to minimize the risk of injury to the muscle during fat removal. A single continuous incision affords better exposure without significantly increasing the risk of muscle injury.



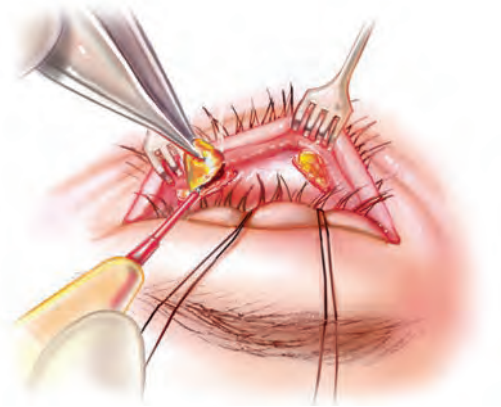
Once the conjunctiva and the adherent lower lid retractors and capsulopalpebral fascia have been incised, the fat compartments may not always be readily visible.



If the fat is not readily visible, gentle spreading with fine, blunt-tipped scissors will easily expose the fat. The central and lateral fat compartments are more easily identified than the medial fat compartment. I have found that resection of the central fat facilitates identification of the medial fat. It should be kept in mind that the inferior oblique muscle separates the central and medial fat pockets, whereas the arcuate expansion of the inferior oblique muscle separates the central and lateral compartments.

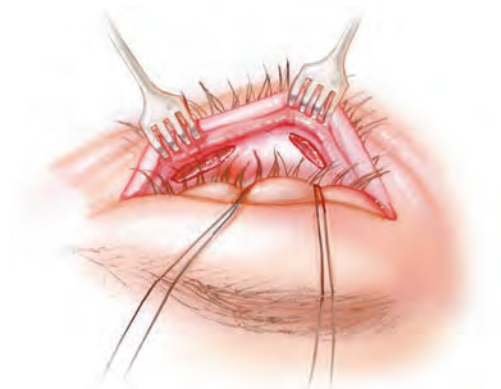


Once the fat is exposed, I like to deliver the fat through the incisions to assess the amount to be resected.

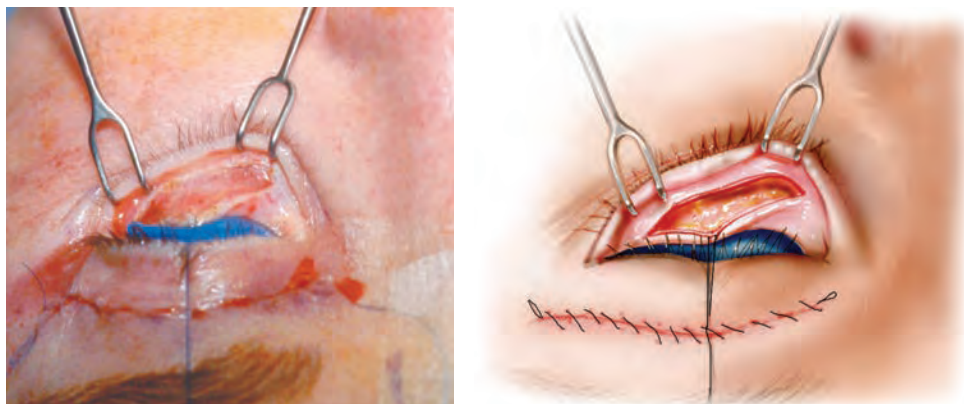


The exposed fat is then removed in a careful, graded fashion with the coagulator and Colorado tip needle. The endpoint is reached when the remaining fat is flush with the infraorbital rim when gentle pressure is applied on the globe.

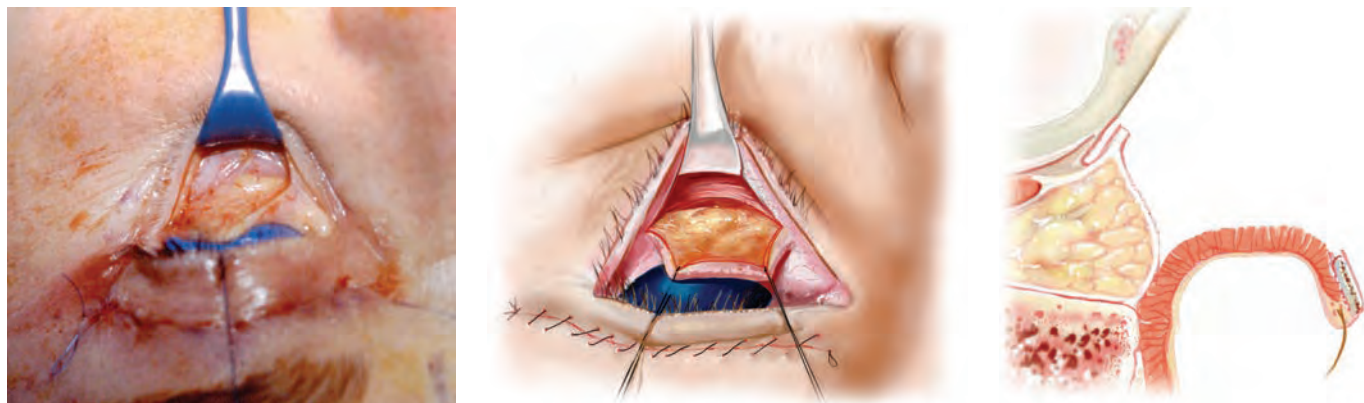
Closure



No closure is required if two separate incisions are made. If a single, continuous incision is made, the wound is sutured.

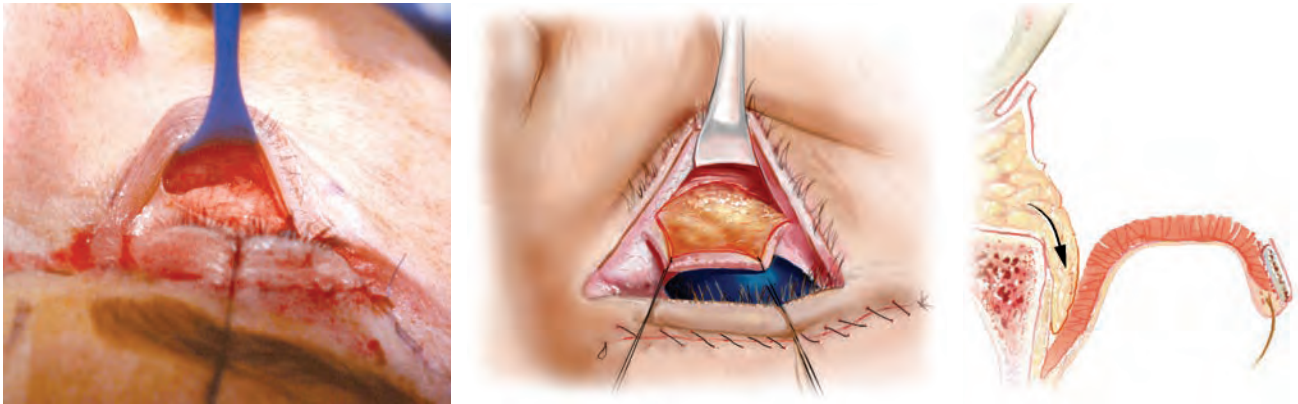
Preseptal Approach: Incisions

One continuous, long incision is made just below the tarsal border. This is facilitated by retracting the tarsal plate upward and inferiorly with Blair retractors or through the placement of stay sutures in the lid margin. The incision is made with the electrocautery and a Colorado tip needle.

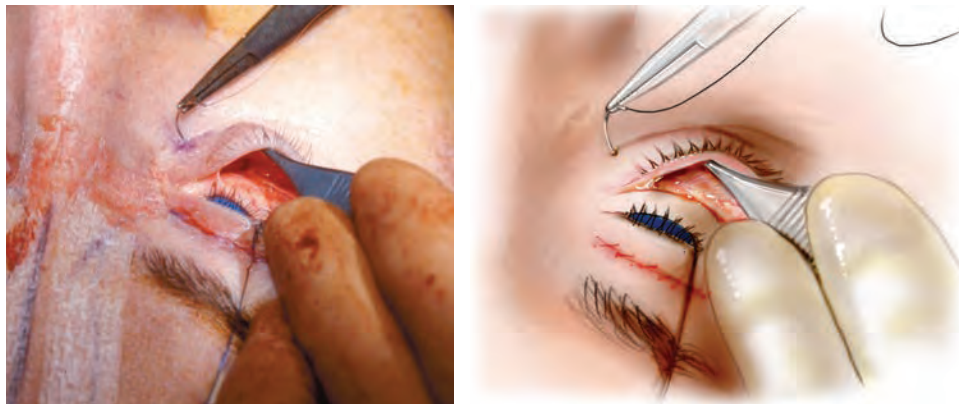


Once the incision has been made, stay sutures are placed along the inferior margin to facilitate exposure. The dissection is continued through the conjunctiva and lower lid retractors, exposing the orbital septum on the deep surface and the orbicularis on the superficial side of the incision. A Desmarres retractor is then placed deep to the orbicularis and pulled downward.

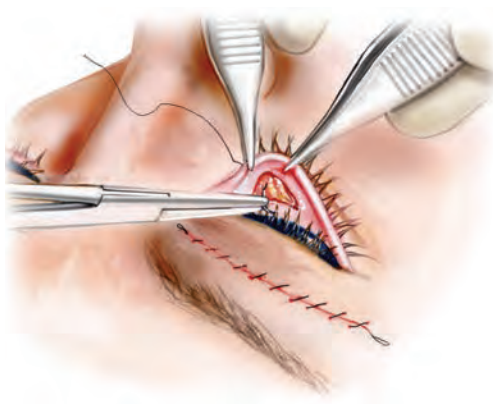
Exposure and Redistribution of Fat



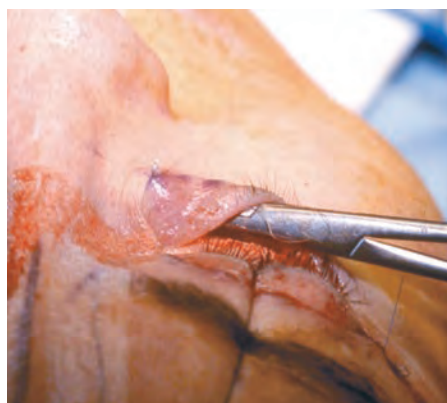
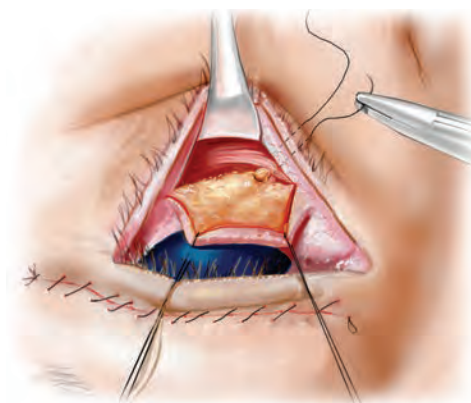
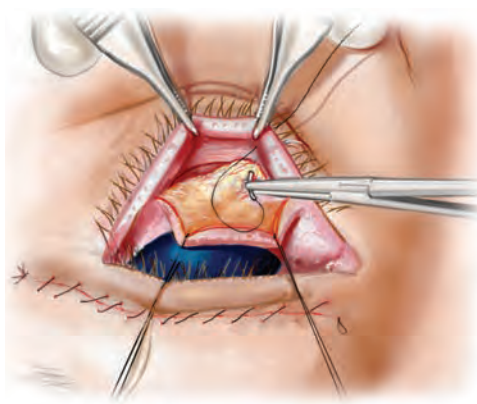
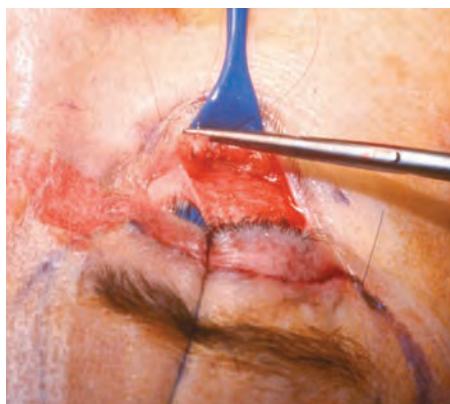
Dissection is continued deep to the orbicularis but superficial to the orbital septum, downward toward the orbital rim. The arcus marginalis is released, and dissection may continue into the midface as needed. The orbital septum is then opened and the fat compartments exposed, trimmed if necessary, and then the fat is mobilized over the orbital rim.



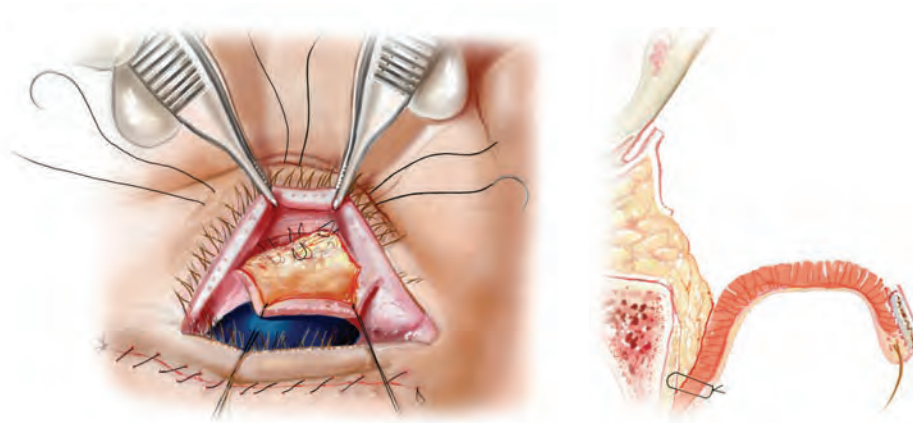
Retention of this fat over the rim is achieved through transcutaneous sutures. My preference is 6-0 catgut, tied over a small pledget of Xeroform if needed. The suture is introduced through the lower lid skin at the lid-cheek junction according to the preoperative markings.



The suture traverses the skin and orbicularis muscle.



It is then placed through the mobilized periorbital fat below and then back through the orbicularis and skin.



Several sutures are placed and tied over the pledgets if needed, once the last suture has been placed. The conjunctival incision is then closed with an intraconjunctival suture so that there will be no exposed sutures that could irritate the cornea.

Postoperative Care

The patient's head is elevated, and ice packs are placed on the eyelids.

Results



This young woman in her early thirties underwent transconjunctival removal of fat from the lower eyelids. The dark circles were ameliorated by the application of hydroxyquinone skin bleach. Her postoperative result is shown several months after the procedure.



Transconjunctival fat removal with erbium laser resurfacing was performed on the lower eyelids of this young woman in her forties. She is shown 1 year and 3 years postoperatively. She demonstrates an average to below average result because the aging of the lid-cheek junction has not been addressed through the transconjunctival removal of fat from the lower eyelid. An alternative approach would have been pre-septal conjunctival fat redraping over the lower lid-cheek junction.



This 70-year-old man requested improvement of the fat bags in the lower eyelid. He wanted a simple procedure with minimal recovery. Transconjunctival postseptal removal of fat from the lower lid was done. The result shown several months later demonstrates satisfactory reduction of the fat bags, although the aging of the lower lid–cheek junction and aging skin have not been addressed.

Outcomes

The transconjunctival approach to upper and lower eyelid blepharoplasty has been relatively trouble free. Complications involving exposure and lid retraction are extremely rare. Recovery is rapid with little risk of chemosis. Postoperative swelling is minimal compared to transcutaneous approaches.

Injuries to the levator aponeurosis in the upper eyelid resulting in ptosis have not been reported. Although injury to the inferior oblique muscle during transconjunctival lower lid blepharoplasty has been reported, it is very rare, and I have not personally encountered it. Although the muscle is always at risk when resecting fat from the central and medial pockets, I do not think that this risk increases with the transconjunctival approach.

Concluding Thoughts

The transconjunctival approach remains a safe and effective method for eyelid recontouring, lid-cheek blending, and periorbital rejuvenation. The approach offers little in the way of orbicularis muscle reshaping, skin removal, or lid anchoring. Modifications such as the skin pinch and approaching the orbicularis and canthus through the upper eyelid have been described, thus extending the indications for this approach.

Clinical Caveats

Upper Lid

Only the nasal fat pocket can be approached through the conjunctiva.

Lateral extension of the conjunctival incision should be avoided because it may damage the levator aponeurosis.

Ideal candidates are individuals with fat herniation of the nasal fat pocket with no real skin excess.

Lower Lid

The preseptal approach allows fat excision, fat redistribution, and access to the midface.

A postseptal approach allows fat removal only.

The inferior oblique muscle separates the medial and central fat compartments.

A preseptal approach with fat redistribution is technically challenging.

Ideal candidates have excess fat with no real excess skin.

Annotated Bibliography

Pacella SJ, Nahai FR, Nahai F. Transconjunctival blepharoplasty for upper and lower eyelids. *Plast Reconstr Surg* 125:384-392, 2010.

The authors review this technique, including anatomy, indications, and surgical approaches. They conclude that this remains a safe and effective technique for the treatment of periorbital aging.

Upper Lid

Guerra AB, Metzinger SE, Black EB. Transconjunctival upper blepharoplasty: a safe and effective addition to facial rejuvenation techniques. *Ann Plast Surg* 48:528-533, 2002.

The authors performed 42 bilateral transconjunctival upper blepharoplasties in patients undergoing facial and eyelid rejuvenation. They introduced the term “bare area.” The CO₂ laser was used concomitantly for treating fine rhytids and tightening loose upper eyelid skin. They found the procedure to be an effective method for removing medial upper eyelid fat with minimal complications.

Januszkiewicz JS, Nahai F. Transconjunctival upper blepharoplasty. *Plast Reconstr Surg* 103:1015-1018; discussion 1019, 1999.

This is our original description of the transconjunctival approach for removal of excess fat in the medial pocket of the upper eyelid. We reported that this was safe and effica-

cious as a primary or secondary procedure. Our initial experience in 20 patients (5 primary and 15 secondary) revealed the following: no complications, no revisions, and the patients were uniformly pleased with their results.

Lower Lid

Goldberg RA. Transconjunctival orbital fat repositioning: transposition of orbital fat pedicles into a subperiosteal pocket. *Plast Reconstr Surg* 105:743-748; discussion 749-751, 2000.

Rejuvenation of the lower eyelid complex is based on the principle that the contour changes that characterize aging involve not only prolapse of orbital fat but also descent of the cheek tissues, resulting in accentuation of the orbital rim and tear-trough groove. When a deep groove is present along the orbital rim in the area of the tear-trough deformity, it is advantageous, rather than removing orbital fat, to reposition the fat over the orbital rim through the opened arcus marginalis onto the superior face of the maxilla. The author describes orbital fat repositioning through a transconjunctival approach and follows 24 patients after orbital fat repositioning. It was found that although the fat pedicle undergoes some variable resorption, the viability of the graft, the texture and contour of the repositioned fat after a healing period of 1 to 2 months, and the excellent patient acceptance are indicative of the viability of orbital fat repositioning.

Jones GE, Trimble-Bried J, Nahai F. Transconjunctival blepharoplasty: a clinical experience. In *Perspectives in Plastic Surgery*. St Louis: Quality Medical Publishing, 1995.

This article describes our technique for transconjunctival fat removal and a comparison of complications with the transcutaneous approach. The overall complication rate was 5.3% with the transconjunctival approach and 12.7% with the transcutaneous approach. Exposure problems and lid retraction were 0% with the transconjunctival approach and 7% with the transcutaneous approach.

McCord CD, Shore JW. Avoidance of complications in lower lid blepharoplasty. *Ophthalmology* 90:1039-1046, 1983.

In an article devoted to avoidance of lower lid malposition, the authors describe the tightening of the tarsoligamentous sling in combination with a lower lid blepharoplasty. As an alternative method, they also describe postseptal fat removal from the lower eyelid. They describe this as "the fornix removal of fatty pads from the lower eyelid—the 'behind-the-lid' blepharoplasty." This alternative method significantly reduced or even eliminated the risk of lid retraction. They recommend this method for patients with excess fat in the lower eyelid and tight skin.

Zarem H, Resnick JI. Expanded applications for transconjunctival lower lid blepharoplasty. *Plast Reconstr Surg* 88:215-220, 1991.

Initial reports on the transconjunctival approach for lower lid blepharoplasty have focused on the young patient with isolated fat prominence. The authors describe their experience with transconjunctival lower lid blepharoplasty. They also discuss indications, which were expanded to include patients with apparent skin excess, and outcomes.

Suggested Readings

Upper Lid

- Guerra AB, Berger A, Black EB, et al. The bare area of the upper conjunctiva: a closer look at the anatomy of transconjunctival upper blepharoplasty. *Plast Reconstr Surg* 11:1717-1722, 2003.
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Lower Lid

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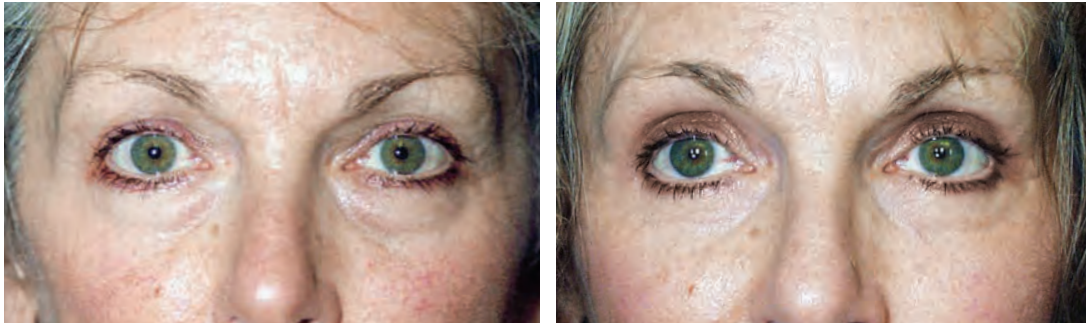
CHAPTER 32



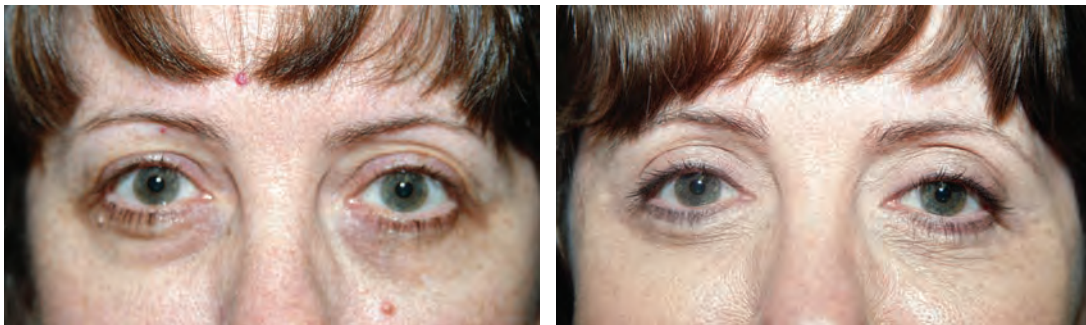
Lower Eyelid Pinch Blepharoplasty

LORNE K. ROSENFELD

The lower eyelid blepharoplasty embodies a classic surgical paradox worth revisiting: the more one performs a particular surgery, the more respect it may command. Whereas ignorance may be bliss, knowledge can be quite motivating. Any surgeon who has critically assessed his or her skin-muscle flap lower blepharoplasty results would heartily agree with this statement.



When I examined my own results, I observed, not as infrequently as I would have liked, two particular stigmata of a less than perfect result at the lower eyelid. First, lasting mild scleral show was evident, often preceded by weeks of overly optimistic eyelid taping. This 55-year-old woman, shown preoperatively and 1 year after a traditional skin-muscle lower blepharoplasty, exhibits this telltale postoperative sign of scleral show.



Second, residual crêpey skin was identified, most often after treatment of prodigious fat herniation. This 48-year-old woman, shown preoperatively and 1 year after a traditional blepharoplasty, exhibits this “untreated” redundant skin.

I was compelled by these discomfiting observations to seek an effective solution—a modified procedure that would at once ensure optimal correction of the eyelid deformities and yet maintain normal eyelid posture. And so was born the pinch blepharoplasty series. My personal experience, reported in 2005, confirmed the safety and efficacy of this approach.

Although the true incidence of eyelid malposition after a traditional muscle flap blepharoplasty is not well defined, the plethora of articles on the subject attests to its persistence. Scleral show has been ascribed to multiple causes: excess skin removal, untreated eyelid laxity, denervation of the orbicularis muscle, and scarring of the outer or middle lid lamellae. This postoperative problem may be considered subtle and indeed is often not even acknowledged, but it represents what could also be seen as a glaring example of the “operated” look that we should all strive to avoid. As for the excess skin left behind postoperatively, this problem has been equally neglected in the literature.

Evolution of Technique

There have been many efforts to reduce the incidence of eyelid malposition following traditional blepharoplasty. As documented by Zarem and Resnick, one approach has been to forego the skin incision entirely, thus preserving the integrity of the outer and middle eyelid lamellae, and to approach the eyelid instead through the conjunctiva only. Although the incidence of scleral show may be less with this approach, there can be a greater chance of untreated excess eyelid skin.

In another effort to avoid the skin incision and still treat the skin, skin resurfacing with a chemical peel or laser, in conjunction with a transconjunctival approach, can indeed reduce the incidence of scleral show. However, unless the skin redundancy is modest and the entire face is treated, resurfacing may not adequately treat the skin redundancy and can otherwise produce distracting lines of demarcation. Additionally, if these therapies penetrate too deeply, undesirable changes in eyelid posture may still occur.

With a skin-muscle flap, a relatively conservative resection of the skin has always been advocated, regardless of the extent of redundancy. Indeed, it is often impressive how little skin is actually removed despite such an aggressive flap dissection. And of course, in a patient with more significant excess skin, this conservatism has surely led to inadequate treatment.

Another adjunctive technique to a blepharoplasty is the canthopexy, particularly in a patient with a lax eyelid. There is no question that this repair helps reduce the incidence of lid malposition, but the results have been frustratingly inconsistent. We have all seen scleral show after a traditional blepharoplasty despite the addition of a canthopexy, even when applied prophylactically. An inadequate canthopexy, coupled with overaggressive skin resection, and the inciting factors of muscle denervation and middle lamellar scarring, probably explain this inconsistency. The deliberate preservation of a wider orbicularis strip of muscle, when conducting a skin-muscle flap approach, may be salutary but has clearly not proved to be the complete answer.

The idea of pinching the excess skin from the lower eyelid is not a new one; in 1973 Parkes et al were the first to suggest the technique. This description, which predated the transconjunctival approach, attenuated its potential benefits by also describing the division of the underlying orbicularis muscle to retrieve the excess fat.

Then in 1992 Dinner et al published a case report on the ultimate combination of the skin pinch with the transconjunctival approach in a “no flap” technique. Ristow, in 1994 in Mimis Cohen’s textbook, included the concept of a direct skin resection with a measured and marked resection.

My impetus to revisit and refine a pinch blepharoplasty came from a personal communication with Glenn Jelks in 2000. The solution became even more lucid when our decades-old standard approach to the upper eyelid blepharoplasty was considered: we “pinch” the eyelid excess to determine the extent of the excision while observing the effect on the eyelash and brow posture. Why not apply the same simple metric to the lower eyelid? So was born the “pinch blepharoplasty” series.

Advantages

My personal experience of more than 400 pinch blepharoplasties confirms that this approach is indeed capable of producing better, more consistent results than the traditional skin-muscle flap technique. This variation offers two distinctive advantages: more crêpey skin can be safely removed, and an aesthetic eyelid posture is secured.

This rewarding marriage of goals is primarily the result of the inherent accuracy of the pinch technique. The approach enables the surgeon to assess and define in real time the prospective skin resection as well as carefully evaluate its effect on eyelid posture. The pinch technique avoids a heavy skin-muscle flap, which can otherwise create both worrisome vertical traction and more swelling. Additionally, the pinch blepharoplasty eliminates the usual violation of the orbicularis muscle and orbital septum, an action that could lead to denervation, scarring, and poor eyelid posture.

Another possible reason for the improved results is the often seen amelioration of the eyelid-cheek groove with a more youthful vertical shortening of the eyelid, perhaps secondary to the effacing effect of the significant skin resection.

These benefits translate into a more adaptable and consistent blepharoplasty. This advantage is seen particularly and most gratifyingly in morphologically challenging patients with a negative vector and poor lid posture; older patients with poor lid tone; patients with extensive skin or festoons; and younger patients with primary

skin redundancy and nominal excess fat. If there is asymmetrical skin between the eyelids, or even within one eyelid itself, the pinch can be tailored accordingly. Empowered with this versatile tool, the surgeon can now treat the medial eyelid skin, a zone that was traditionally neglected, for an even more complete result. In addition, because the skin excess is more thoroughly treated, the surgeon can avoid the need for regional laser resurfacing of the eyelid, with its added period of healing and attendant, often distracting lines of demarcation.

The advantages of the pinch blepharoplasty can be doubled with a staged reapplication of the pinch to excise even more skin. This “repinch” can be accomplished quite simply, with a local anesthetic. Thus it is feasible that essentially all crêpey skin at the lower eyelid can now be removed.

Indications and Contraindications

The pinch lower blepharoplasty can comfortably usurp the standard skin-muscle flap technique. Therefore this approach may be offered to the same group of patients. In contradistinction to the standard technique, there is a productive breadth of application, depending on the extent of the patient’s problem. That is, all patients are candidates, but some are better candidates than others. Although results will be superior in all patients, defining the best and worst patient candidates for the pinch most effectively illustrates the nuances of the technique.



The ideal patient has abundant thin, crêpey skin, minimal excess fat, and morphologically advantageous anatomy (such as high cheekbones and almond-shaped eyes). With the application of the pinch and a planned second pinch procedure, if necessary, the improvement achieved in these patients can be dramatic, simply because the surgeon is able to more fully treat the eyelid.



At the opposing end of the spectrum, the imperfect patient is one with thicker, sun-damaged skin, which clearly will not “pinch” well. In these patients, it is best to plan the surgery so that the skin will have the least distortion from local anesthetic and to apply the pinch conservatively. Just as with patients with very thin skin, a thick-skinned patient will equally benefit from a staged second pinch procedure.

Because a dramatic skin resection can be done with this approach, the surgeon must be cautious when applying the pinch to a patient with equally significant redundant fat, because some of this skin must remain to redrape the now less convex lower eyelid. Again, these patients can always undergo a simple second pinch procedure at a later date.

Pertinent Anatomy

The essence of the pinch technique embodies a key anatomic principle: to violate the eyelid anatomy as little as possible, and if it is compromised by age or genetics, to repair it. Between the transconjunctival approach and the pinch, the pinch touches and takes only what it needs to—the skin—leaving behind the critical neuromechanical support: the orbital septum and the orbicularis muscle and its attendant nerves.

As for the canthopexy, the key anatomic principle is to keep it simple. Because the lateral canthus truly comprises several components and is not easily identified as a distinct structure, the canthopexy has to become a kind of maneuver “on faith”: you can only really feel its presence. That is, rather than trying to dissect and visualize the canthal tissues themselves, the surgeon need only grasp and pull whatever tissue is present in the area to know the “right stuff” has been captured. Then it simply becomes a matter of manipulating this anchor thoughtfully to perform an individualized canthopexy.

Preoperative Assessment

History

There are several critical historical points to be gleaned, including a history of eye dryness, tearing, or the need for drops; allergies; Graves' disease; prior eyelid surgery; and previous injection of tissue fillers.

Physical Examination

The preoperative physical examination should include the same components as for any blepharoplasty. However, the difference is that because the pinch allows one to modify the surgery to match the patient's problem, the value of a detailed analysis is even more rewarding.

The critical elements to evaluate are listed in the box.

Critical Factors to Assess in the Physical Examination

The extent of the redundant skin: If necessary, a second pinch procedure can be planned in advance. This is particularly relevant in a patient with significant "active" skin: exaggerated wrinkling on animation.

The extent of the redundant fat: Depending on the volume of excess, more or less skin should be pinched to ensure that enough skin is left behind.

The degree of lid laxity and attendant scleral show (as evaluated by a snap test): This can be treated efficiently with a stitch canthopexy.

The level of the lateral canthus (canthal tilt): The canthal position can be adjusted relatively precisely with a stitch canthopexy.

The vector angle of the globe to the malar (positive/neutral/negative): This aids the surgeon in the design of the best application of the pinch and canthopexy components of the surgery.

Photography

There are several tenets to be followed for photographic evaluation of the eyelids and documentation of the results.

Prevent Parallax Error

Parallax refers to the apparent displacement or difference in the apparent position of an object viewed along two different lines of sight, such as occurs because the lens of a camera and the viewfinder see the subject from a slightly different position. Thus photographs must be taken with the patient and surgeon seeing “eye to eye”; that is, there should be no height discrepancy that could distort the appearance of the posture of the lower eyelid in relation to the globe.

THE PARALLAX EFFECT



Patient tipped up



Patient tipped down



Patient level



Camera high



Camera low



Camera level

This problem can be manifested when either the patient is not level or the camera is not level. These effects can mask or exaggerate the actual eyelid position.

Beware of the Moro Reflex



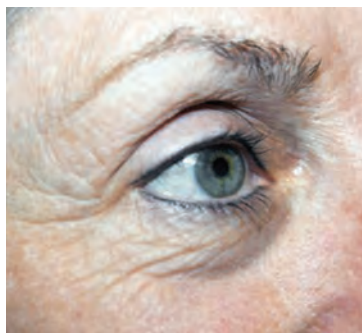
Close-up with Moro



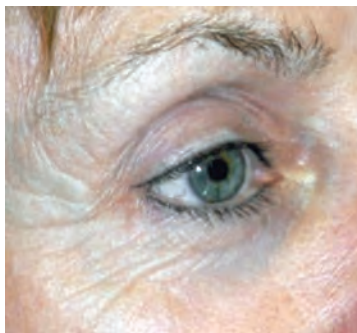
Full face without Moro

When a tighter photo of just the eyelids is to be taken, some patients, anticipating the flash's effect, may widen their eyes dramatically. If this is noted, pulling the camera back to include a full-face picture should correct the distortion.

Follow the Dermatologist's Credo



Close-up preoperative photo



Close-up postoperative photo

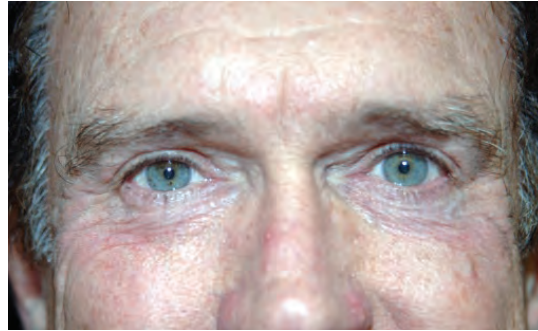
To accurately document the effects of the pinch procedure, progressively closer pictures of the face should be taken, from full face to just wrinkles at the lower eyelid.

Control the Patient's Emotions

There is a place for both active and passive photographs of a patient's lower eyelid. Photos should be taken of the patient smiling to define the extent of muscle-skin excess.



Patient smiling preoperatively



Patient smiling postoperatively

Often orbicularis wrinkling is the patient's primary concern, and any correction of this problem is a true measure of a technique's efficacy.



Patient's smile hides scleral show



Patient at rest with scleral show

On the other hand, a smile can camouflage an eyelid posture or a scleral show problem.

Compare the Present With the Past

The patient should be asked to bring photographs from the past (such as college or wedding photos or well-focused candid photos). The insight gained from reviewing such historic images is invaluable not only for observing changes in the characteristics of the periorbital area but also in our attempt to recapture the patient's characteristic expression or persona.

Patient Education

A patient with significant wrinkling must be informed that a second pinch blepharoplasty should be considered, depending on the salutary effects of the first procedure. The goals and actions of a canthopexy should be explained, because the palpebral fissure will become more almond shaped.

Planning and Technique

Particularly when first attempted, the pinch procedure is best conducted with infiltration of as little local anesthetic as possible. With deeper sedation or general anesthesia, it is both possible and ideal to use no local infiltration. This consideration is critical, because it allows the surgeon to most accurately judge and pinch the skin excess without the potential distortion caused by aggressive local infiltration.



32-1 Pinch
blepharoplasty

Surgical Plan

1. If a local anesthetic must be used, place it in the lower eyelid in the region of the future pinch.
2. Conduct the upper eyelid blepharoplasty, leaving the wound open.
3. Complete the transconjunctival portion of the lower blepharoplasty.
4. Perform a stitch canthopexy through the upper-outer eyelid wound.
5. Close the upper eyelid wound.
6. Perform the lower eyelid pinch procedure and close the wound.

Marking



The first step is to mark a guiding “pinch line” along the lower eyelid, representing the *uppermost* margin of the future excision. Medially, this line is usually placed within a few millimeters of the ciliary margin, continuing in a straight line laterally, deliberately leaving a progressively enlarging triangular island of intact skin of 4 to 5 mm in minimum height below the lateral eyelid margin. This maneuver further discourages scleral show by lessening the purse-string–like scar contracture that may occur with a curvilinear incision hugging the ciliary margin. However, the latitude of this line can be modified, depending on the location and quality of the excess skin. That is, the pinch line can be moved up or down on the eyelid to facilitate maximal skin removal. If the skin is noticeably thicker, the pinch line should be moved farther away from the ciliary margin to help prevent scleral show.

Sequencing of Procedures

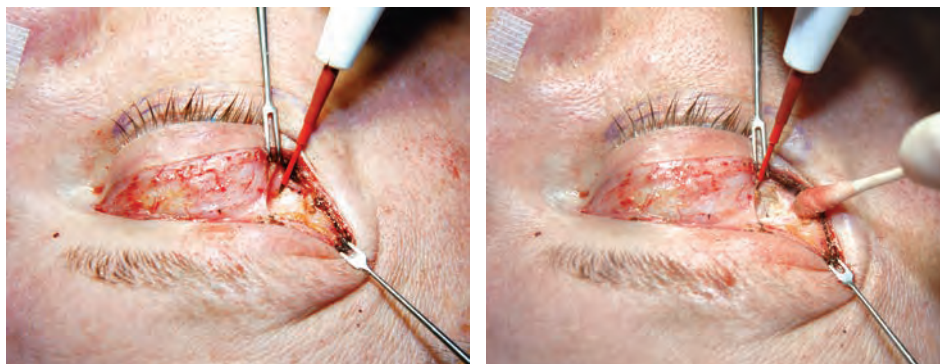
The sequence of operative steps is critical. If an upper blepharoplasty is planned as well, it should be conducted first, with wound closure delayed until after a canthopexy but before the lower eyelid pinch. Thus the lateral upper eyelid wound is available for the canthopexy, and any lower eyelid skin redundancy that may be treated with closure of the upper eyelid takes place before the pinch procedure. On the other hand, if only a lower blepharoplasty is to be performed, to accomplish a pexy a 10 to 15 mm counterincision may be made in the lateral upper eyelid along the path of an upper blepharoplasty.

Operative Technique

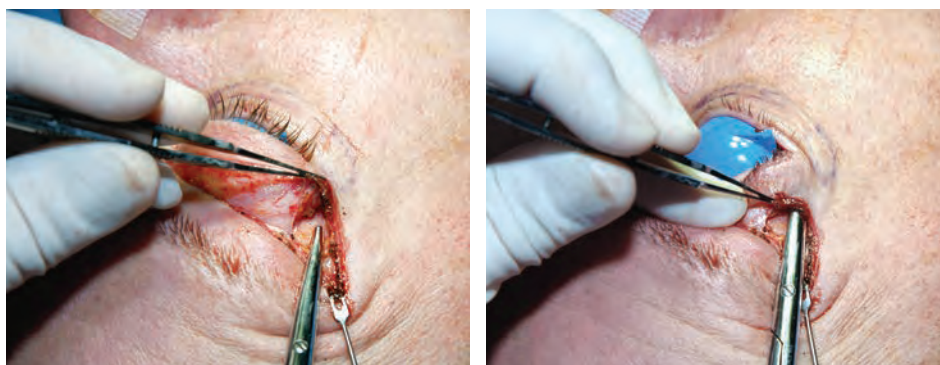
After the markings, the surgeon applies any local anesthetic early and judiciously to minimize the amount of local swelling and maximize its resolution. The transconjunctival portion of the procedure is best conducted preceding a possible canthopexy, lest the surgeon have difficulty distracting or even undoing the tightened eyelid. The canthopexy should be performed before the lower eyelid pinch procedure, because the potential lateral lift of the pexy can treat some of the lower eyelid excess. As for the lower eyelid, the excess fat is trimmed as indicated and the wound reapproximated at its midsection with a 6-0 fast-absorbing catgut suture.

The upper eyelid portion of the blepharoplasty is then performed as premarked. The excess skin and as indicated, excess muscle, are resected. Then the underlying orbital fat is treated, if necessary, with electrocautery and/or excision. Before closure of the upper eyelid wound, the lateral stitch canthopexy is performed.

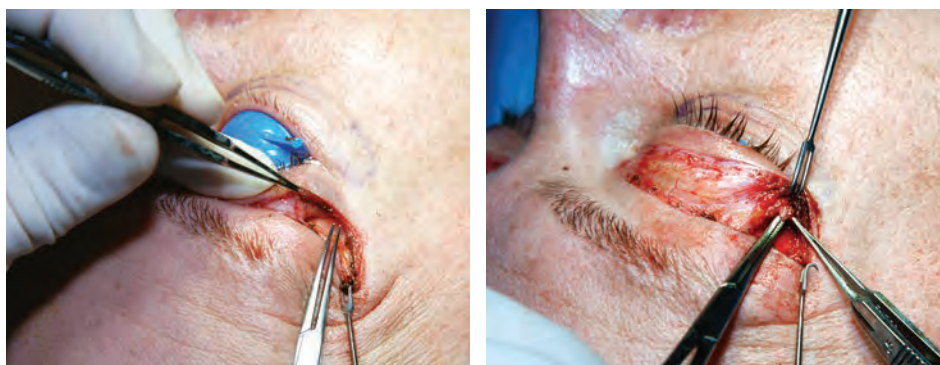
I distinguish two kinds of canthopexy to consider and design: prophylactic and therapeutic. The choice is primarily determined by two factors: the position of the lateral canthus and the posture and tone of the lateral lower eyelid. If the lateral canthus is at or above the horizon and/or the lower eyelid tone is mildly weak without scleral show, a prophylactic pexy is in order. If instead the lateral canthus is below the horizon and/or the lower lateral eyelid tone is weak with scleral show, a therapeutic lateral canthopexy should be performed. Clearly, there is always a gray zone in this arbitrary categorization: there are patients with a normal neutral canthal cant who could have an aesthetic improvement with a slight elevation of the lateral canthus, and as such the canthopexy could be considered not only prophylactic but therapeutic as well. This nuance is particularly relevant in a patient who in youth had an almond-shaped eye.



In either case, the procedure is conducted through the lateral aspect of an upper blepharoplasty incision. First, using the Bovie, a segment of approximately 1 cm of the superolateral inner orbital rim is exposed, with great care to preserve the integrity of the periosteum.



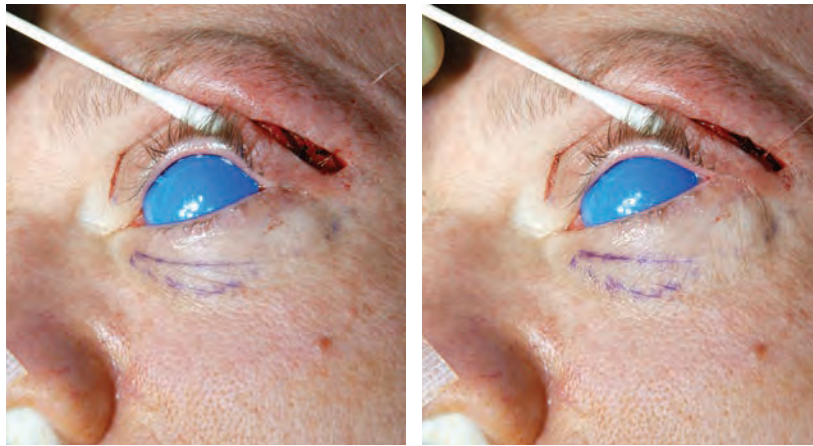
Then a subfascial/submuscular “tunnel” is created between the orbital rim and the lateral canthus using round-tipped iris scissors.



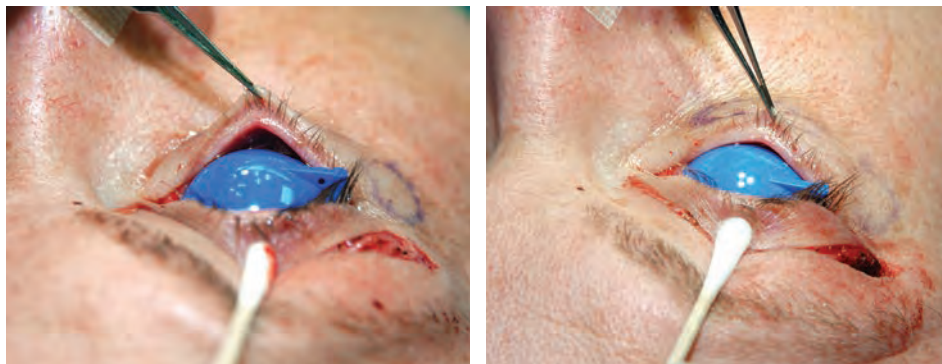
A very fine, curved mosquito clamp is passed down the tunnel, and its very tip is used to capture the lateral canthal tissue.

If a prophylactic canthopexy is planned, the mosquito clamp tip is passed up to the orbital rim to determine the ideal pexy location, which will at once modestly tighten the lower eyelid and maintain the canthal angle. If a therapeutic pexy is desired, the

mosquito clamp is manipulated as needed to produce the desired correction of the eyelid posture and/or canthal position. If necessary, the canthal tissues, still within the grasp of the mosquito, can be gradually released with a scissors or Bovie. This maneuver should be conducted with the mosquito on tension so that the surgeon can proprioceptively conduct adequate liberation of the canthus. At most, a partial release is all that is necessary to properly treat the majority of eyelids and thwart overcorrection.

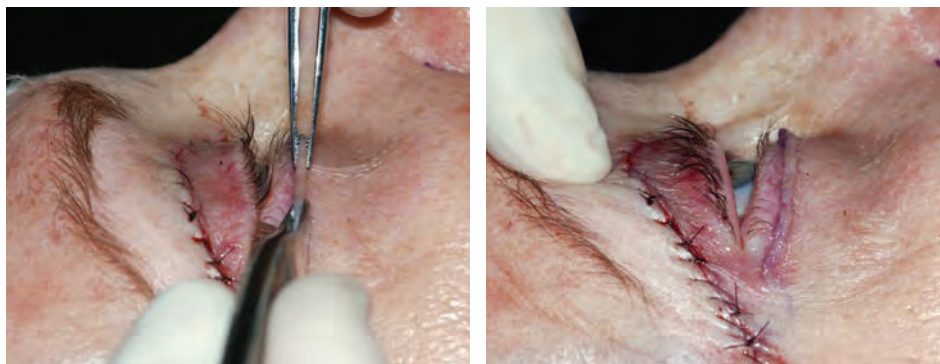


The canthopexy is sutured in place by taking a double bite of the captured canthal tissue with a 5-0 clear nylon suture and securing this tissue to the periosteum within the orbital rim. The canthopexy is shown before and after it is secured. If desired, transparent scleral protectors may be used, or those shown may be removed, to facilitate placement of the pexy stitch.



The surgeon can evaluate the efficacy of the pexy on eyelid tone by conducting an immediate distraction test. An intraoperative distraction test is shown before and after the canthopexy. The canthal position can also be assessed by sitting the patient upright. NOTE: The suture should be reapplied if the desired lid tightening or canthal positioning effect has either not been achieved or is exaggerated.

Pinch Blepharoplasty



Then, using a pair of fine Adson-Brown forceps, the subciliary skin is progressively pinched along the premarked line into a standing “wall” of skin. The endpoint should be the maximal effacement of wrinkled skin resting primarily *below* while preserving a normal posture of the eyelid margin *above*.



With a forceps producing linear traction and a straight pair of scissors, the wall is amputated at its base.



The appropriate amount of skin has been removed if the wound edges are close to each other or just kissing. The wound may be opened to electrocoagulate any small bleeding vessels and is then closed with a 7-0 running nylon suture. No taping or other support of the eyelids is necessary.

Postoperative Care

Patients are started on iced cotton eye soaks during the surgery itself. If the eyes are iced meticulously, there will be less swelling and bruising. The patient performs this same icing routine continually for the first 48 hours, with intermittent breaks to avoid anxiety. Thereafter, icing can be used for comfort as needed.

As an additional proactive effort to encourage faster healing, patients undergo in-office ultrasonic therapy and lymphatic massage within the first postoperative day or two. This is continued for two more sessions over the subsequent week or so. This modality is a natural adjunct to the pinch blepharoplasty's goal of a faster recovery. In addition, herbs (*Arnica montana* and bromelain) to reduce bruising and swelling are given for the first 2 weeks postoperatively. Stitches are removed at 5 days, and no supportive tape is applied. At 2 weeks after surgery, the patient may gradually return to routine exercise over the subsequent 4 weeks.

At 6 months or more after the initial procedure, a planned repinch may be performed. It is usually performed with a local anesthetic and the addition of diazepam (Valium) as necessary. If the patient has lost some of the effect of the first canthopexy or still has a significant amount of redundant skin, planning a repeat canthopexy is prudent.

Problems and Complications

The gratifying essence of the pinch technique is that its entire premise is built on the goal of preventing the routine problems and complications seen with the traditional approach. Thus scleral show and residual eyelid wrinkling are very rare occurrences. However, some issues unique to the pinch blepharoplasty should be noted. If a non-absorbable nylon-type suture is used for the canthopexy, its knot can sometimes be seen postoperatively in a very thin-skinned patient and may need to be clipped. If the pinch is electively performed slightly lower on the eyelid, where the wrinkles often rest, the scar may initially be more visible; however, these scars do uniformly mature inconspicuously. In a patient with a significant amount of excess skin who specifically asks for or prefers a scar aligned with the eyelash, they should be informed of the reduction in wrinkle removal that may result.

When conducting the canthopexy, if there is excessive manipulation of the tissues, a chemosis covering the lateral white triangle of the globe may result. This problem is usually self-limiting but should be supported with lubricating or medicinal eye-drops. To obviate this nuisance effect, it is best to deliberately capture the pexy material with your first bite.

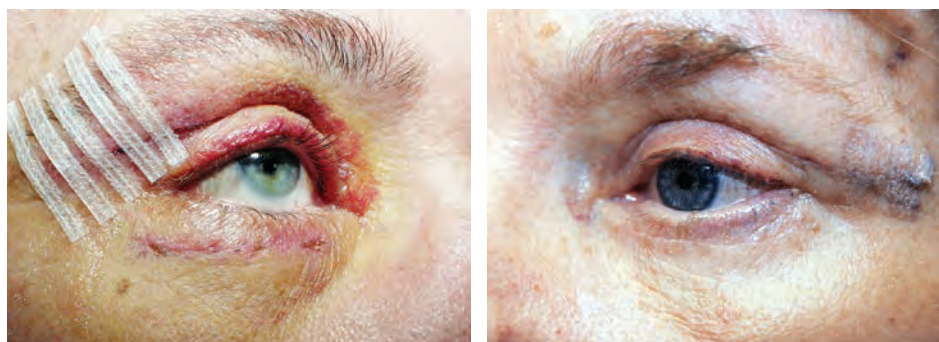
Finally, if performed too aggressively, the canthopexy will produce an overly corrected result. Usually the effect will improve over time. On the other hand, if the pexy is not harnessed adequately, the patient may be left with a canthal or lid deformity. The best preventive maneuver is to critically assess and redo the pexy if necessary in the first place.

Outcomes

The spirit of this modification of the lower blepharoplasty is defined by a triad of maneuvers: (1) the deliberate preservation of the eyelid's integrity with a transconjunctival incision, (2) the mindful alignment of the lower eyelid with respect to the globe and canthus with the application of the canthopexy, and, pivotally, (3) the proficient excision of the redundant skin with the mastery of the pinch technique.



These examples demonstrate the extent of skin excision possible with pinch technique, averaging 8 to 12 mm. In addition, the patient usually has less bruising and swelling and heals more rapidly.



The typical early appearance of a postoperative patient is shown at 5 days and at 7 days. Together these efforts consistently deliver a salutary removal of redundant skin of the eyelid while still safeguarding its posture. In fact, with greater comfort performing the stitch canthopexy, the surgeon can often go one step further and cre-

ate a subtle, more aesthetic shape to the otherwise normal lower eyelid. On the other hand, particularly in a morphologically challenging patient, the canthopexy may definitively correct the attendant canthal deformity. Additionally, the application of the repinch procedure, best planned for before the first pinch is performed, has reliably contributed to even more satisfying results.

Results

The following cases were chosen to demonstrate the power of the pinch procedure given various patient presentations—from the best to the more difficult blepharoplasty candidates.

The Older Patient

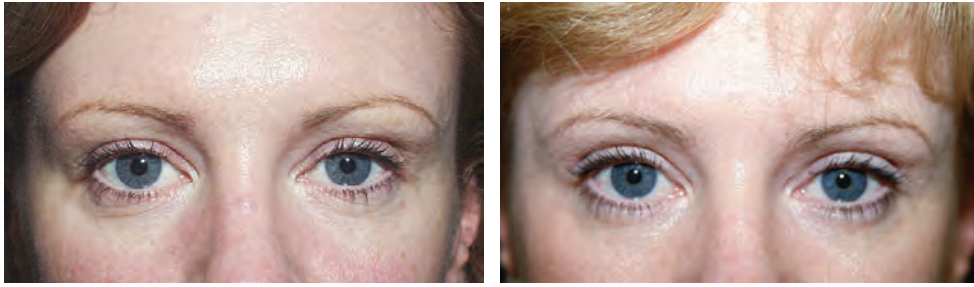


This 68-year-old woman is shown preoperatively and 1 year after an upper and lower pinch blepharoplasty. Lower eyelid aging was corrected and a normal eyelid posture was ensured.



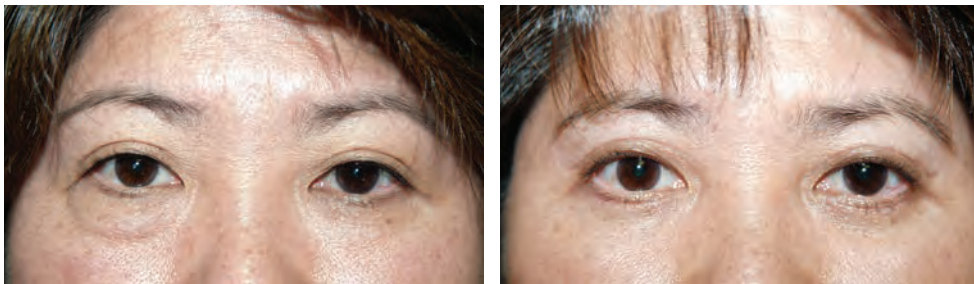
This 53-year-old woman with the classic stigmata of aging would previously have undergone a routine blepharoplasty with CO₂ laser or chemical resurfacing. Instead, upper and lower pinch blepharoplasties with prophylactic canthopexies were performed. She is seen preoperatively at age 53, in a historic photo at age 23, and postoperatively at age 54, with an attractive, youthful eyelid posture restored.

The Younger Patient



This 36-year-old patient presented with modest wrinkling. She underwent only a lower pinch blepharoplasty with full correction, as seen 2 years postoperatively, obviating the need for laser or other resurfacing intervention.

Orbital Groove



This 42-year-old woman, who requested upper and lower blepharoplasty, demonstrated significant asymmetrical excess of both fat and skin. The pinch blepharoplasty allowed an equally asymmetrical excision and a salutary effacing of the deep orbital groove, as seen 14 months postoperatively.

Problem: Anatomy



This 45-year-old patient had morphologically challenging anatomy: a triad of a large globe, a negative orbital vector, and lateral canthal cant (*left and center*). In addition to an upper blepharoplasty, she underwent a therapeutic canthopexy and pinch lower blepharoplasty that corrected both the depressed canthus and the eyelid problem itself, as shown 18 months postoperatively (*right*).

Problem: Anatomy

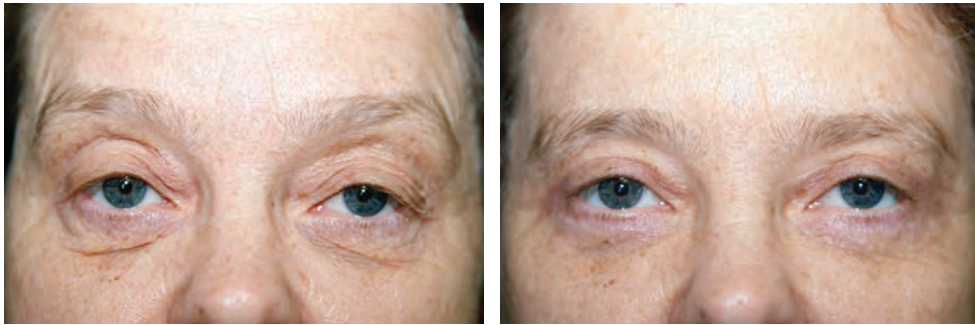


This 58-year-old patient had a spectrum of poor “design” issues: negative cheek and lateral canthus angles and scleral show. He is seen 16 months after upper and lower blepharoplasties with pinch and therapeutic canthopexies (*right*).



This 63-year-old patient had poor morphology and significant, albeit asymmetric redundancy at the lower eyelids, and proper scleral show. He underwent an upper and aggressive lower pinch blepharoplasty with an asymmetrical canthopexy. He is shown preoperatively and (*below*) with results at 7 days and at 6 months.

Problem: Redundant Skin

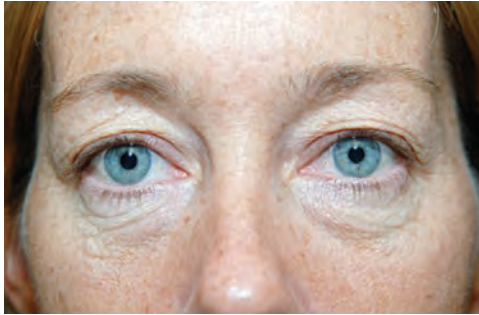


This 52-year-old woman had considerable excess crêpey skin. Two years after an upper and lower pinch blepharoplasty, she demonstrates essentially complete removal of the redundant skin; good eyelid posture has been maintained.

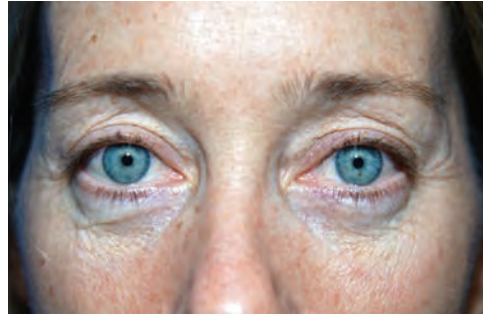


This 73-year-old woman was an ideal patient for a pinch blepharoplasty. The photo series reveals the pathway to relatively complete repair of lower eyelid aging. The patient is shown intraoperatively, demonstrating the prodigious pinched wall of skin and wound, with preservation of an attractive eyelid posture. The 1-year postoperative view confirms the rewarding improvement.

Problem: Persistent Skin Excess Requiring a Repinch Procedure



Preoperative



6 months after first blepharoplasty with canthopexy

This 56-year-old patient presented with advanced sun-damaged skin at the eyelids, so a second pinch procedure was planned. She underwent an upper and maximal lower pinch blepharoplasty with canthopexy. At 6 months postoperatively she demonstrated persistent excess in the upper and lower eyelids.



A revision was performed, with reexcision at the upper and repinch at the lower eyelids. The repinch roll and extent of repinch wound at approximately 10 mm are shown.



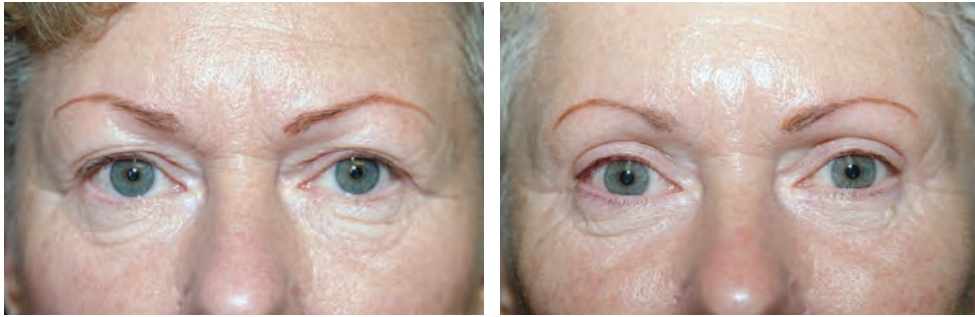
At age 20



1 year after repinch procedure

The patient is seen in a historic photo at age 20 and 1 year after the repinch surgery, demonstrating reasonable success at recapturing her youthful look.

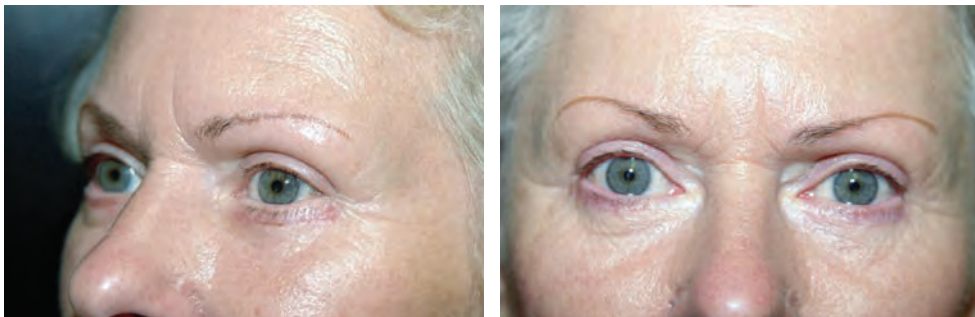
Repinch Procedure



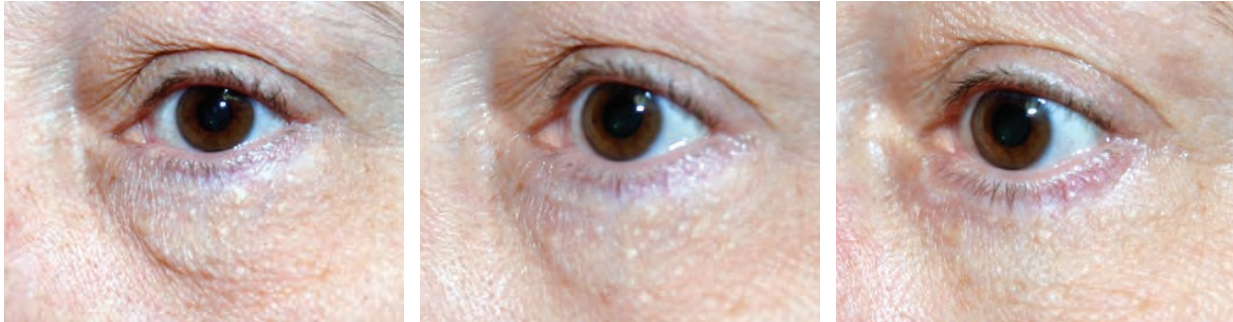
This 72-year-old woman illustrates the power of the repinch procedure. The staged surgery was performed at approximately 6 months. The patient is shown preoperatively and 6 months after the first pinch procedure.



The intraoperative views demonstrate the second pinch roll, the wound kissing, and the pinch wound.



The patient is shown 4 days after the second pinch procedure and 1 year later.



This 68-year-old patient is seen in close-up views of progressive correction: preoperatively, following the first pinch blepharoplasty, and following the repinch surgery, each result 6 months apart.

Concluding Thoughts

One could say that these modifications empower the surgeon to tame and command greater control of the lower eyelid. Personally, I have found the effects of this technique quite gratifying: I have both a newfound serenity when approaching the lower eyelid with this more reliable means for preventing surgical stigmata and a satisfaction with the results because of the more comprehensive eyelid correction that can be realized.

The procedure's advantages are particularly manifested when one is confronted by challenging morphology. As an endorsement of the efficacy of the pinch blepharoplasty, I have not performed a skin-muscle flap lower blepharoplasty in more than 12 years. The pinch blepharoplasty has eliminated the need for lower eyelid resurfacing in most cases.

In addition, we have abolished the proverbial “therapeutic” postoperative taping. I now perform more canthopexies intelligently and excise more skin confidently. The results of these efforts have included consistently faster patient recovery, more accurate canthal and eyelid positioning, and what is most important, significantly improved aesthetic outcomes.

Clinical Caveats

The surgeon should infiltrate the local anesthetic as early and minimally as possible. The less distortion of the tissues, the more accurate and facile the pinch maneuver will be. This is particularly germane at the start of a surgeon's learning curve. To this end, it is often helpful to sedate the patient more deeply just before the pinch procedure.

The addition of a stitch canthopexy is a preoperative decision predicated on evaluation of both the position of the lateral canthus and the posture and tone of the lower eyelid. The action of the canthopexy may be classified as either prophylactic (elderly, prominent globe, malar hypoplasia, or "negative" lateral canthal position) or therapeutic (laxity or scleral show).

Generally, if a patient is deemed to be a candidate for a lower blepharoplasty, at least a prophylactic canthopexy should probably be performed. Thus almost every patient now undergoes a canthopexy. In effect, the stitch canthopexy, when judiciously harnessed, empowers the surgeon to take full advantage of the pinch procedure and perform the most complete removal of redundant skin.

Both the pinch blepharoplasty and the stitch canthopexy techniques have a notable learning curve. During this evolution, the surgeon should be aware that it is deceptively easy to "overpinch" or "overpexy." As a layer of protection initially, it is prudent to pinch a few millimeters farther away from the lash margin compared with the traditional incision. This scar consistently heals imperceptibly. Also, when conducting a stitch canthopexy, the surgeon should have a low threshold for replacing the stitch if an overcorrection is perceived; it may not "settle" enough on its own postoperatively. Likewise, the pexy should be reattempted if an undercorrection is noted.

The pinch portion of this technique can easily be repeated with the patient under local anesthesia to treat any residual crêpey skin.

Annotated Bibliography

Dinner MI, Glassman H, Artz JS. The “no flap” technique for lower-lid blepharoplasty. *Aesthetic Plast Surg* 16:155-158, 1992.

In a case report, the authors described the first lower blepharoplasty with a skin pinch in combination with the transconjunctival approach.

Parkes M, Fein W, Brennan HG. Pinch technique for repair of cosmetic eyelid deformities. *Arch Ophthalmol* 89:324-328, 1973.

This is the first description in the medical literature of the pinch technique for skin removal. However, the approach negated some of the benefit of the pinch, because Parkes divided the orbicularis muscle to access the fat.

Ristow B. Transconjunctival blepharoplasty. In Cohen M, ed. *Mastery of Plastic and Reconstructive Surgery*, vol 3. Boston: Little Brown, 1994.

Ristow included the concept of a direct excision of skin in conjunction with a transconjunctival blepharoplasty. Rather than pinching the redundant skin, it was measured, marked, and excised in a fashion akin to the traditional upper eyelid skin removal.

Suggested Readings

Jelks G. No touch blepharoplasty. In Cardoso de Castro C, ed. *Midface Surgery*. Philadelphia: Elsevier/Saunders, 2009.

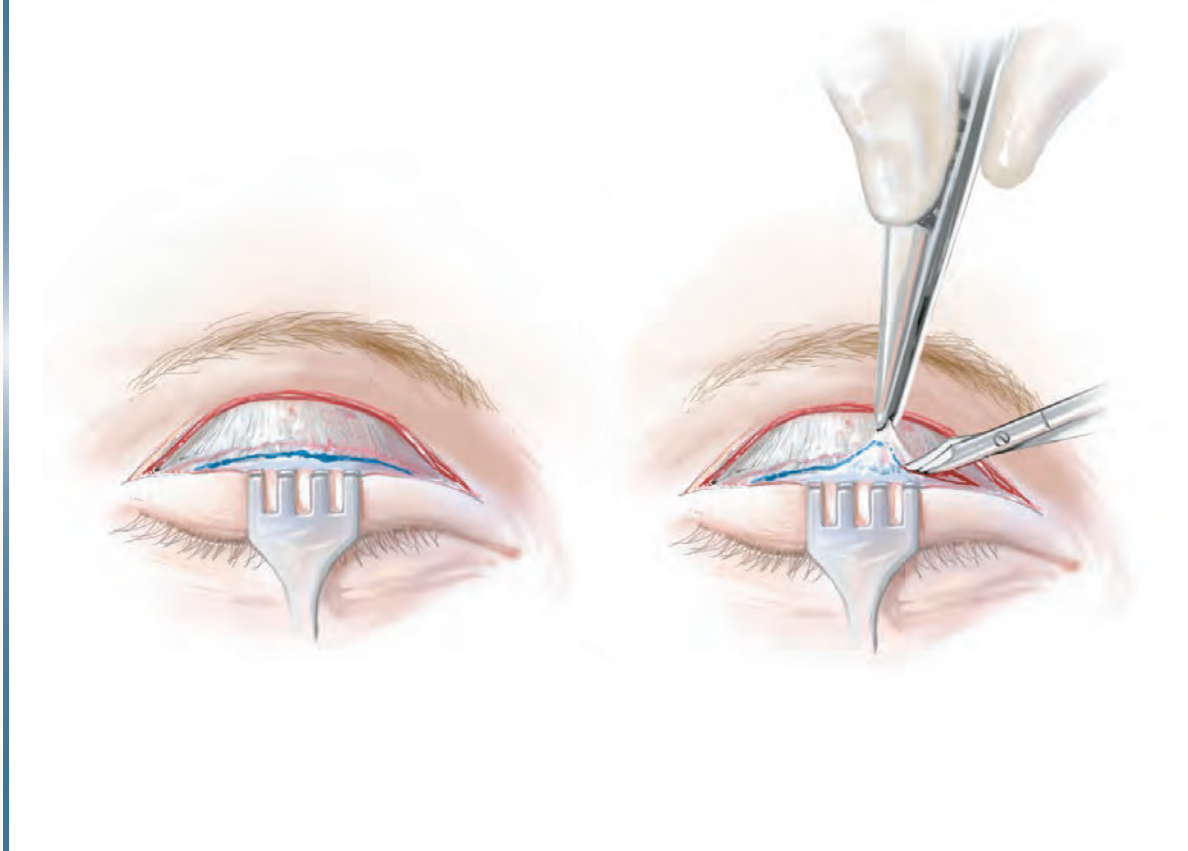
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Rosenfield LK. The pinch blepharoplasty revisited. *Plast Reconstr Surg* 115:1405-1412; discussion 1413-1414, 2005.

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Zarem HA, Resnick JI. Minimizing deformity in lower blepharoplasty: the transconjunctival approach. *Clin Plast Surg* 20:317-321, 1993.

CHAPTER 33



Ptosis Surgery in the Blepharoplasty Patient

CLINTON D. MCCORD, JR., FOAD NAHAI

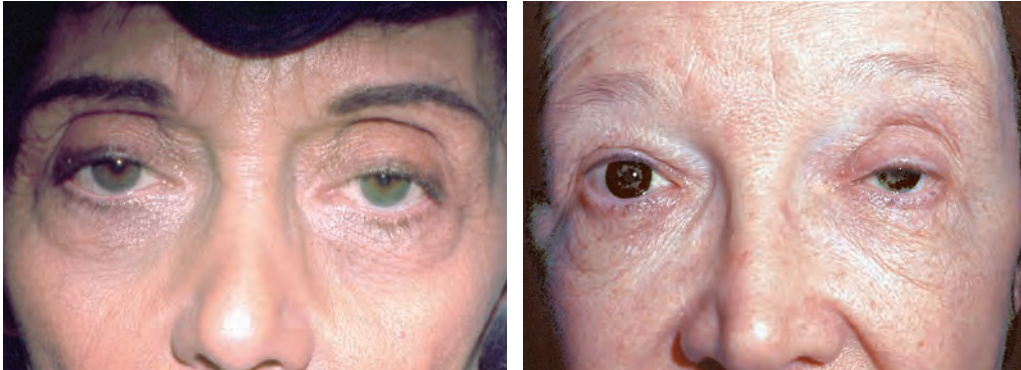
Eyelid ptosis, or abnormal drooping of the eyelid, is a condition frequently encountered during aesthetic and reconstructive eyelid surgery. Failure to identify this problem preoperatively or to incorporate correction of this condition into the operative plan will compromise the ultimate result. This chapter focuses on adult ptosis resulting from acquired dehiscence of the levator aponeurosis and the type of levator surgery that is most effective for a patient seeking blepharoplasty. For this group of patients, the primary goal of surgical correction is on repair of the levator aponeurosis. Ptosis may be repaired alone or in combination with upper lid blepharoplasty. Although the correction of lid droopiness is the primary goal in ptosis surgery, other important related issues include eye protection and identification of any underlying pathologic process requiring diagnosis and treatment. Sudden-onset ptosis with neurologic signs of pupillary abnormalities and ocular motility should alert the surgeon to underlying neuromuscular problems, such as myasthenia gravis, Horner's syndrome, and third nerve paresis. A patient with these signs should undergo neurologic evaluation.

Pertinent Anatomy

Levator Dehiscence

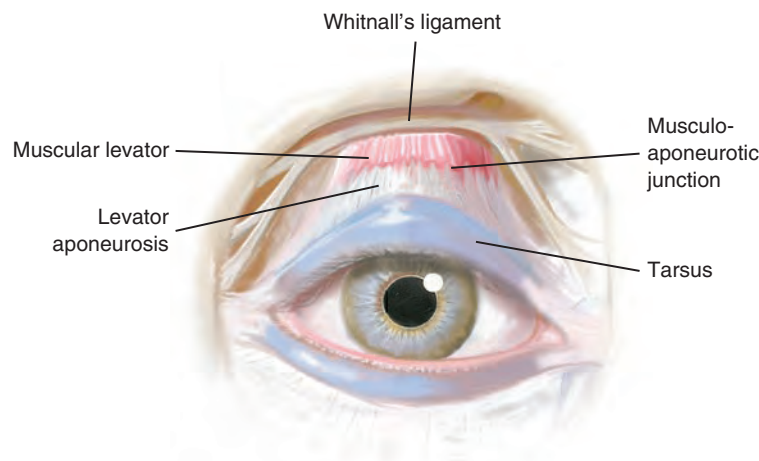
Levator dehiscence is an abnormality or thinning and stretching in the levator aponeurosis that allows a downward movement of the tarsal plate. It may occur without any known predisposing cause or may occur following direct trauma, such as acute swelling from a bee sting or a "black eye." Levator dehiscence is known to occur following an ocular procedure, such as cataract surgery, and is thought to be exacerbated by wearing rigid gas-permeable contact lenses. Any significant edema can cause levator dehiscence in predisposed individuals. Levator muscle function and elasticity are normal in these patients, and there is no lagophthalmos in downgaze.

The characteristic clinical appearance of ptosis as the result of aponeurotic dehiscence is good to excellent levator function, a high lid crease, and thinning of the eyelid tissues above the tarsal plate. In some cases the high lid crease may be obscured by dermatochalasis.



These patients demonstrate various examples of levator dehiscence. The patient on the left has bilateral levator dehiscence, whereas the patient on the right demonstrates levator dehiscence following cataract surgery.

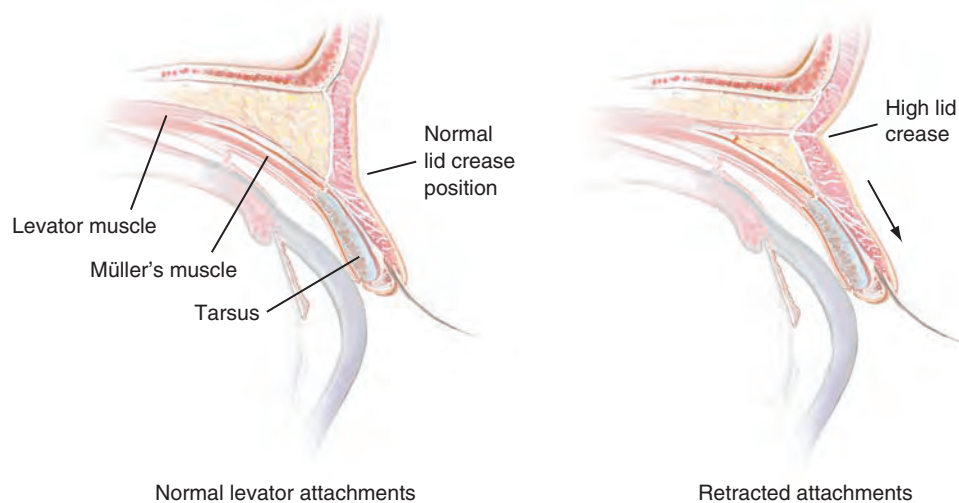
Landmarks of the Levator Complex



The three major attachments of the levator Müller's complex are illustrated in the schematic of upper eyelid anatomy. These attachments include:

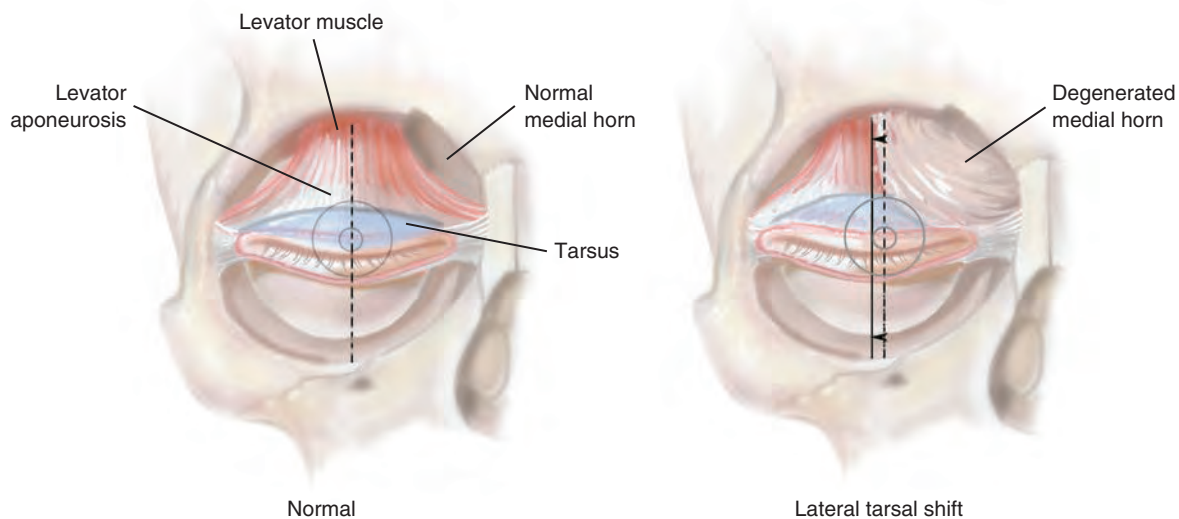
1. Müller's muscle, inserting into the upper tarsal border
2. Aponeurosis attachments to the anterior tarsus, inserting into the lower third of the anterior tarsus
3. Additional extensions of the aponeurosis that penetrate the orbicularis muscle, inserting into the skin and creating the lid crease

In a patient with involutional ptosis, the anterior tarsal attachments of the aponeurosis are defective because of stretching and disinsertion, thus causing lengthening of the lid and ptosis. Some of the lid crease attachments of the aponeurosis tend to remain intact, and the persistent attachments to the skin cause the migration of the lid crease to a higher level. An additional anatomic change that occurs in patients with involutional ptosis is dehiscence of the medial horn, which causes a lateral displacement of the upper lid tarsal plate.

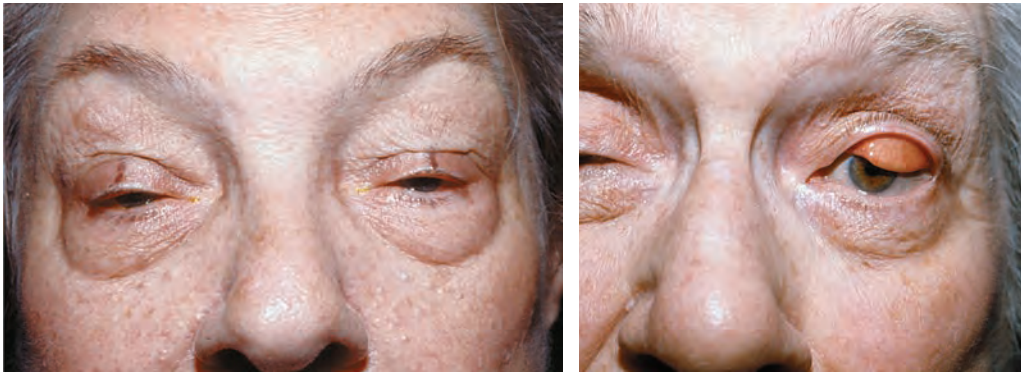


This cross section of the upper eyelid shows normal attachments of Müller's muscle and levator aponeurosis (*left*). Aponeurotic dehiscence with retraction of the lid crease is illustrated (*right*).

The accompanying dehiscence of the medial horn of the levator causes outward migration and a lateral shift of the tarsal plate so that the peak of the tarsal plate, which is normally centered above the pupil, is shifted temporally. If one performs surgery on the levator so that the maximum pull of suturing is at the peak curvature of the tarsal plate, the result will be consistent temporal overcorrections and "flare."



The levator is shown on frontal view. Normal structures and landmarks can be seen (*left*). The lateral shift of the tarsal plate as a result of dehiscence of the medial horn and supportive structures of the upper lid is demonstrated (*right*).



This woman with involutional ptosis is shown with markings placed on the eyelids in line with the peak curvature of the tarsal plate superiorly. With her eyes open, lateral displacement of the peak of the tarsal plate is evident as a result of release of the medial horn on the ptotic side.

Levator function is characteristically good to excellent in these patients. In some patients, however, ptosis may rarely be caused by levator weakening from fatty degeneration of the levator muscle rather than from aponeurotic thinning. This uncommon occurrence is thought to represent another subgroup within the etiologic factors of involutional ptosis. In many cases of acquired ptosis, diagnostic testing is needed to rule out neurologic or myopathic disease.

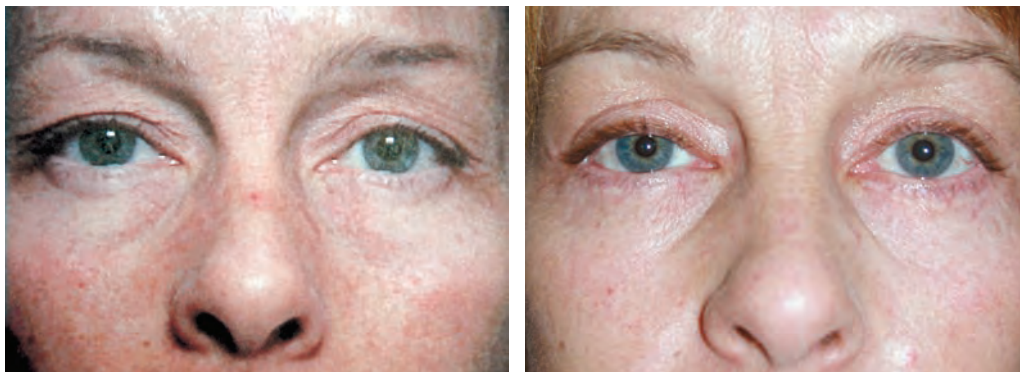
Preoperative Assessment

Obtaining a detailed medical history is essential. The surgeon should ask for a list of medications the patient takes, about any previous history of trauma, previous ocular surgery, instances of severe eyelid swelling, any bee, hornet, or wasp stings, or a family history of ptosis. Symptoms such as double vision or difficulty in swallowing should be evaluated. Old photographs of the patient sometimes reveal a ptosis that was not recognized at an earlier age, and this may be the only clue that the ptosis is congenital.

In the absence of any history or indicators in old photographs, the dynamic behavior of the lid may provide clues about the cause. If the lid is stiff, with lagophthalmos on downgaze in the ptotic eye, a congenital cause is very likely. However, levator muscles that have been scarred by trauma, inflammation, or previous surgery may also be stiff, and lagophthalmos in downgaze may be present in these patients and may make it difficult to establish the cause of ptosis.

Ptosis correction procedures always produce some postoperative stiffness of the upper lid. If the eye retains its moisture with an adequate tear film and good protective rotary eye movements are present, the patient should tolerate mild degrees of postoperative lagophthalmos. If there is impairment of eye protective mechanisms, exposure problems and conditions that threaten vision may develop. Each patient should be questioned about the presence of dry-eye symptoms and be examined for adequacy of tear film and evaluation of motility, including an assessment of Bell's phenomenon. Slit-lamp examination can show inadequacy of the precorneal tear meniscus. In patients with suspicious symptoms, a Schirmer's test with anesthesia should be performed. Additional deficiencies, such as decreased corneal sensation or facial nerve weakness, may further aggravate postoperative exposure. With the loss of one or more eye protective mechanisms, one should reconsider a surgical procedure or, at a minimum, the patient should be informed that a special lubricant might be necessary. If the patient's eyes are more intolerant of postoperative lagophthalmos, punctal plugs or actual reversal of the ptosis procedure may be necessary.

Almost all patients who wear contact lenses can be considered to have a normal tear meniscus and are safe candidates for ptosis surgery, because adequate tears are essential for wearing contacts. Postoperatively, soft lens wearers can resume routine wear of their contact lenses in 1 week. Patients who wear rigid gas permeable lenses must resume with a time buildup and are advised to get a special suction cup to assist with lens removal postoperatively. They can usually resume normal wear after a time but may need to modify the mechanics of their lens removal procedure.



A range of “normal” positions exists for the upper lid margin. Generally, iris color is visible above the upper pupillary edge. In cases of unilateral ptosis, the amount of ptosis relates to the position of the opposite normal eyelid. Subtle degrees of ptosis may be missed and unmasked by blepharoplasty if these landmarks are not observed, as can be seen in this patient, who, following upper lid blepharoplasty, maintained that her ptosis had resulted from the surgery. However, a comparison of the preoperative and postoperative photographs clearly demonstrates the presence of ptosis before surgery, and the condition was subsequently “unmasked” by the surgery.

Levator Function



Upper lid excursion, from extreme downward gaze to extreme upward gaze with the eyebrow firmly splinted, is the accepted method of measurement of levator function. This is measured in millimeters by placing a rule vertically in front of the eyelid. Patients with pure aponeurotic dehiscence will have upper lid excursion of at least 10 to 12 mm. Less function than that should alert the surgeon to another possible cause for the ptosis. Patients with congenital ptosis commonly have less than 10 mm of levator function and, in congenital ptosis, precise measurement of the amount of function is critical in determining the amount of levator resection needed or whether to employ frontalis suspension.

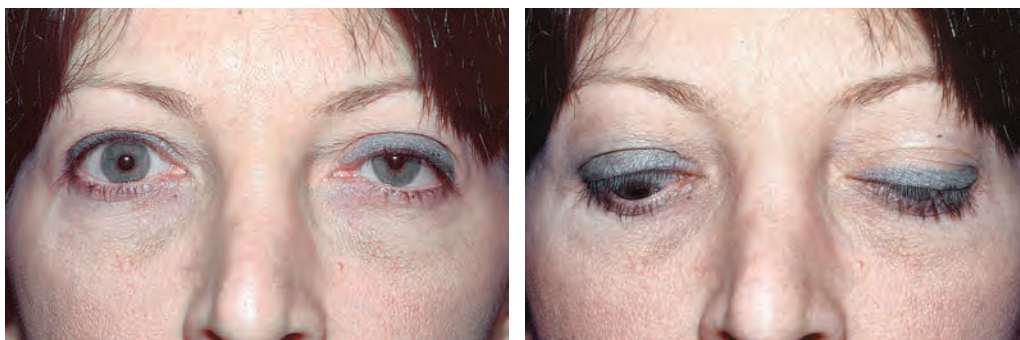
Preexisting ptosis from levator dehiscence may be exacerbated if blepharoplasty is performed without surgical repair of the levator. In bilateral cases the surgeon must carefully explain to the patient what the lid position will be following surgery. Asymmetric ptosis is common, in which a more severely ptotic eyelid on one side masks a lesser degree of ptosis in the opposite eyelid. In this situation, an unconscious effort on the patient's part will cause normalization of position in the less ptotic lid, making it appear that only the more ptotic lid needs correction (Herring's law). However, if only the more ptotic lid is corrected, the voluntary effort will cease and the ptosis will then appear on the nonoperated side. It is important to recognize this asymmetry and compensatory effort preoperatively by having the patient alternately cover and uncover the eyes. Occlusion of the more ptotic eye usually allows relaxation of the less ptotic or nonptotic eye, revealing true ptosis. Bilateral ptosis surgery is needed to prevent the asymmetry.



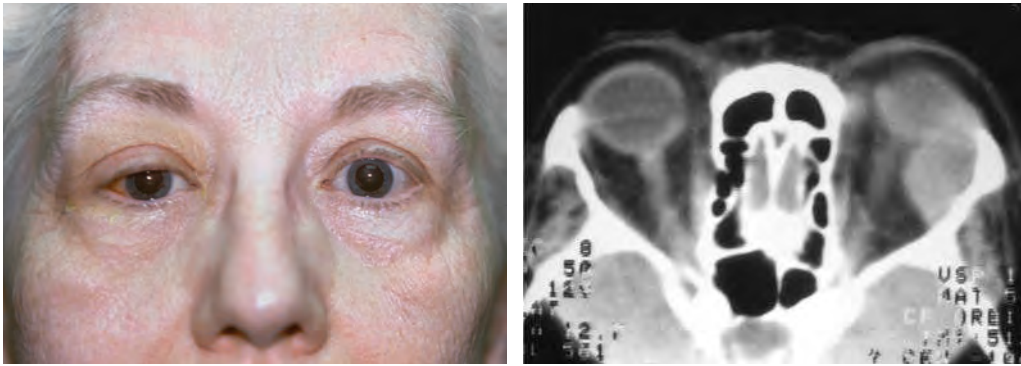
This patient exhibited levator dehiscence on the left following upper lid blepharoplasty. The patient is seen (*right*) after levator repair and preaponeurotic fat advancement.

Differential Diagnosis and Pseudoptosis

Many conditions mimic ptosis but are not true ptosis and should be differentiated from it. Retraction of the opposite lid from *Graves' disease*, in many cases, may simulate ptosis. *Enophthalmos* may simulate true ptosis, because the globe is recessed and the upper lid migrates downward to a lower position. Contralateral exophthalmos may also cause an upward movement of the lid, producing a relative enophthalmos and ptosis on the opposite side.



This patient with Graves' disease had unilateral upper eyelid retraction on the right side, causing pseudoptosis on the left. Lagophthalmos of the right upper eyelid was evident in downgaze (Von Graefe's sign), consistent with Graves' disease.



This patient with ptosis of the right upper lid underwent corrective surgery. A CT scan of the right orbit revealed a mass in the lacrimal gland area consistent with lymphoma.



This young woman had acquired ptosis of the left upper lid. The CT scan shows en plaque meningeoma as the underlying pathologic condition.

Any *mechanical pressure* on the lid, such as heavy skin folds, eyelid edema, or tumor, can produce a downward position of the lid margin and, in many cases, may be difficult to differentiate from a true ptosis. *Guarding* or *squinting* in the presence of an irritative phenomenon may also simulate ptosis.

Spasm may occur with aberrant regeneration of a seventh nerve palsy, hemifacial spasm, or benign essential blepharospasm. Abnormal closure of the eyelid may occur with regeneration of the seventh nerve following palsy or paresis. This is seen as eyelid closure when the patient smiles or contracts his or her lower facial muscles, and it can be misinterpreted as ptosis. In these cases of spasm closure, the lower lid will also elevate as the upper lid comes down.



This patient had a narrowing of the left fissure with lower facial muscle contraction (*left*). The patient exhibits misdirected regeneration of a left seventh nerve palsy. The patient is seen with lower facial muscles relaxed and opening of the eyelid (*right*).

Congenital Versus Involutional Ptosis

In evaluating patients, one must distinguish congenital ptosis from acquired ptosis. Surgical procedures for acquired ptosis and congenital ptosis are entirely different. Although aponeurotic repair is effective for acquired ptosis, it usually has little effect on congenital ptosis, which is the result of a developmental dystrophy in the levator muscle itself—an absence of striated muscle fibers with fibrosis. In congenital cases, the levator muscle is inelastic and stiff and does not respond to aponeurotic repair. Patients with acquired ptosis have a more contractive, elastic muscle. The stiffness of the lid is a diagnostic sign for congenital ptosis and causes lagophthalmos in downgaze. This can be an important diagnostic aid in the absence of history, when one wishes to differentiate congenital ptosis from levator dehiscence. In ptosis from levator aponeurotic dehiscence, stiffness or lagophthalmos in downgaze will not be present. Congenital ptosis only responds surgically to graded levator resection or frontalis suspension.



This young woman has congenital ptosis. When she gazes downward, lagophthalmos is evident, and there is a higher lid position on the ptotic side because of the stiff dystrophic levator muscle.

Evaluation of Preblepharoplasty Patients

- Rule out other causes of ptosis.
- Evaluate both eyes for ptosis by alternately occluding each eye.
- Differentiate congenital from involutional ptosis.
- Inform the patient that ptosis surgery is imprecise.
- Inform the patient that even in the best of hands, a subsequent revision procedure may prove necessary (revision rate 10% to 20%).

Preoperative Planning

An anatomic aponeurotic repair is the senior author's preference for ptosis correction. As mentioned previously, patients undergoing aponeurotic surgery should have, by selection, excellent levator function with only an aponeurotic defect or dehiscence. Other procedures that have been used in lieu of aponeurotic surgery are Putterman's mullerectomy and the Fasanella tarsomullerectomy. Although we do not use the procedure, Putterman's mullerectomy is well accepted as safe and predictable in certain patients. It does require an additional row of stitches on the undersurface of the upper lid, which seems unnecessary if one is performing ptosis surgery combined with an external upper blepharoplasty. The Fasanella-Servat procedure is still used by some ophthalmic surgeons; however, it does involve excision of a portion of the tarsal plate and is nonanatomic in nature. Corneal complications may occur with this pro-

cedure, and any needed reoperations are rendered much more difficult after it has been performed. It has been generally replaced by the more anatomic, aponeurotic repair approach to ptosis surgery for these patients, as described next.

Operative Technique

Anesthesia

Some surgeons favor performing aponeurotic repair with the use of local anesthesia and sedation, having the patient voluntarily open his or her eyelids while the surgeon adjusts until the eyelids have reached the desired levels. This requires that there be no paresis of the levator from a local anesthetic. Local anesthesia is achieved with a supraorbital nerve block for the lid and infiltration of the eyelid crease area with 0.50 to 0.75 ml of short-acting infiltrative anesthetic placed along the site of the intended lid crease, just beneath the skin, with a minimal amount in the nasal lid. In most cases anesthesia is achieved without loss of levator function.

However, this approach can be frustrating: variations in the local anesthetic may cause levator akynesia, an epinephrine effect on Müller's muscle that causes inappropriate lid retraction, and anomalous movement with variations in depth of sedation and patient cooperation. Because of these problems, we have abandoned this method in favor of an anatomic approach with the patient under general anesthesia or full local anesthesia.

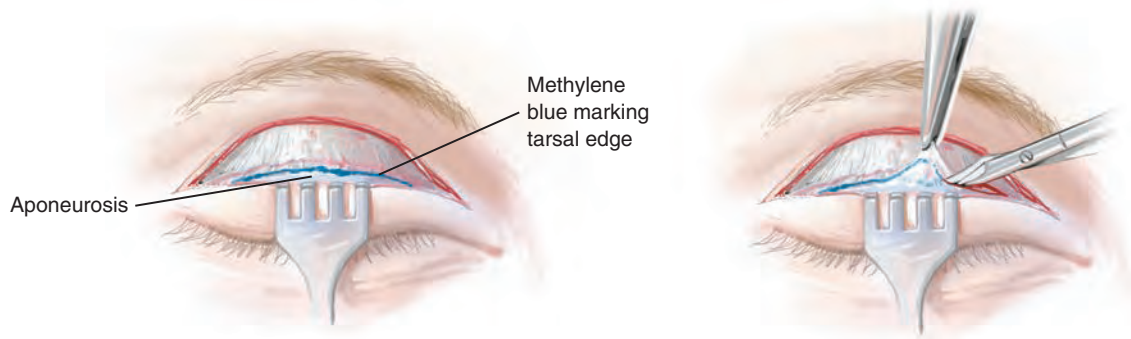
Technique



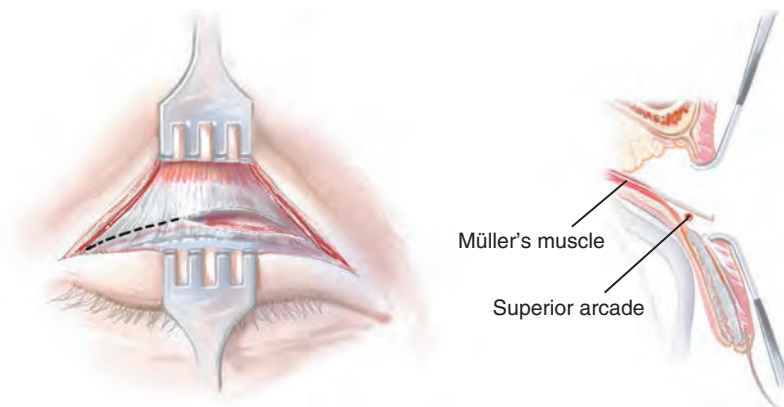
Exposure for aponeurotic surgery

Skin marking and tissue excision are outlined. A lid crease incision is made at the desired level, usually at the upper border of the tarsal plate (approximately 9 to 10 mm above the lash line). The desired amount of skin and muscle above the crease can then be removed. An opening through the orbital septum must be made for surgical exposure. In the aesthetic patient, we think that an “open-sky” approach is necessary, with full exposure of the preaponeurotic space.

The orbital septum must be incised or partially excised, as in the open-sky technique, to expose preaponeurotic fat, the levator aponeurosis, and the musculoaponeurotic junction, which are the landmarks for aponeurotic repair. In some cases, the levator aponeurosis may appear relatively intact at the upper tarsal edge; however, in many cases it is rarefied and stretched, allowing Müller's muscle and the superior arterial arcade to be visible near the superior edge of the tarsus.

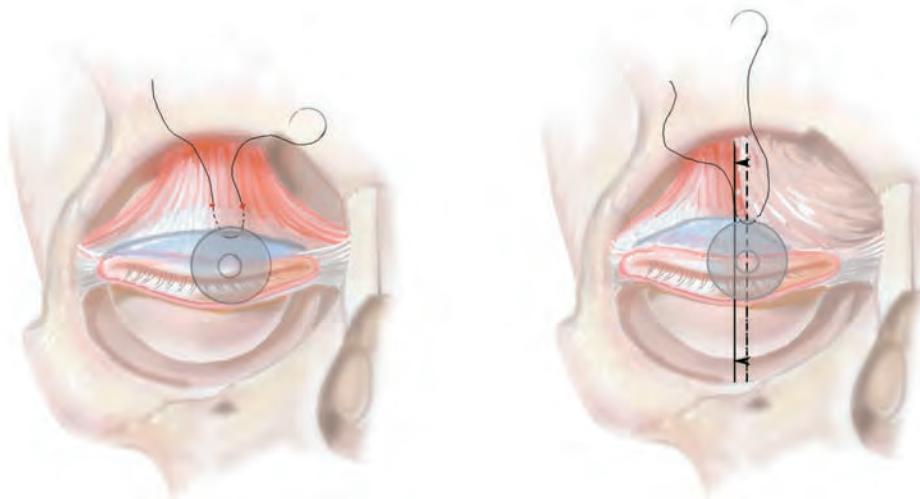


The aponeurosis is marked at the superior tarsal border with methylene blue and is incised just inside the superior edge of the tarsal plate to avoid traumatizing the superior arcade. In aponeurotic surgery it is not necessary to disturb Müller's muscle or the superior vascular arcade, thus reducing the amount of bleeding during the procedure.

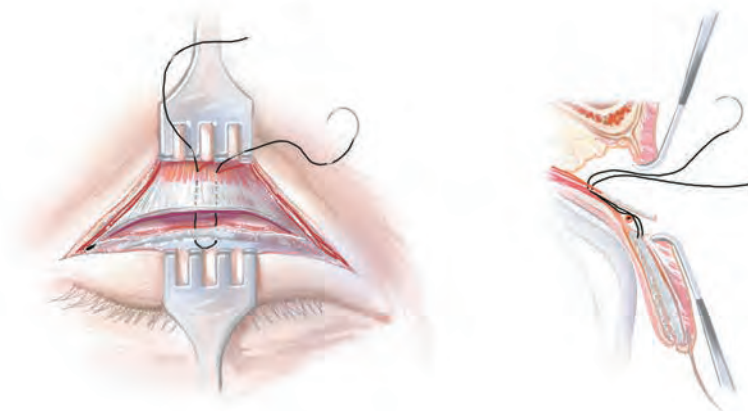


The anterior view of the upper lid shows dissection of the levator aponeurosis. The cross-section depicts the structures after dissection.

After the levator has been dissected free from Müller's muscle and the musculoaponeurotic junction is exposed by retraction of the preaponeurotic fat, a 6-0 suture, with a small cutting needle, is introduced half-thickness within (2 to 3 mm) the upper edge of the tarsal plate. This suture is the central lifting suture and should be placed in the exact vertical line with the pupil. This aspect is important when dealing with involutional patients who have a lateral displacement of the tarsal plate.



The position of the central lifting suture in the tarsus is demonstrated above. On the left, a more central position in a normal, youthful upper lid is shown. The image on the right shows the position of suture placement that is usually needed in adult levator dehiscence to produce a normal contour. Alignment with the pupil is needed because of a lateral shift of the tarsus.



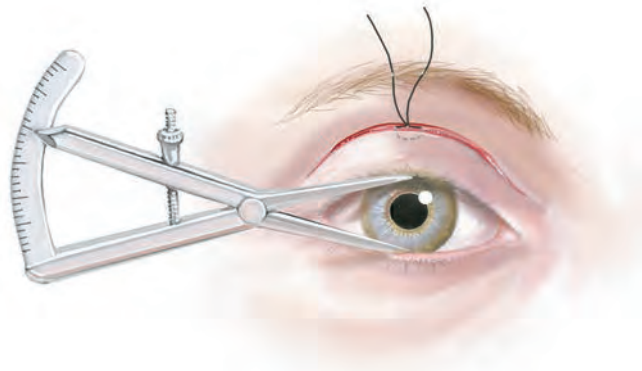
On the left is an anterior view and on the right a cross-sectional view of suture placement through the musculoaponeurotic junction. A double-armed suture is used, which then can be brought underneath the levator through the junction of the upper edge of the aponeurosis and the levator muscle, the musculoaponeurotic junction. The central suture is the lifting suture for the upper lid, and tightening this suture provides the desired elevation. Nasal and temporal sutures are rarely placed, and if placed, serve only for contour adjustment. Approximation of the superior tarsus to the musculoaponeurotic junction of the levator restores the anatomic integrity of the upper lid, resulting in correction of the ptosis.

Quantitation With the Anatomic Method

In bilateral cases, there are surgical conditions that control the final eyelid level: the anatomic symmetry of the surgical repair, intraoperative eyelid gaping, and intraoperative eyelid springback tension.

Whether bilateral ptosis is symmetrical or asymmetrical, the surgery should be performed with:

- Symmetrical dissection of the aponeurosis
- Symmetrical suture placement on the tarsus
- Symmetrical placement at the musculoaponeurotic junction
- Symmetrical tension on the central lifting suture knot



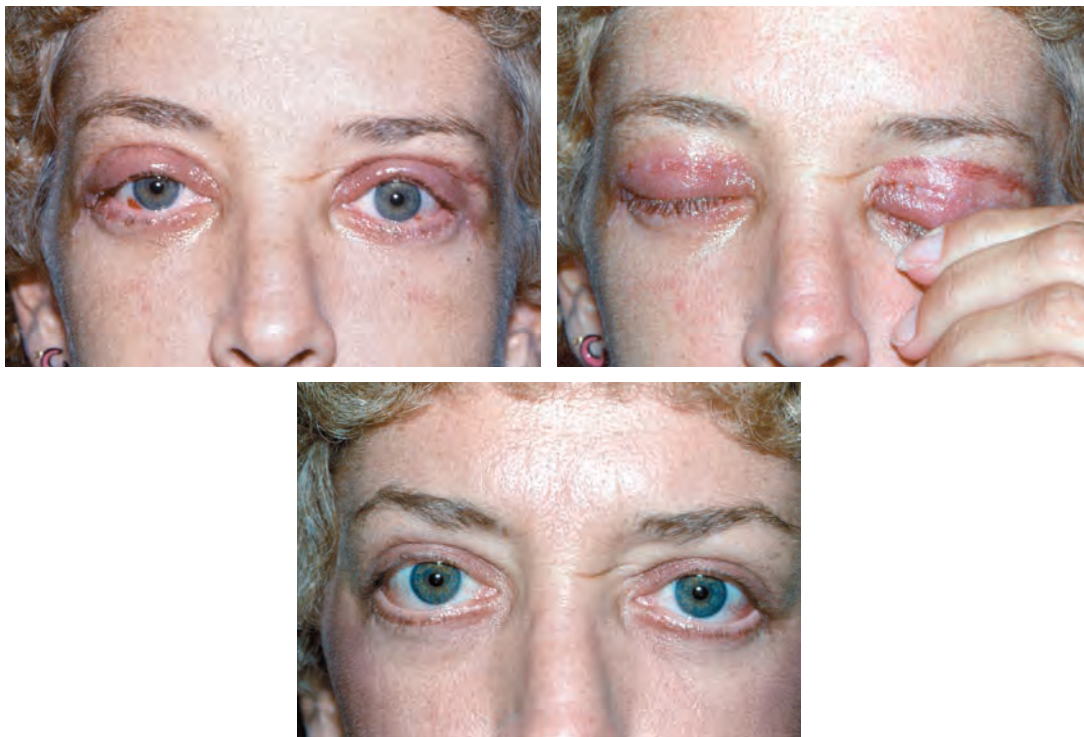
Despite attempted symmetry of surgical technique, there will be slight differences in the tension of pull on the upper lids. These differences can be further neutralized by loosening and tightening the tension of the central suture until the upper lid elevation produces symmetrical gapping of the eye fissure. This can be verified with caliper measurement, as seen here, which depicts the intraoperative measurement of gapping needed to refine the accuracy of upper lid placement.

Springback Test

Even further refinement to the upper lid may be needed. It is well known to ophthalmic surgeons correcting strabismus that despite symmetrical positioning of the eye, subtle differences in tension can affect eye alignment. The same is true in ptosis surgery, so the final adjustment on suture tension is to equalize the “springback” between the two lids. Both upper lids are closed by forced traction with forceps and then released to observe the velocity with which the lid “springs open” to the gapped position. Tension on the central suture is then adjusted until the springback is symmetrical.

True Unilateral Ptosis

The springback test and intraoperative assessment of gapping are not appropriate in cases of unilateral ptosis; only the anatomic landmarks observed at surgery are pertinent. There is a greater incidence of postoperative adjustment in such patients. In many ptosis patients, regardless of the method of quantitation used, some form of postoperative adjustment will be needed. The easiest postoperative adjustment to make is loosening of an overcorrected lid. Most cases of mild overcorrection can be improved by early postoperative stretching. More-persistent overcorrections can be improved a few weeks after surgery by a simple central lid crease incision and clipping of the central suture and adhesions, followed by massage. Undercorrections require reoperation.



This patient with Graves' disease is seen after levator surgery; she exhibits early signs of overcorrection. To address the overcorrection, a program of stretching exercises was initiated for 10 days. These exercises produced an improvement, as can be seen in the final eyelid position. No surgical revision was required.



This patient with bilateral ptosis underwent blepharoplasty and ptosis repair. She is shown preoperatively and 10 days after surgery with overcorrection of the left upper lid. To address this problem, stretching exercises were initiated. Six weeks after surgery, the patient's lid had responded to the stretching exercises, and no surgical loosening was required.

Because of the inherent imprecision of any ptosis surgery, postoperative surgical revisions are necessary in 10% to 20% of cases. In a series of patients operated by the author (C.D.M.) using an anatomic approach, general anesthesia, and in conjunction with other aesthetic surgical procedures, the revision rate was lower (approaching 2%), and the surgery was much less tedious for the surgeon and the patient. The following three cases demonstrate the results of a series of patients who underwent aponeurotic repair in conjunction with aesthetic surgery.

Results



This patient is shown before and after upper blepharoplasty and lower lid midface surgery, combined with tarsal levator repair. No postoperative adjustments were necessary.



Upper blepharoplasty and lower lid midface surgery was used to treat this patient's problem. She also underwent tarsal levator repair, an endoscopic brow lift, and a lower face lift. No postoperative adjustments were necessary.



In this patient, levator repair was done to the right upper lid, combined with a lower lid midface lift, an endoscopic brow lift, and a lower face lift. The patient required secondary surgical loosening of the right upper lid, which was performed as a minor outpatient procedure. With a small amount of local anesthetic placed in the central lid crease, a small incision was made to release some of the aponeurotic attachments. Postoperative stretching exercises were instituted.

Special Problems

Floppy Upper Lid in Males

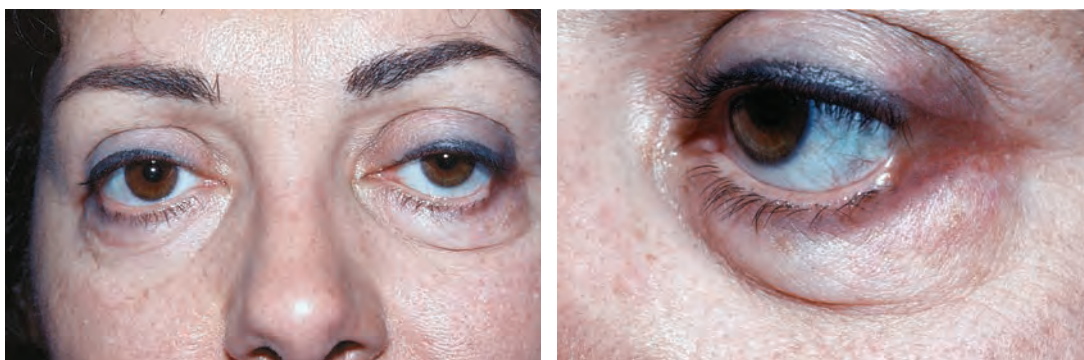
Floppy upper lids more commonly occur in obese men. Severe distensibility of the upper lid and lower lid requires a reconstructive type of canthoplasty on both upper and lower lids. Failure to resect any redundant upper lid will result in overlapping of the upper lid and poor closure. Subtle variations of this may occur. A canthoplasty type procedure must be performed on the upper lids to stabilize them.



This obese young man exhibits ptosis with floppy lid syndrome in his primary gaze. Distention shows dramatic loss of elasticity in the upper lid. An upper lid canthoplasty is needed to stabilize the lid.

Blepharochalasis Syndrome

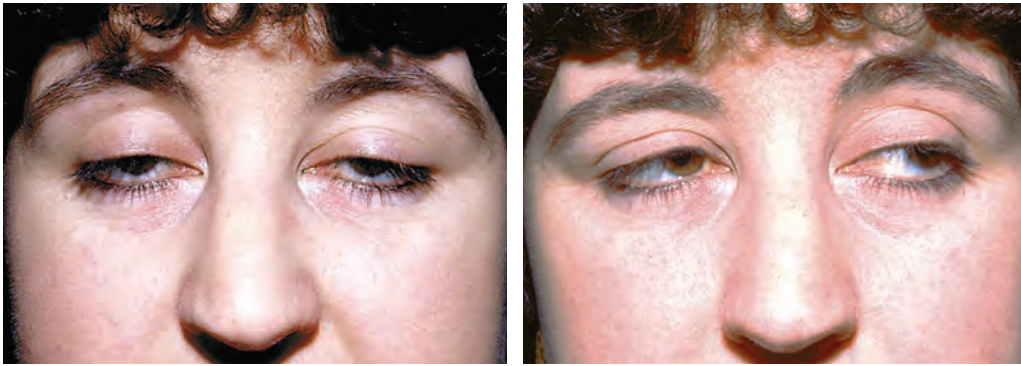
Blepharochalasis syndrome is a rare condition that occurs in young people, usually females, characterized by recurrent idiopathic edema of the eyelids. This results in stretching of the skin, levator aponeurosis, and the lateral canthal tendon, and occasionally in atrophy of the nasal fat pad. The patient's ptosis is surgically correctable with aponeurotic repair, but staged procedures are usually required, including lateral canthoplasty, blepharoplasty with aponeurotic repair and dermal fat grafting to atrophied areas.



Tissue changes resulting from the blepharochalasis syndrome are evident in this woman. She had repeated bouts of inflammatory edema during childhood resulting in loss of elastic tissue dehiscence of the levator, loss of the nasal fat pad, lateral canthal dehiscence, and crêpey skin changes. The patient was referred because of “skin growing between her upper and lower lid.” She also has levator dehiscence in addition to canthal dehiscence.

Chronic Progressive External Ophthalmoplegia

Chronic progressive external ophthalmoplegia (CPEO) results from a progressive muscular dystrophy that principally affects the extraocular muscles including the levator muscle. Its onset can be subtle, and it may begin in childhood or adolescence, with gradual development of ptosis. Very early cases may be difficult to recognize because of the absence of diplopia. These patients will develop progressive impairment of ocular rotations and eye protection, and postoperative corneal exposure may be a problem.



This woman has an advanced stage of CPEO. She is shown attempting eye rotation. She has extremely poor levator function and very poor ocular motility and is at severe risk for corneal exposure with any ptosis surgery.

Concluding Thoughts

Patients who request aesthetic eyelid rejuvenation may have associated ptosis, and recognition of the ptosis at the initial consultation is essential. The cause must be established and the ptosis corrected at the time of aesthetic blepharoplasty.

Clinical Caveats

Recently acquired ptosis, in many cases, warrants neurologic evaluation.

Congenital ptosis will not respond favorably to aponeurotic repair.

Adequate eye protective mechanisms are more critical for patients undergoing ptosis surgery than for patients undergoing blepharoplasty.

Acquired ptosis can be a sign of an underlying pathology of the lid or orbit.

Lateral displacement of the upper tarsal plate must be surgically compensated to achieve good postoperative contour.

The vector of pull should be centered over the pupil.

In bilateral cases, symmetry of surgery with fine tuning of suture tension is the most important requirement for postoperative symmetry.

In most patients, one suture is usually enough. Extra suturing will reshape the lid.

Annotated Bibliography

Dortzbach RK, Kronish JW. Early revision in the office for adults after unsatisfactory blepharoptosis correction. *Am J Ophthalmol* 115:68-75, 1993.

The most common complications of levator palpebrae superioris muscle blepharoptosis repair are undercorrection, overcorrection, and abnormalities of the eyelid contour. Previously described nonsurgical as well as surgical methods delay the repair of such complications and introduce the same confounding factors that can affect judgment of the eyelid level as during the initial surgical procedure. The authors present their technique and results in 22 patients who underwent a highly predictable surgical technique to revise unsatisfactory postoperative eyelid positions.

Fagien S. The role of the orbicularis oculi muscle and the eyelid crease in optimizing results in aesthetic upper blepharoplasty: a new look at the surgical treatment of mild upper eyelid fissure and fold asymmetries. *Plast Reconstr Surg* 125:653-666, 2010.

The author presents a simple yet comprehensive approach to upper blepharoplasty that considers both the youthful or desired appearance and the management of upper eyelid asymmetries by preservation or selective treatment of the orbicularis oculi muscle and placement of the upper eyelid crease to improve aesthetic outcomes.

McCord CD. The evaluation and management of the patient with ptosis. *Clin Plast Surg* 15:169-184, 1988.

The author discusses the fundamentals for evaluating and correcting ptosis for a variety of patients. He emphasizes there are many subgroups of ptosis patients that require the ptosis surgeon to have a flexible approach and a repertoire of surgical procedures. In a certain percentage of patients, results will remain unpredictable, and the surgeon must always be prepared to perform revisional surgery. He also stresses that formulas are only a starting point for each surgeon to develop individual variations to obtain the best and most predictable ptosis correction.

Shore JW, Bergin DJ, Garrett SW. Results of blepharoptosis surgery with early postoperative adjustment. *Ophthalmology* 97:1502-1511, 1990.

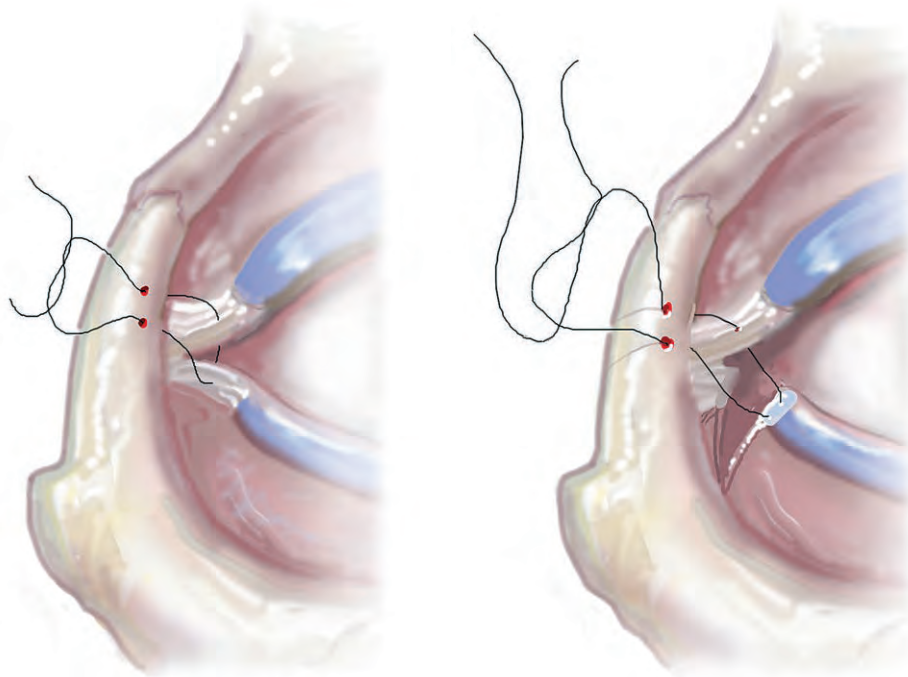
The authors review 157 cases (207 eyes) of blepharoptosis corrected by external levator resection and present the results. They found early or late reoperation is effective in correcting unsatisfactory results after external levator resection. However, the benefits of early surgery include a reduction in time to final result, the ease with which it is performed, potential cost savings, and the opportunity of correcting unsatisfactory results.

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CHAPTER 34



Avoidance and Treatment of Complications of Aesthetic Eyelid Surgery

CLINTON D. MCCORD, JR., FOAD NAHAI

Awareness of the complications that may occur after aesthetic eyelid surgery can help a surgeon to avoid them. In many cases, postoperative complications are visible and obvious; however, on occasion, a patient's result may look acceptable from an aesthetic standpoint but eyelid dysfunction may still be present from subtle changes in eyelid flexibility, position, or movement. For example, even mild lower lid retraction, if accompanied by reduced upper lid closure from excessive skin removal, can produce severe exposure problems, particularly if there are coexisting conditions such as eye dryness or poor eye movement.

Most patients with no history of suspicious eye symptoms preoperatively, or those with a history of a "normal" eye examination in the recent past, are generally good candidates for eyelid surgery. It is safe to assume that contact lens wearers, because of the adequate moisture that is required by the lenses for wear, will be tolerant of the usual stiffness that occurs after blepharoplasty, but there may be exceptions. Patients who have suspicious symptomatology or unusual findings on an eye examination and those with a history of eye problems should be evaluated by slit-lamp examination, tear tests, or consultation with an ophthalmologist.

Complications following blepharoplasty may be as minimal as an unfavorable scar, as devastating as visual loss, or anything in between. The majority of complications in between are mostly related to lid retraction and its consequences. We divide these complications into two categories:

1. The unfavorable aesthetic result in which the basic protective mechanisms of the eyelid are unimpaired, but the patient is realistically displeased by surgical changes, or disappointed with the result, which may not have met expectations
2. Functional complications in which the patient suffers from eyelid malposition or is left with faulty eyelid mechanics so that the eyelid fails to protect the eye

These two categories are not mutually exclusive, and both may have to be addressed.

Early complications following blepharoplasty include bleeding/hematoma and chemosis. Fortunately hematomas following blepharoplasty are rather rare, in our experience less than 1%; on the other hand, chemosis is by far the most common early complication, ranging up to 11.5% in some series. Lid retraction and its consequences represent the majority of late complications and account for most secondary or corrective procedures.

Complications Following Blepharoplasty

Unfavorable Aesthetic Results

Unacceptable scar
Residual skin excess
Overresection or underresection of fat
Overresection or underresection of orbicularis oculi muscle
Changes in eye shape
Eyelid asymmetry

Functional Problems

Chemosis
Hematoma
Exposure problems
Infection
Lid retraction
Ptosis of the upper eyelid
Muscle palsy (most commonly the inferior oblique muscle)
Loss of vision

Early Complications

Hematoma

Eyelid Hematoma

Predisposing factors for hematoma following blepharoplasty are the same as those following a face lift, including hypertension, increased venous pressure, nausea, vomiting, and anxiety. (See Chapter 50 for a detailed discussion.)

A hematoma confined to the preseptal area is not usually a threat to vision; however, it may affect the surgical result. With a skin-muscle flap, hematoma may result in scarring and skin and lid retraction as it resolves. Therefore it is advisable to aggressively evacuate or drain any blood collection after blepharoplasty.

Orbital Hematoma

Postseptal bleeding causing an intraorbital hematoma is a serious matter. Profuse intraorbital bleeding may increase orbital pressure, thereby compromising optic nerve function. If the hematoma is mild, not expanding, and produces no detectable visual or pupillary changes, it can be treated conservatively by observation, systemic steroids, and cold compresses. Severe bleeding producing intense orbit and pupillary or visual changes is an emergency requiring urgent intervention. Immediate lateral canthal lysis, removal of sutures, and evacuation of hematoma is performed at the patient's bedside. Time should not be wasted in trying to return the patient to the operating room. Once the pressure has been relieved, a search is made for the source of bleeding, which is then cauterized.

An orbital hematoma is most likely to occur during the immediate postoperative period. Therefore it is important that the patient be observed by a trained, responsible person in the recovery area. Any significant change in orbital volume or severe pain following blepharoplasty should alert the nurse and the surgeon to the possibility of an orbital hematoma. Severe eye pain in the recovery room may also signal corneal abrasion or another ocular event. It is our practice to avoid pressure bandages on the eye and to apply ice compresses intermittently.

Types of Hematomas and Recommended Treatment

Eyelid Hematomas

Skin-muscle flap

Observation

Skin flap

Drainage (Bard-Parker No. 11 blade or removal of stitches)

Orbital Hematomas: Mild, Without Pupillary Changes

Observation/drainage

Systemic steroids

Cold compresses

Orbital Hematomas: Severe, With Pupillary and/or Visual Changes

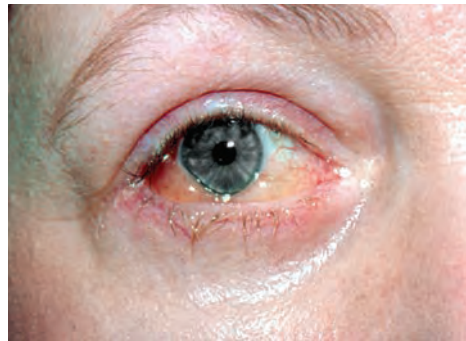
Remove stitches and evacuate hematoma

Large canthotomy and cantholysis

Orbital decompression if edema becomes chronic

Chemosis

Postoperatively, the conjunctiva on the surface of the eye may swell, retain fluid, and become chemotic. If this occurs, a corresponding dry spot (*dellen*) forms on the cornea. The initial cause of this swelling is likely multifactorial and may be the result of lymphatic drainage obstruction, poor eye closure with exposure, and an inflammatory reaction. This problem is much more likely to occur in patients who have preexisting conjunctivochalasis (redundant conjunctiva), significant swelling, and fluid retention postoperatively, or who do not use lubricants postoperatively. On occasion, the surgeon may see this condition develop intraoperatively. In such a case, the bulbar conjunctiva can be snipped in the inferior fornix without consequences. If significant excision is performed, a 6-0 plain gut suture can be inserted in the bulbar conjunctiva near the fornix.



Postoperatively, if mild chemosis is diagnosed early, 2 drops of 2.5% phenylephrine (Neo-Synephrine) and 2 drops of dexamethasone eyedrops can be placed in the chemotic eye, which alleviates the problem in many cases. These drops are commonly used by ophthalmologists who perform strabismus surgery, because they suppress inflammation and stabilize the vessels of the conjunctiva. The patient should be monitored during treatment with these eyedrops. The use of steroid drops in a patient with glaucoma or a family history of glaucoma may lead to worsening of the condition. Treatment is usually limited to 5 to 7 days. If chemosis persists or becomes more severe, the eyelids are bandaged closed for 24 hours or more. The proper technique to immobilize eyelids with bandaging (eyelids must stay closed) is as follows:

Three oval eye pads are used.

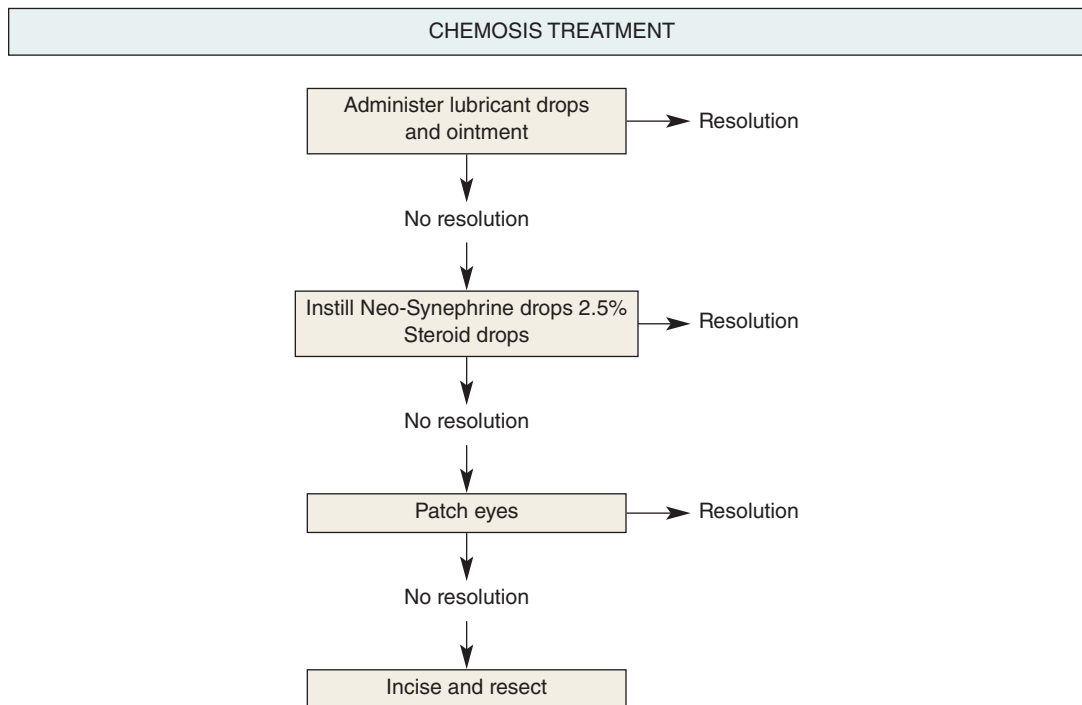
The bottom pad is folded, moistened with saline solution, and placed against closed eyelids.

Two dry pads are placed on top and firmly taped in place with multiple strips of tape.

The tape is anchored on the central forehead, tightened over the eye pads, and extended obliquely down to the cheek.

The patient should not be able to open his or her eye under the pads.

If chemosis recurs after patching, and if the eye has little inflammation, topical phenylephrine (Neo-Synephrine) drops and topical anesthetic drops are instilled, and the billowing area is incised and resected with sharp scissors. The incision in the conjunctiva must go through the tenon capsule to allow fluid to escape. Once this procedure is completed, the patch is reapplied.



Late Complications

Most if not all late complications are related to lid retraction, its consequences, and alterations in eyelid closure mechanics. A brief review of eyelid mechanics and innervation follows to identify the anatomic causes of these problems.

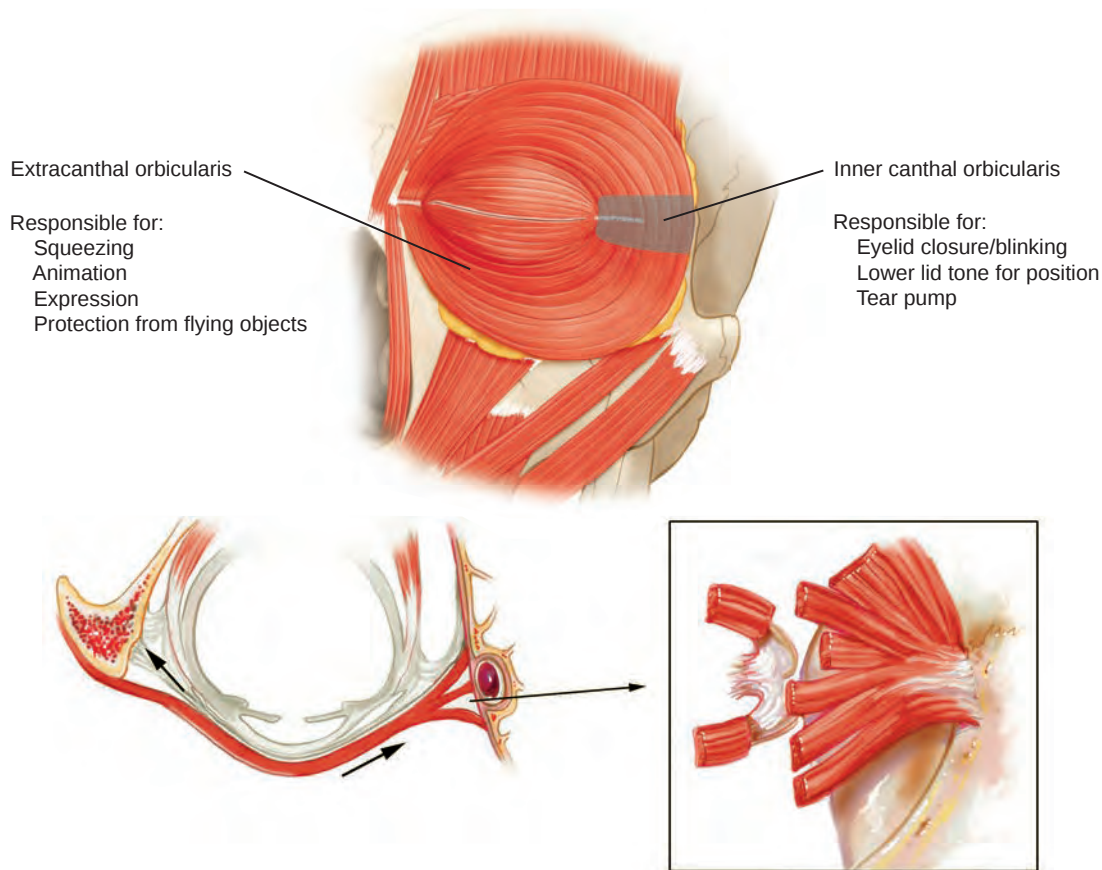
Eyelid Mechanics and Innervation

Eyelids have multipart mechanics contributing to orbicularis muscle function. Contracture occurs in different parts of the muscle, depending on the function needed. There is interplay between orbicularis contracture and counter pull at the eyelid attachment at the lateral canthus. This interplay affects eyelid blinking and eye fissure shape.

Eyelid Movement: Division of Labor in the Orbicularis

In previous studies involving segmental surgical removal of the orbicularis oculi muscle in large series of patients with blepharospasm, it was shown that only the orbicularis muscle in the inner canthus is responsible for everyday eyelid tone, movements associated with blinking, and normal eyelid closure. This section of the orbicularis also provides the “motor” for the lacrimal pump mechanism for the drainage of tears. The rest of the orbicularis, the extracanthal orbicularis, is responsible only for emergency and emotional eyelid closure, such as squeezing, squinting, and animations of expression.

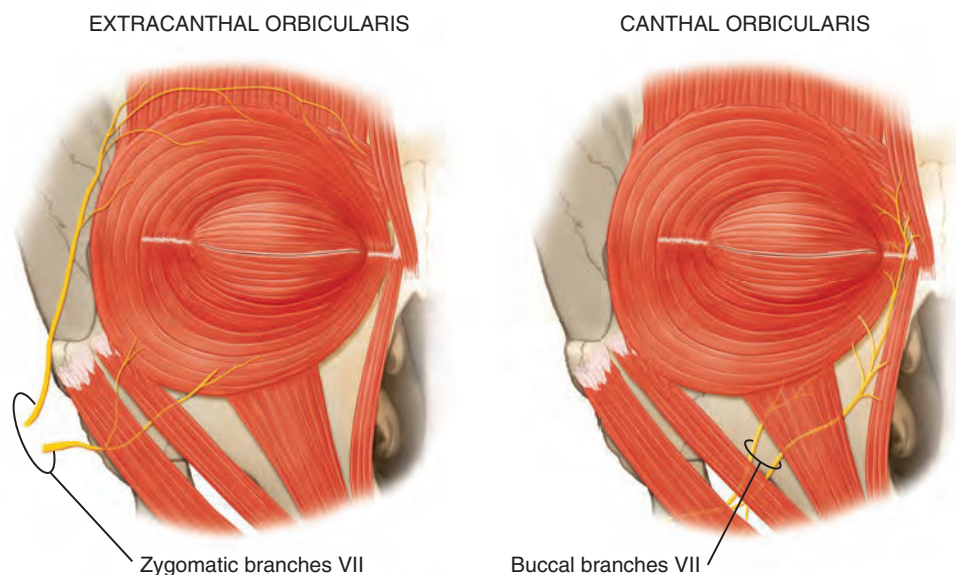
Anatomic classification of the orbicularis into the orbital, preseptal, and pretarsal orbicularis is convenient for surgical labeling, but a functional classification of the orbicularis into an inner canthal orbicularis and an extracanthal orbicularis should be adopted for better understanding of eyelid function.



These illustrations show the division of function (division of labor) seen in the orbicularis muscle. The extracanthal orbicularis is primarily responsible only for accessory squeezing movements and expression of the eyelid. The inner canthal orbicularis, as shown in the upper illustration (*purple-shaded area*), is responsible for normal blinking movements, eyelid tone, and the lacrimal pump mechanism. The larger areas shown at the lower left demonstrate the vector of pull of the intercanthal orbicularis toward the nose and the counterpull on the eyelids by fixation of the lateral canthal tendon.

Eyelid Innervation: Division of Innervation of the Orbicularis

It follows that because there is a division of labor in orbicularis muscle function, there is also a duality of innervation of the orbicularis. Electromyographic (EMG) studies, clinical observations, and anatomic studies have shown this to be the case. The extracanthal orbicularis is supplied by the zygomatic branch of the facial nerve, whereas the inner canthal orbicularis is supplied by a vertical extension of the buccal branch of the facial nerve.

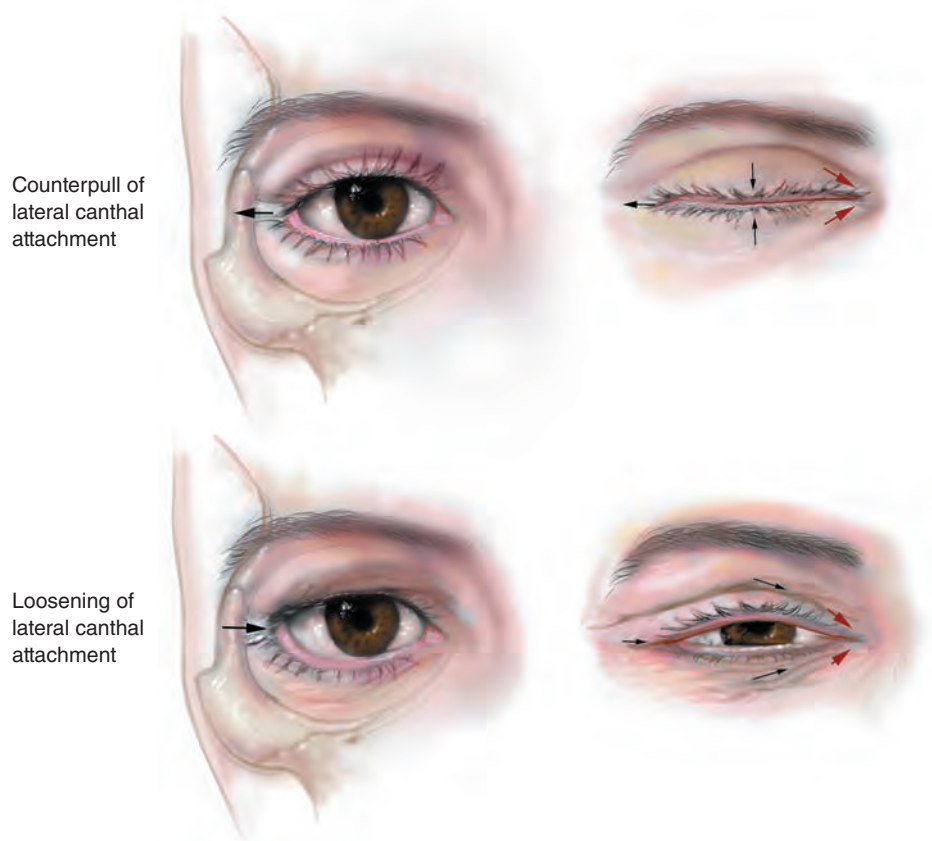


The dual innervation of the orbicularis muscles is illustrated. Branches of the zygomatic portion of the facial nerve supply the extracanthal orbicularis, and vertical branches of the buccal branch of the facial nerve supply the canthal orbicularis and corrugator muscles.

Loss of innervation from the zygomatic branch of the facial nerve to the extracanthal orbicularis can occur, but in the absence of lower lid laxity it will produce little change in eyelid position or tone as long as the buccal branch innervation to the inner canthus remains intact. Standard surgical incisions in the pretarsal or preseptal orbicularis external to the inner canthus cause no abnormalities in lower eyelid position or tone. With regard to the effect of subciliary incisions, recent EMG studies show that microdenervation of the pretarsal orbicularis muscle does not occur, even if the recording electrode is placed directly into the surgical incision line. However, loss of eyelid innervation from the buccal branch of the facial nerve to the inner canthal area will cause profound changes in eyelid function, with reduction or absence of eyelid blinking, poor lower lid tone and position, and a weakening of the lacrimal pump mechanism, causing tearing.

Lateral Canthal Anchoring

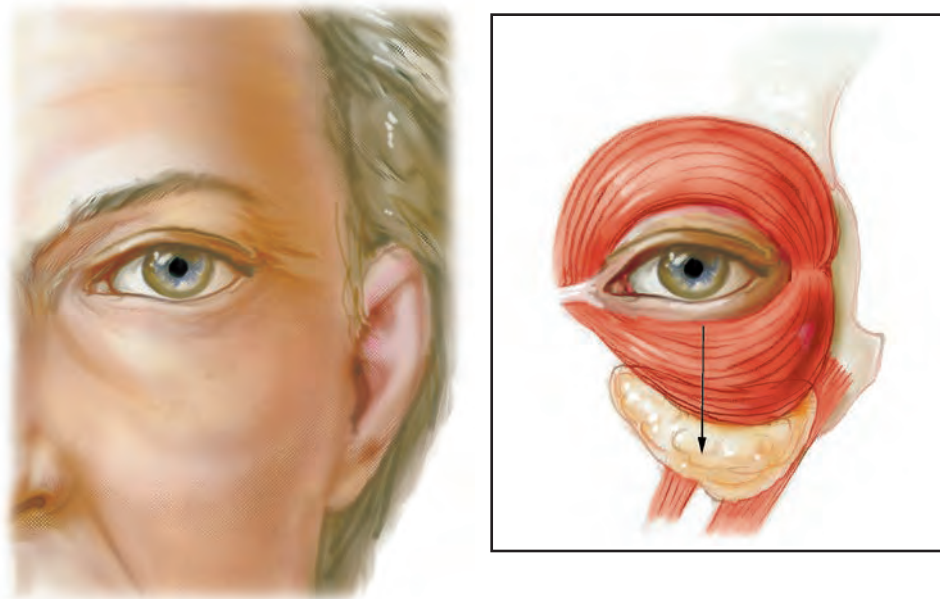
The mechanics of eyelid closure, the normal blinking movements of the upper and lower lid, require firm attachment at the insertion of the lateral tendon for counterpull. Because contracture of the orbicularis in the inner canthus is responsible for blinking of the eyelids, if it is unopposed, an abnormal nasally directed eyelid movement occurs with each blink. Firm anchoring laterally is needed for counterpull against canthal contracture to convert the vector of the blink movement into a vertical one for proper eyelid closure. Patients who lack lateral canthal anchoring suffer from faulty eye-blinking mechanics. The nasal movement of the eyelids that occurs with each blink results in “fish-mouthing” of the eyelids when the individual attempts eyelid closure. This situation can cause lagophthalmos and eye exposure of varying degrees.



The structures in the eyelids that are responsible for blinking movements are shown. The inner canthal orbicularis, with its contracture, provides the motor for the eyelid blink but can only be effective if there is firm counterpull of the eyelids laterally at the outer canthus. The top illustration shows normal closure with firm lateral canthal anchoring. The bottom illustration shows reduced closure, to the point of fish-mouthing, with weak or dehiscent lateral canthal attachments.

AESTHETIC GOALS IN THE LOWER LID: A MIDFACE AESTHETIC UNIT

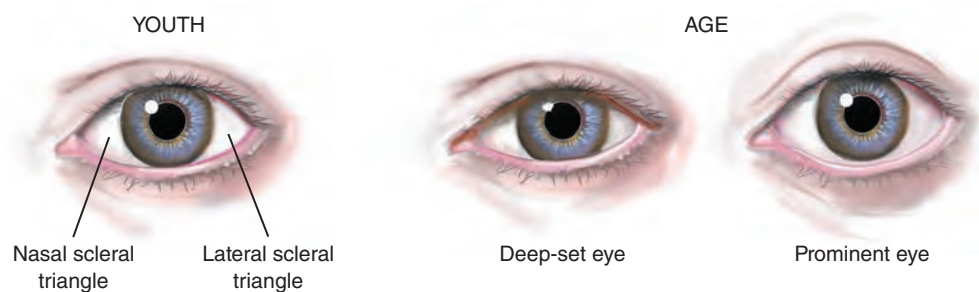
Normally the inferior arc of the orbicularis oculi muscle and the underlying suborbicularis oculi fat (SOOF) span the eyelid and orbital rim area in the midface. With aging there is sagging or ptosis of the orbicularis muscle, accompanied by loosening of the orbitomalar ligament, which causes a downward descent of the SOOF and malar fat. This facial descent results in a loss of padding over the inferior orbital rim and a loss of cheek fullness, characteristics that are inconsistent with a youthful appearance. This descent is usually accompanied by herniation of fat as well as skin laxity in the eyelid.



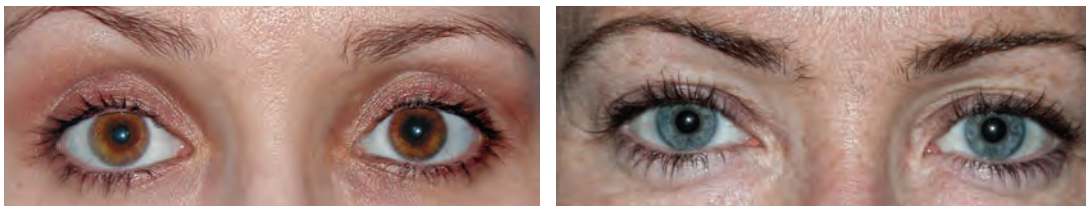
The skeletonization of the orbital rim area associated with age is a major contributor to the aging appearance in the midface area. Surgery that fails to address the eyelid and cheek area as an aesthetic unit falls short of producing a true reversal of aging changes in this area. Techniques that use supraplacement of the inferior arc of the orbicularis muscle to reposition the midcheek upward correct the underlying problem of ptosis of the orbicularis. In patients undergoing primary cosmetic surgery, as the skin of the lower lid and midface is recruited upward, the resulting skin redundancy can be excised. In patients undergoing reoperation with lower lid retraction caused by excessive skin removal, the additional skin recruited by upward movement of the orbicularis introduces needed skin into the lower lid. In corrective surgery, the technique of orbicularis redraping is a valuable tool that allows the surgeon to avoid skin grafts in patients with a shortage of skin in the lower lid.

Eye Fissure Shape

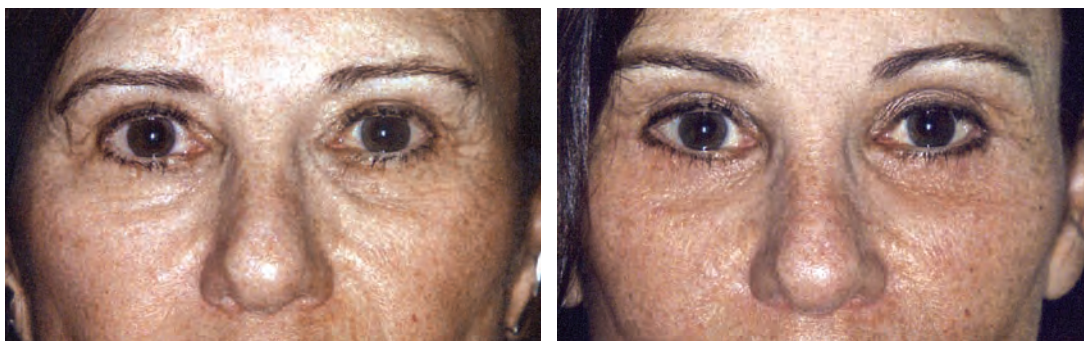
In patients undergoing aesthetic eyelid surgery, a youthful configuration of the eyelid fissure is needed to reduce the perception of aging in the eyelids. The elements that define eye fissure shape are the position of the eyelid margins and the shape of the exposed scleral triangles on either side of the cornea. The size of the cornea is uniform in all persons, but the shape of the scleral triangles may vary. Generally, the nasal scleral triangle is smaller, and the lateral scleral triangle is larger and more pointed. In most individuals, the position of the lateral canthus is slightly higher than the inner canthus and is at the level of the inferior edge of the pupil.



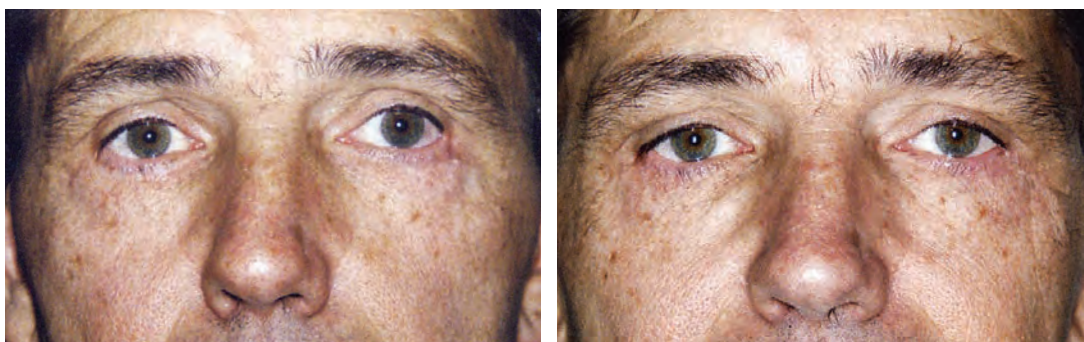
The youthful eye fissure shape shown above is defined by the position of the eyelids and the exposed sclera on either side of the iris, the nasal (medial) scleral triangle, and the lateral scleral triangle. The standard position of the lateral canthus is in line with the inferior edge of the pupil and is slightly higher than the inner canthus. Eye fissure changes that occur with age are shown in the eyes at right. In a deep-set eye, the eye fissure becomes smaller, with a reduction in the size of the lateral scleral triangle. In a prominent eye, downward bowing of the lower lid is evident.



The shape of the scleral triangles and eye fissures is seen in the eyes of these young women. With aging there is relaxation of lateral canthal attachments, which may cause the eye fissure to change in shape according to eye prominence. In persons with normal or deep-set eyes, the fissure tends to become rounder and smaller. In persons with prominent eyes, a downsliding of the lower lid, scleral show, and enlargement of the lateral scleral triangle may occur. Proper canthal anchoring restores a more youthful look to the eye fissure by changing the shape of the fissure and the shape of the lateral scleral triangle.



This woman is shown before and after lateral canthopexy and a midface lift. The eye fissure has been corrected from rounded and small with age (*left*) to a more open, elliptical, youthful shape (*right*).

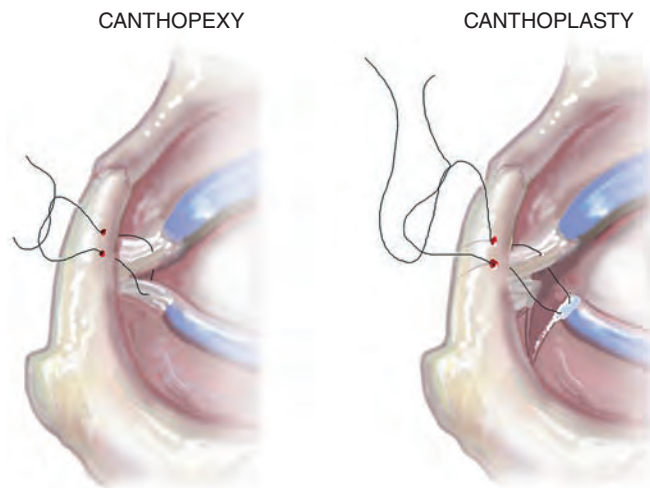


A change in eye fissure shape is demonstrated in this man. After canthal anchoring, the shape of his eye fissure changed from rounded (*left*) to a more youthful, elliptical shape (*right*).

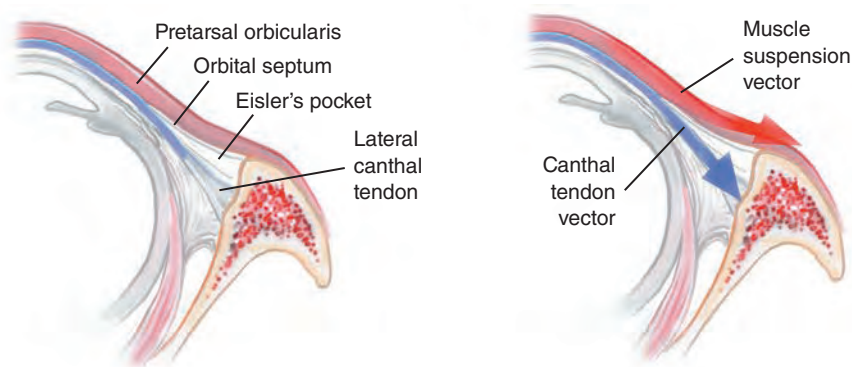
It has been shown mathematically that protrusion of the eye against the eyelid affects the shape of the eye fissure. Upper lid curvature is determined almost exclusively by indentation of the globe on the eyelid. Lower lid curvature is determined by a combination of globe indentation and the position and tone of the lateral canthal tendons. Lateral canthal anchoring has a powerful influence on lower lid position and curvature.

Techniques of Lateral Canthal Anchoring

Strengthening the eyelid attachments at the lateral canthus can take the form of a pexy procedure, with plication of the canthal tendons or canthoplasty, cantholysis, and shortening of the lower lid with reattachment to the lateral periosteum. In patients with lower lid laxity, reinforcement with shortening of the lower lid is necessary.



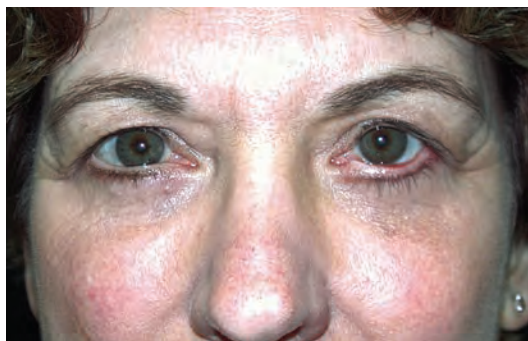
The two common methods of lateral canthal anchoring are illustrated. With canthopexy, a mattresslike suture attaches both the upper and lower tendons to the periosteum inside the orbital rim. With canthoplasty, the lower lid is shortened to compensate for laxity. In both cases the upper lid is included in the anchoring to the orbital periosteum. Whichever procedure is used, the axial vector of lid anchoring must travel inside the lateral orbital rim so that the lower lid will be flush with the curvature of the globe.



The normal vectors of attachment of the lateral canthal tendons and the orbicularis muscle are shown. The lateral canthal extension of the tarsoligamentous sling inserts well inside the orbital rim, whereas the orbicularis muscle inserts externally on the orbital rim.

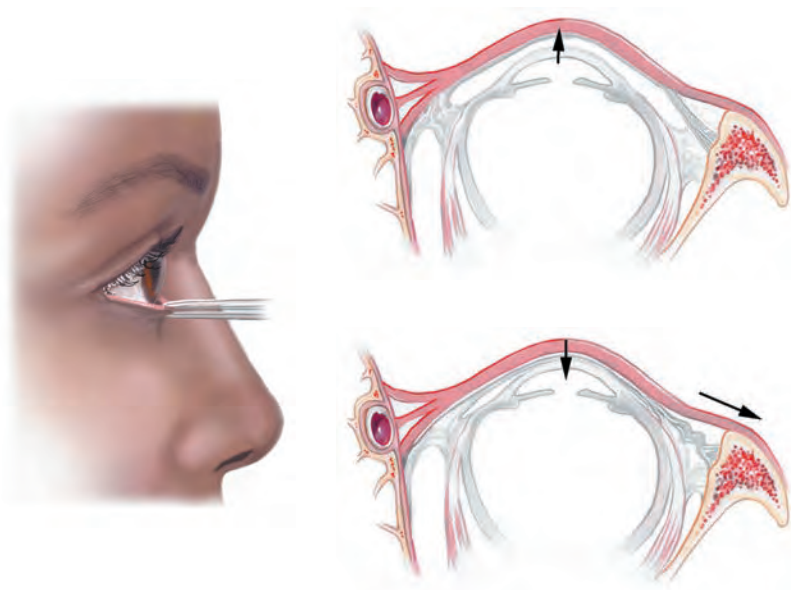
Indications for Canthoplasty Versus Canthopexy

Significant laxity of the tarsoligamentous sling must be addressed surgically by tightening or shortening the lower lid to stabilize it and prevent postoperative ectropion or buckling when a blepharoplasty is performed.



This patient, who had lower lid laxity after blepharoplasty, demonstrates outward buckling of the lower lid with ectropion. No shortening of the tarsoligamentous sling was performed. There is a disparity in tone between the anterior lamella (orbicularis) and the posterior lamella (tarsoligamentous sling), which causes the lid to buckle outward.

The *intraoperative distraction test* is the best method for detecting lower lid laxity. Preoperative eyelid distraction tests have been described in the past, but we think it is more meaningful to apply the distraction test intraoperatively. No more than 1 to 2 mm of distention from the globe should be seen with outward traction on the lower lid with the patient in the recumbent position intraoperatively. In addition, there should be a firm “snap back” to the globe after distention. If this amount of tension is not seen in the lower lid, a tightening procedure of the tarsoligamentous sling of the lower lid must be performed.

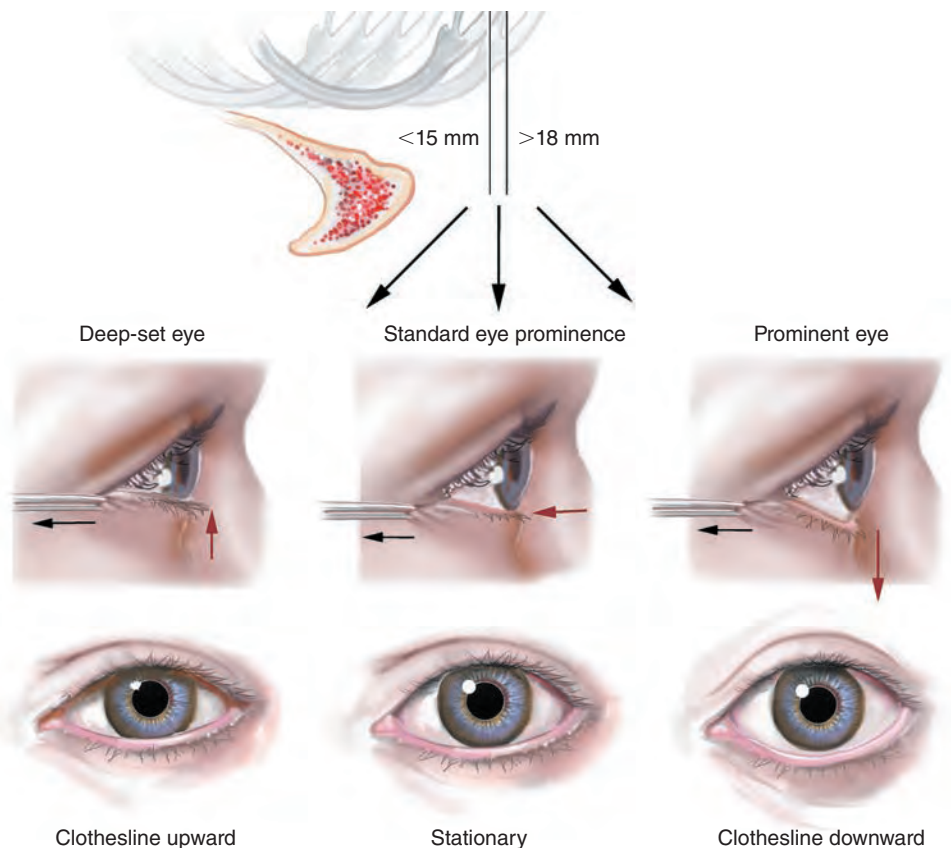


In patients with laxity of the tarsoligamentous sling, tightening only the orbicularis muscle will not correct internal lower lid laxity and can produce outward buckling of the lid because of redundancy in the posterior lamella. Tightening of the tarsoligamentous sling itself must be performed.

Either canthopexy or canthoplasty is used until the proper tension is obtained. If canthopexy is tried first and the tension of the lower lid against the globe does not seem adequate, or there seems to be redundant tissue at the lateral canthus, the lower lid should be resected and canthoplasty performed.

Variations in Placement of Lateral Canthal Anchoring

As mentioned earlier, the pull of lateral canthal anchoring on the eyelids against the globe will influence the shape of the eyelid fissure according to the prominence of the eye. To produce the desired youthful fissure shape, variations in placement of the anchoring are used according to eye prominence. Because the lateral pull of canthal anchoring of the lower lid results in changes in the size, shape, and position of the lateral scleral triangle, different placements of anchoring must be used in patients with differences in eye prominence.

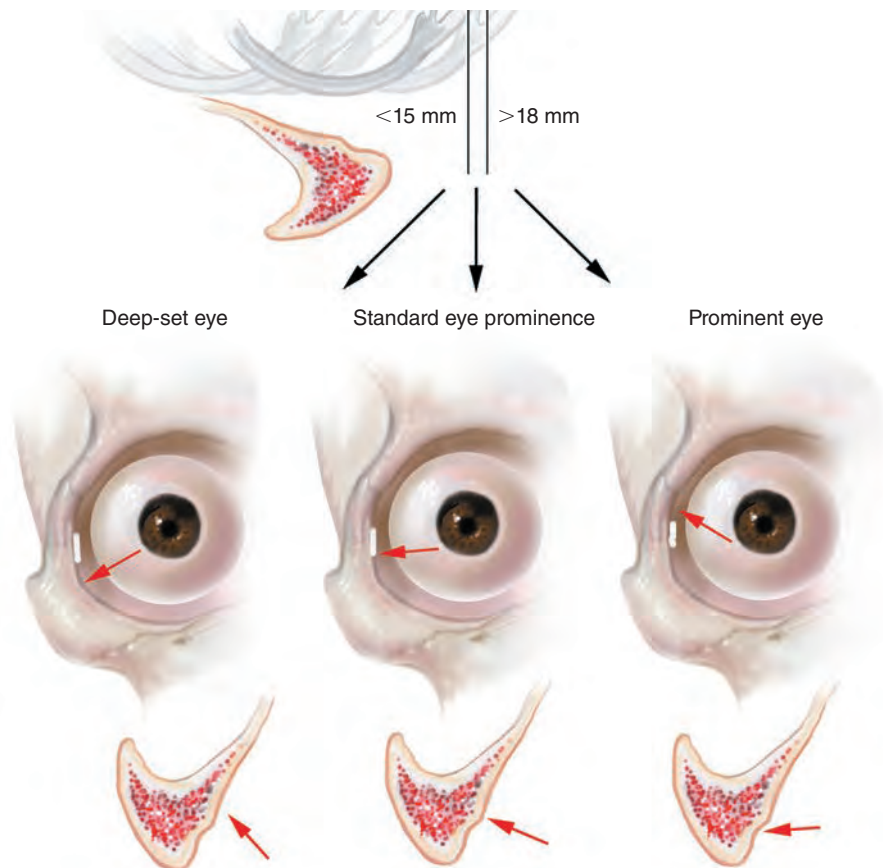


The position of the lower lid changes in response to traction at the lateral canthus. The lower lid position will either remain stationary, "clothesline" downward, or clothesline upward in response to the lateral pull of canthal anchoring, with differences in eye prominence. Lower eyelid movement depends on whether the eye is deep-set (less than 15 mm), standard position (15 to 18 mm), or prominent (more than 18 mm). In an eye with standard prominence, a lateral pull in line with the inferior edge of the pupil will maintain a good lower lid position. In a deep-set eye, this same vector of pull will result in upward clotheslining, giving the patient a small

eye fissure postoperatively. In a prominent eye, the same pull will cause downward clotheslining.

During a lower lid blepharoplasty, if the surgeon fails to take these factors into account and fails to modify lateral canthal anchoring accordingly, abnormalities of the eye fissure may result. Preoperatively, the proper placement of canthal anchoring can be planned according to preoperative measurement of eye prominence as measured with an exophthalmometer.

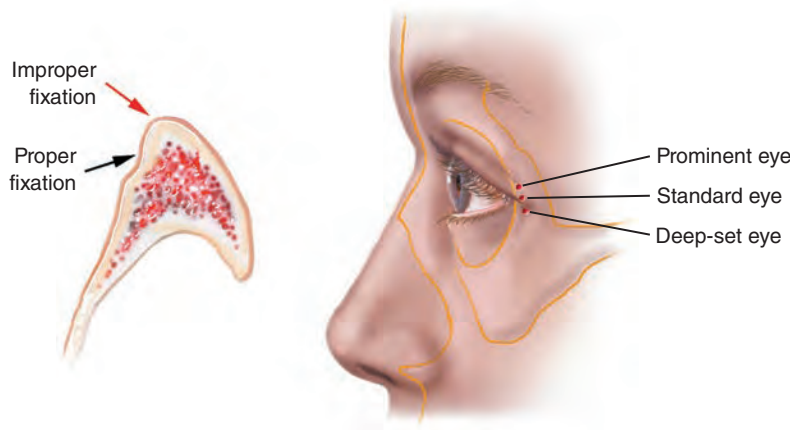
This approach to treatment is offered as a general guideline; the surgeon makes the final determination on anchoring after assessing the behavior of the lower lid intraoperatively. During surgery, if the final resting position of the edge of the lower lid is at the desired level in relation to the cornea (usually just inside the lower limbus), the position of anchoring can be deemed adequate.



The proper vectors of canthal anchoring are demonstrated in patients with deep-set eyes, eyes with standard position, and prominent eyes. In patients with deep-set eyes, canthal anchoring should be directed more downward and internally to compensate for globe curvature. For patients with standard eye prominence, canthal anchoring should be placed at the level of the inferior edge of the pupil inside the orbital rim. For patients with prominent eyes, the vector of anchoring should be more upward, with mild supraplacement.

Standard Eye Prominence

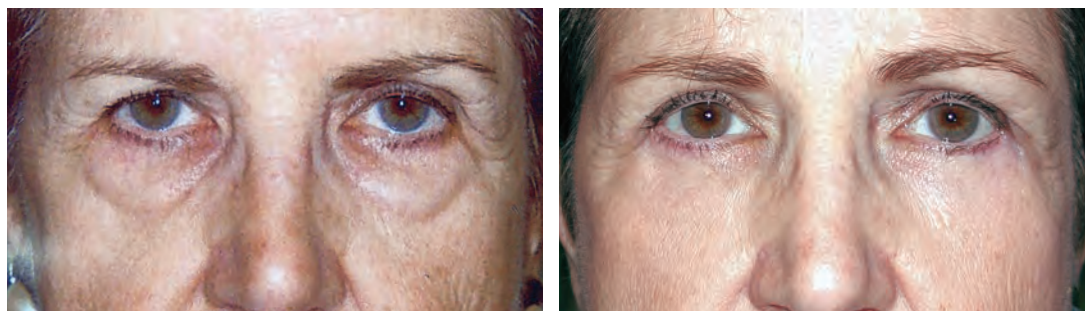
Lateral anchoring for an eye with standard prominence (16 to 18 mm) is usually best accomplished by placement at the level of the inferior edge of the pupil.



The image on the right depicts positioning of canthal anchoring in the various situations of eye prominence. The highest placement is for a prominent eye. The lowest placement is for a deep-set eye. In the left image, the proper vector of fixation is indicated by the black arrow. The red arrow indicates a placement that is too anterior in most cases.

The Deep-Set Eye

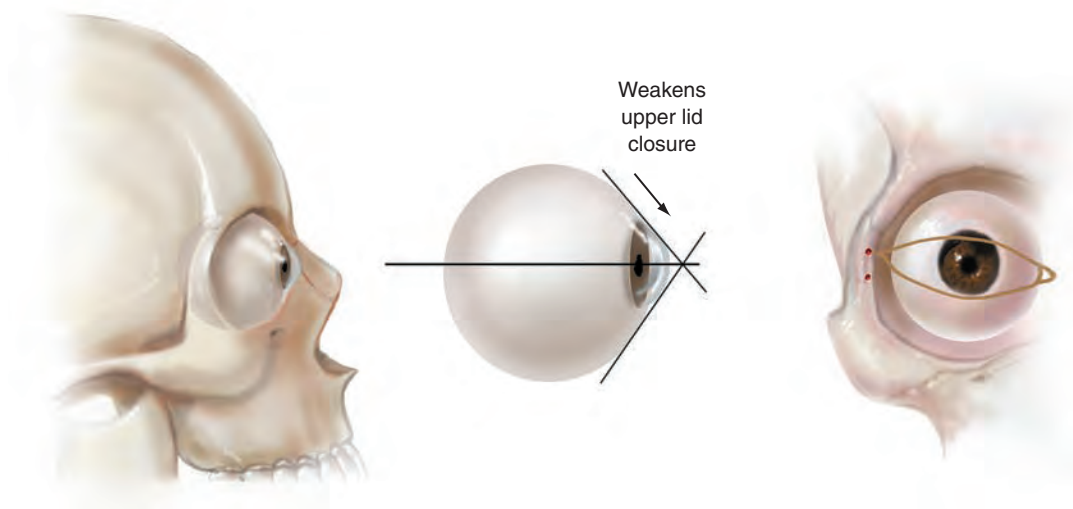
In a patient with deep-set or inwardly recessed eyes, a lower lid clotheslining upward may occur that narrows the fissure and reduces the size of the lateral scleral triangle. This may cause the patient to complain of “little, squinty eyes” postoperatively. In these patients with deep-set eyes (less than 15 mm), anchoring is placed more inferiorly and more internally to prevent the upward clotheslining of the lower lid that may occur (see the preceding two figures). This also prevents narrowing of the lateral scleral triangle and postoperative patient complaints of “small eyes.”



This patient with deep-set eyes (15 mm) is shown before a cheek lift (*left*). Because she was at risk for narrowing of the eye fissure with standard placement of canthal anchoring, a modified approach was used. On the right, the patient is shown after a midface lift and canthal anchoring, which was modified with downward and inward placement to compensate for her enophthalmos.

The Prominent Eye

In a patient with prominent eyes, tightening the lower lid in the standard vector can cause a clotheslining effect that produces a bowing downward of the lower lid or, in more severe cases, scleral show. Currently we depend on slight supraplacement of lateral canthal anchoring to position the lower lid upward to counteract this effect in milder cases. We have found that the position of the canthal anchoring in the prominent eye should not be higher than the center of the pupil, particularly in patients with more severe eye prominence.



This illustration depicts the limitations of supraplacement of the lateral canthal tendon, which can result in the weakening of upper lid closure because of the mechanical factors involved. Canthal anchoring should not be supraplaced above the mid-level of the pupil; leverage of upper lid closure is lost as the canthus is supraplaced. This is particularly true in patients with prominent eyes.

Limitations of Canthal Supraplacement

If certain limits of lateral canthal supraplacement are exceeded in patients with increasingly prominent eyes, there is an adverse effect on upper lid closure. This is because the fulcrum of upper eyelid movement may slide upward past the vertex of the cornea as lateral anchoring moves upward, which causes reduced closure of the upper lid with lagophthalmos. Increased tightening of the upper lid can aggravate this situation; it is analogous to the clotheslining effect that occurs with tightening of the lower lid in these patients. Excessive manipulation of the lateral tendons upward may also intrinsically weaken the upper tendon attachment.



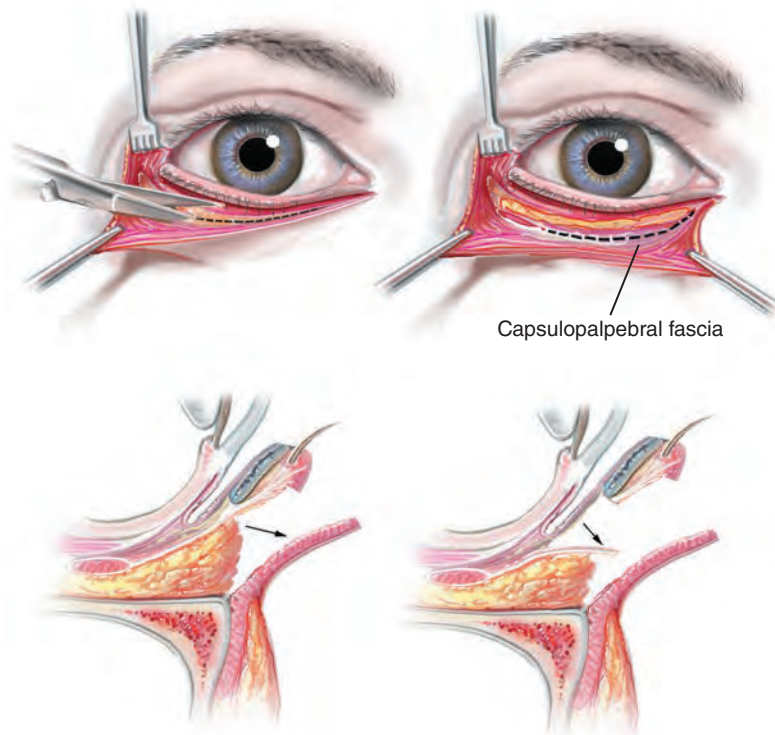
Preoperative

Postoperatively

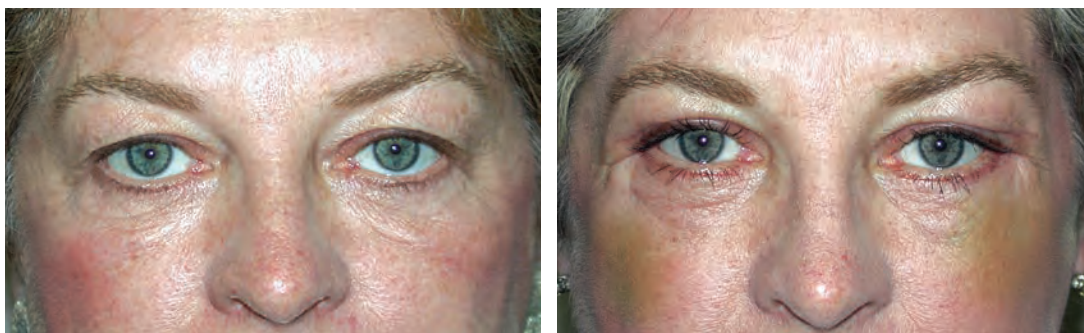
This patient with prominent eyes and preexisting scleral show is shown preoperatively and postoperatively. Postoperatively, excess supraplacement of the canthal angles is evident because of the retinacular suspension used to elevate the lower lid margin. Note the weakening of upper lid closure.

Other Compensatory Procedures in Patients With Prominent Eyes

If mild lateral canthal supraplacement does not elevate the lower lid enough, the first surgical step to be used to counteract any clotheslining tendency is a *release or recession of the inferior retractors*, capsulopalpebral fascia (CPF), in the lower lids. A gain of 1 to 2 mm in the lower lid position against scleral show can be achieved with CPF recession.

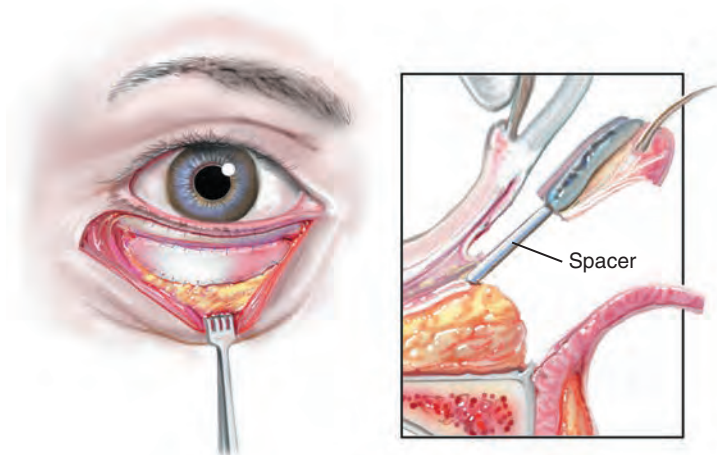


This illustration shows recession of the inferior retractors (CPF) of the lower lid to elevate the lid margin.

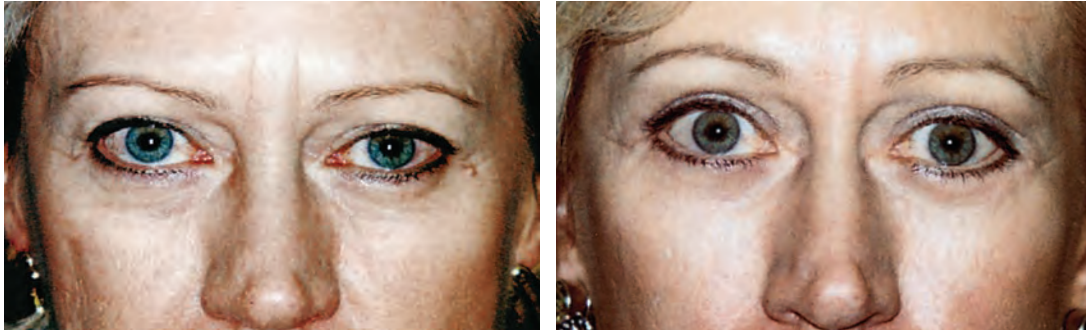


This woman with prominent eyes (greater than 18 mm) is shown before and immediately after canthal anchoring with slight supraplacement combined with recession of the CPF in the lower lid. There is normalization of the lateral scleral triangles.

In patients with more severe eye prominence, loosening the CPF may not provide enough lid elevation to prevent postoperative scleral show, and *spacer material must be inserted* in the posterior lamella of the lower lid. For spacer placement, we prefer a full-thickness blepharotomy in the posterior lamella 6 mm below the lower lid margin (sparing the inferior arcade, which is approximately 4 mm below the lid margin). Most of the blood flow to the lower lid comes from the nasal arterial complex, so care is taken not to dissect or cauterize unnecessarily in this area. It is convenient to use AlloDerm of sufficient thickness as a spacer material in previously unoperated patients.



Incision of the inferior retractors (CPF) and conjunctiva is shown, with full-thickness blepharotomy of the posterior lamella of the lower lid and insertion of spacer material to elevate the lid margin.



This patient with prominent eyes (greater than 19 mm) is shown before and after midfacial lid surgery combined with upper lid brow surgery, in which a primary spacer of AlloDerm was used to prevent downward clotheslining and scleral show.

Our present approach for preventing postoperative problems in patients who have prominent eyes is a progression from conservative lateral canthal supraplacement to recession of the inferior retractors, followed by insertion of a spacer to produce a desirable eye fissure shape.

Lower Lid Complications and Their Treatment

Abnormalities of eye fissure shape and lower lid retraction or ectropion are the most common problems that may be seen after aesthetic lower lid surgery. Shape deformities range from a simply undesirable eye shape (such as rounding, bowing, or narrowing of the lateral scleral triangle) to lid malposition. Commonly these problems result from inappropriate canthal anchoring. Patients with poor anchoring may also have poor eyelid closure mechanics. The causes of ectropion or downward retraction of the lower lid are as follows:

- Overzealous skin removal
- Failure to surgically anchor supporting elements of the eyelid (the lateral canthal tendons or the orbicularis muscle flap)
- Failure to recognize preexisting lower lid laxity
- Failure to recognize significant variation in eye prominence

Lower lid malposition may have medical consequences in addition to aesthetic ones. Postoperative exposure can be particularly intensified if lagophthalmos in the upper lid is present as well.

Nonsurgical Management

In the early postoperative period, some edema, with its fluid accumulation, causes thickening, which exacerbates lower lid malposition. The conservative approach is essential in patients who still have edema and thickening of the lower lid. It may take several weeks for the fluid to be resorbed, the edema to resolve, and the lid tissue to soften and elevate. Upward massage is therapeutic.

Watchful waiting and reassurance constitute the best approach during the early recovery. If mild edema is accompanied by excessive stiffness in the eyelid skin or subcutaneous tissues, judicious injection of steroids may be useful. Caution must always be exercised when injecting steroids to avoid subcutaneous fat atrophy, thinning of the skin, and telangiectasia.

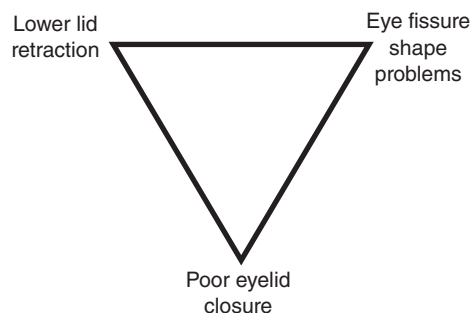
Corrective Surgical Procedures

Lower lid retraction or malposition that does not resolve with conservative measures requires surgical correction. These corrective procedures may have to be staged, depending on the severity of the problem and the desire to avoid external skin grafts in certain patients.

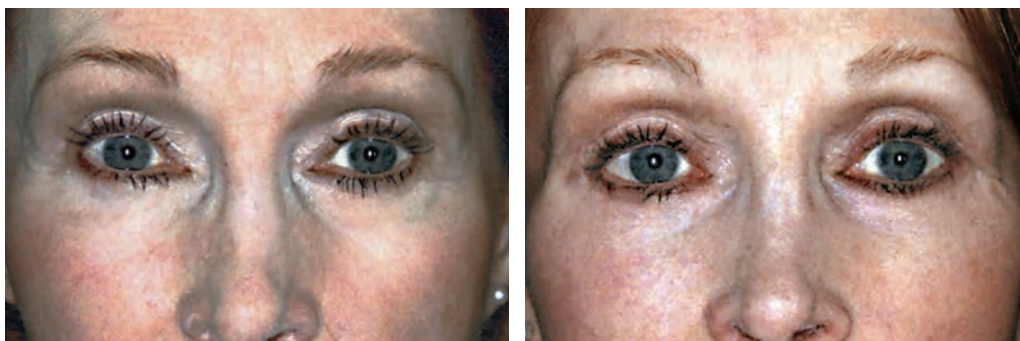
We classify lower lid complications in the following three broad categories:

1. Lower lid retraction
2. Eye fissure shape changes
3. Eyelid closure mechanics

These problems may occur independently, but for many patients they appear in combination.



Common procedures to correct lower lid complications are anchoring (or reanchoring) of the lateral canthus and anchoring (or reanchoring) of the inferior arc of the orbicularis muscle. Both structures offer support for repositioning the lower lid, and each, if appropriately anchored, can restore an undesirable eye fissure shape.



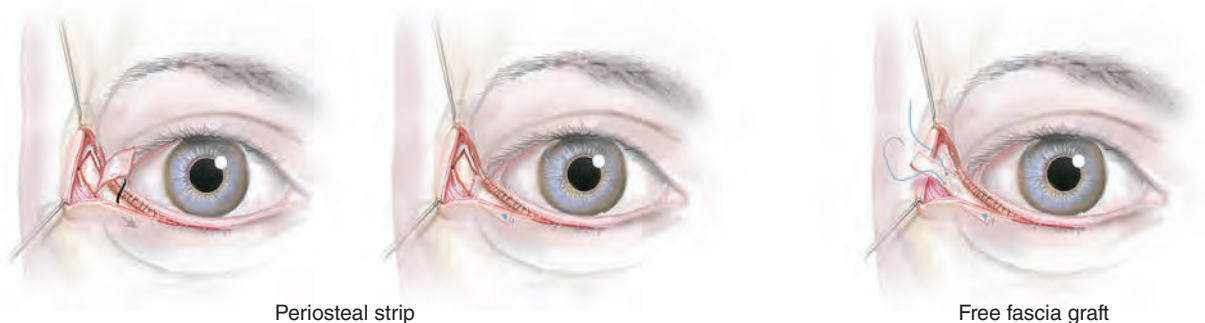
This is an example of a patient with eye fissure narrowing after blepharoplasty. The patient complained of “little bitty eyes” after blepharoplasty; note the narrowing of her eye fissures. After canthal reanchoring modified with downward and inward placement, she was pleased with the enlargement of her eye fissures and thought that her eyes had a more normal shape.



On the left is a close-up of a patient with deep-set eyes after a lower lid blepharoplasty in which the proper type of canthal anchoring was not performed. She had a marked reduction in the size of the lateral scleral triangles in both eyes. On the right, after canthal anchoring with downward, inward placement to compensate for the deep-set eye, enlargement of the lateral scleral triangle is shown (*see red outlines*). If skin shortage is a significant factor in lower lid retraction, canthal vertical anchoring of the inferior arc of the orbicularis muscle will recruit skin upward into the lower lid and will, in most cases, correct retraction without the use of a skin graft. Insertion of spacer material into the posterior lamella of the lower lid is particularly useful in patients with prominent eyes and those with retraction caused by scarring of the middle lamella. Spacer material, interposed after scar release, acts as a barrier against postoperative scar contraction. Autologous material such as dermis, ear cartilage, or hard palate is best used in reoperative cases.

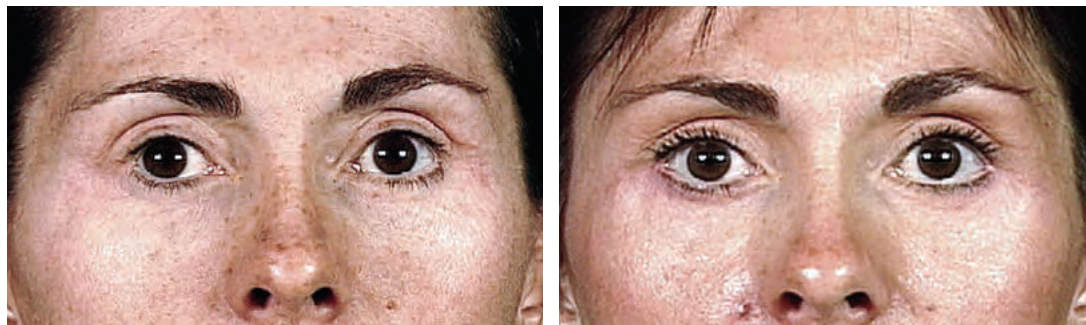
Canthal Anchoring (Reanchoring)

In patients who have minimal scarring and an intact lateral rim periosteum, canthal reanchoring may be performed as one would in an unoperated patient. In patients with unusual scarring or tissue deficiency in the canthal area, extra tissue may be needed for lateral reinforcement. In milder cases, a periorbital rim–based periosteal strip can be used for support.



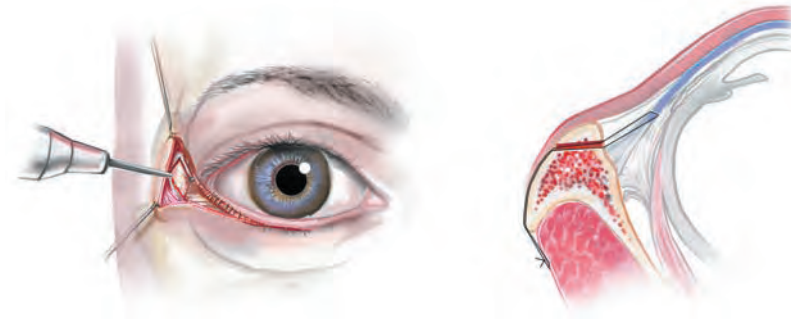
Techniques of canthal anchoring using reinforcement with additional tissue are shown. A reflected flap of lateral rim periosteum can be used as a reconstructive procedure at the lateral canthus and can act as additional support. In lieu of periosteum, free grafts of fascial tissue, either temporalis or fascia lata, can be used for additional support of canthal reanchoring.

A free fascia patch graft may also be used. This approach, in which additional soft tissue is introduced, is particularly helpful in cases in which there is a shortage of eyelid tissue in the lateral lid.

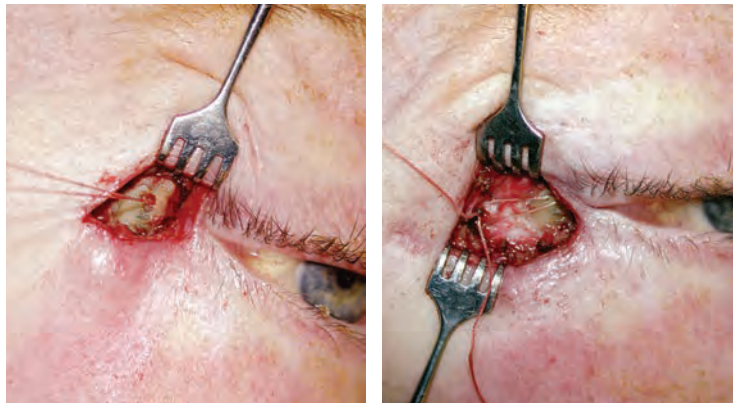


After an earlier eyelid surgery, this patient had a loss of normal lateral canthal attachments in the right eye and phimosis from tissue loss in the left eye. Both lateral canthi were reconstructed with reanchoring and periosteal flap placement, as shown on the right.

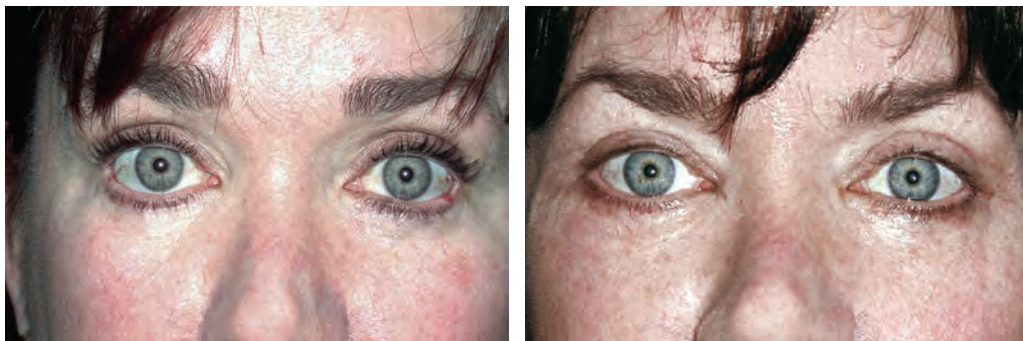
Our procedure of choice for the most secure canthal anchoring is refixation of the lateral canthus through a drill hole in the lateral orbital rim. This is a useful technique in patients with poor periosteum and weakness of soft tissue support at the lateral canthus. It is best used for patients with severe distortion of the eye fissure or patients who have poor eyelid closure caused by lateral anchoring deficiency. Drill-hole fixation enhances the permanency of anchoring.



The technique of canthal anchoring using drill-hole fixation to the lateral orbital rim is shown. A single drill hole can be used. The double-armed suture (4-0 Mersilene) is passed through the single drill hole and secures the canthus inside the lateral orbital rim. The double-armed suture can then be fixed to the deep temporal fascia. The use of a single drill hole allows greater precision in canthal placement and possibly a more secure attachment to the orbital bone.

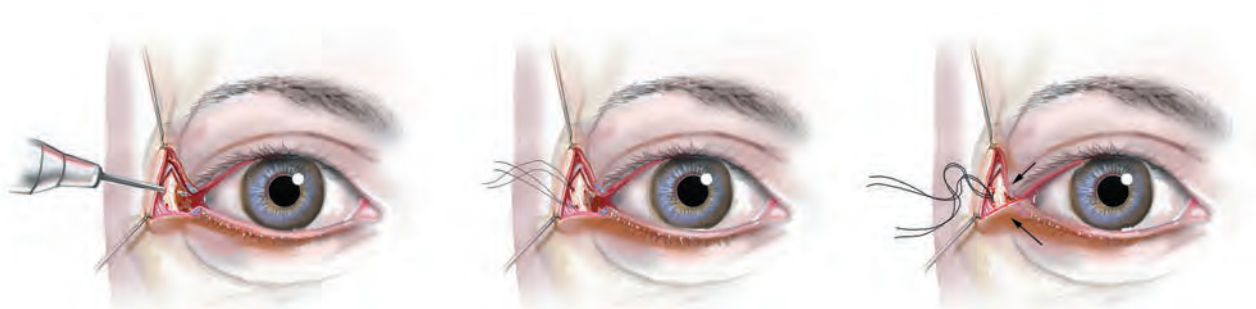


The doubled-armed suture attached to the canthal structures is brought out through the drill hole and secured to the deep temporal fascia.



On the left, this patient shows deformity of the right canthus that had resisted conventional forms of canthal reanchoring; on the right, the same patient is seen after drill-hole canthal anchoring.

The need for drill-hole canthal fixation commonly occurs in patients with prominent eyes who also have eyelid retraction and stiffness of the upper and lower lids. In these patients a double drill-hole fixation is necessary in which the lateral tendons of the upper and lower lid are independently fixed to drill holes in different positions.



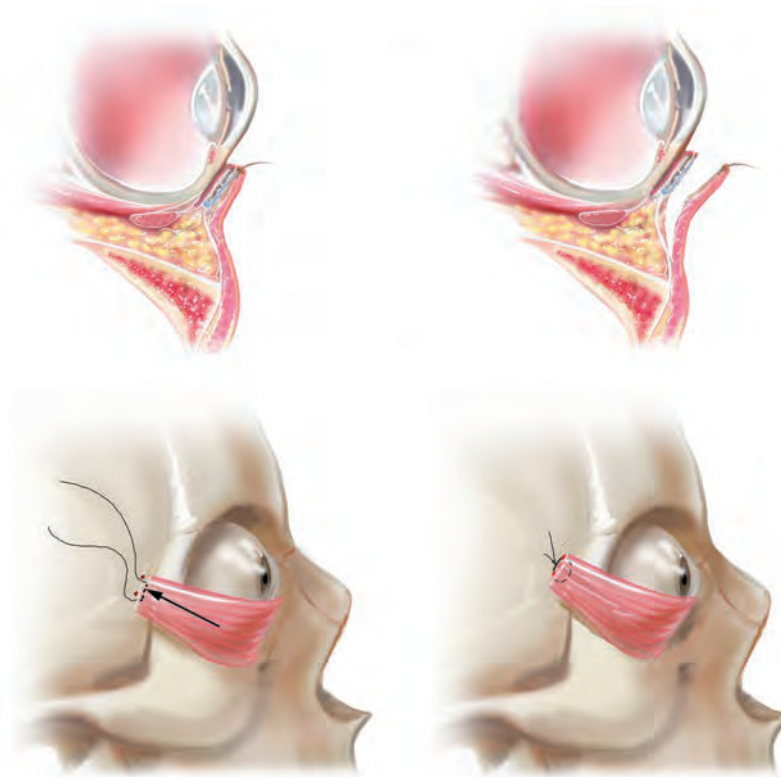
To obtain the proper vectors of pull at the lateral canthus to ensure good lid closure, a crisscross attachment can be used. This is particularly important in patients with prominent eyes and poor closure. The vector of pull that improves closure in the upper lid is obtained by placing it in the inferiorly placed drill hole. A cantholysis is performed, and the edge of the upper lid is attached to the lower drill hole. The lateral tendon of the lower lid can be placed in the superiorly placed drill hole, allowing a higher supraplacement of the lower lid without affecting upper lid closure. This improves the upper lid closure mechanics and also allows more supraplacement of the lower lid. This crisscross drill-hole fixation is commonly used in conjunction with the other reconstructive procedures.

Vertical Reanchoring of the Inferior Orbicularis Muscle

The upward redraping of the inferior arc of the orbicularis, with tightening and firm attachment to the temporal fascia, will add support to the lower lid.

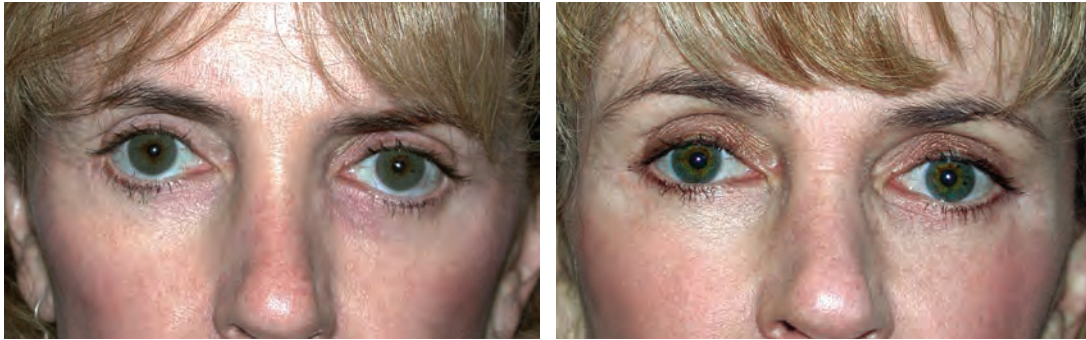


The skin is recruited upward into the lower lid, with vertical reanchoring of the inferior arc of the orbicularis muscle.

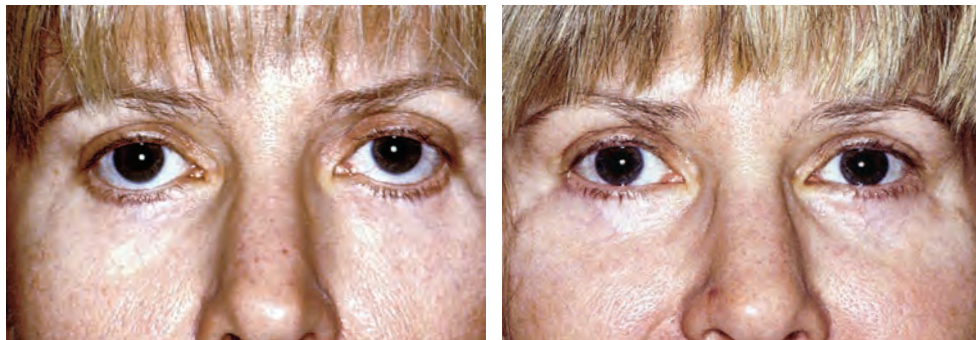


Vertical reanchoring of the orbicularis muscle is demonstrated, with recruitment of skin into the lower lid. Reanchoring the orbicularis also acts as the supportive sling for lower lid repositioning. The vector of orbicularis anchoring is performed in accordance with eye prominence. A more vertical vector of fixation, to the temporal fascia and periosteum, is used when more skin recruitment is required and in patients with more prominent eyes.

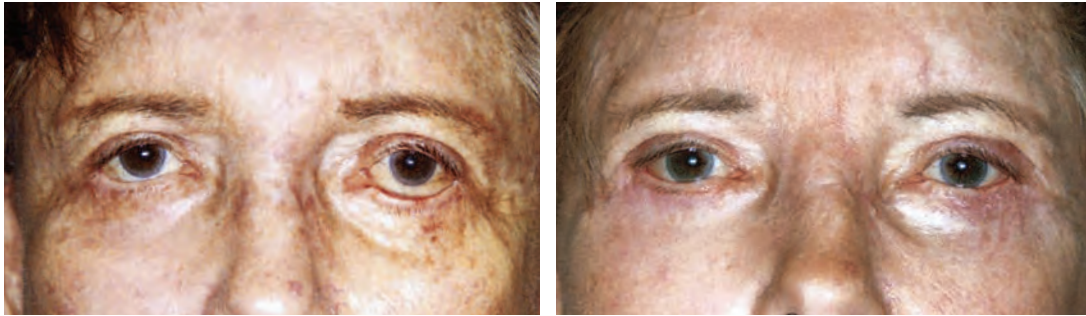
Orbicularis reanchoring is usually combined with canthal reanchoring, as described earlier. One may use a more limited orbicularis dissection and reanchoring in milder cases of lower lid retraction in which the skin shortage is not severe.



This woman exhibits mild retraction and skin shortage in the lower lid before and after recruitment using vertical reanchoring of the orbicularis muscle. In patients with increased or severe skin deficiency, extensive vertical repositioning of the inferior arc of the orbicularis may be needed to recruit greater amounts of skin upward into the lower lid, which usually eliminates the need for skin grafts in these patients.



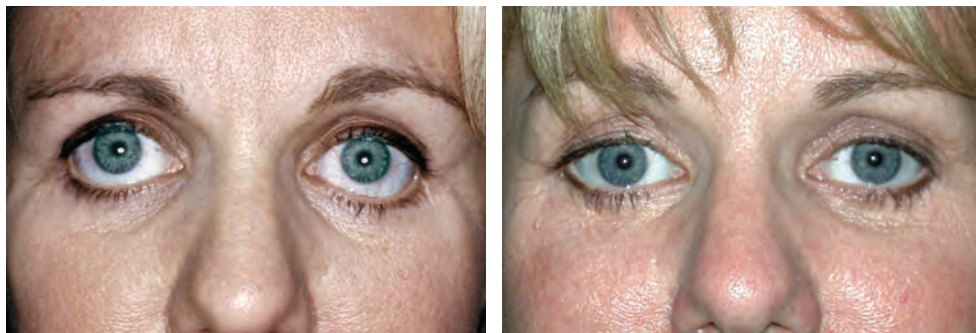
Moderate retraction and skin shortage in the lid is evident in this patient both before and after recruitment using vertical reanchoring of the orbicularis muscle.



This patient has retraction and skin shortage in the left lower lid before and after recruitment using vertical reanchoring of the orbicularis muscle. In the past this patient would have required a skin graft for correction.

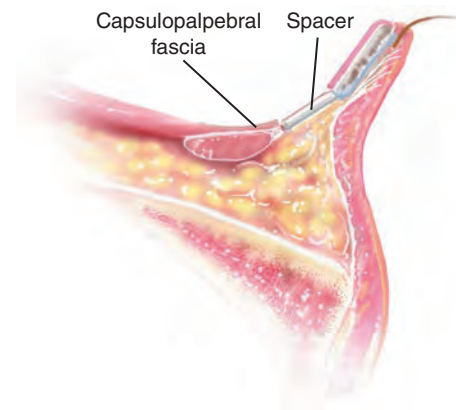
Spacers

The use of spacer inserts in the lower lid posterior lamella in patients undergoing primary surgery was described earlier in this chapter. The same procedure is used in patients with secondary lower lid retraction for corrective surgery. Spacer inserts in the lower lid (AlloDerm, ear cartilage, autogenous dermis) lengthen the posterior lamella and elevate the lower lid margin upward in patients with significant eye prominence (defined as 19 mm or more as measured by an exophthalmometer).



On the left, this woman is shown after lower lid blepharoplasty with extremely prominent eyes and moderately severe lower lid retraction. She required transcutaneous placement of spacer material in the posterior lamella of the lower lid with vertical recruitment of skin. Her postoperative result is shown on the right.

Even in patients with normal eye prominence with significant middle lamella scarring, spacers can help prevent postrepair contracture of scar tissue. On occasion, in reconstructive patients who do not require skin recruitment, the spacer may be placed internally without a transcutaneous approach.



The position of the spacer material is shown after internal placement in the lower lid. Spacers are usually needed in patients with very prominent eyes or those who have retraction from scarring of the middle lamella. In more severe cases, transcutaneous spacer placement may be required, in conjunction with orbicularis elevation for skin recruitment.

Complications of Autologous Fat Injections

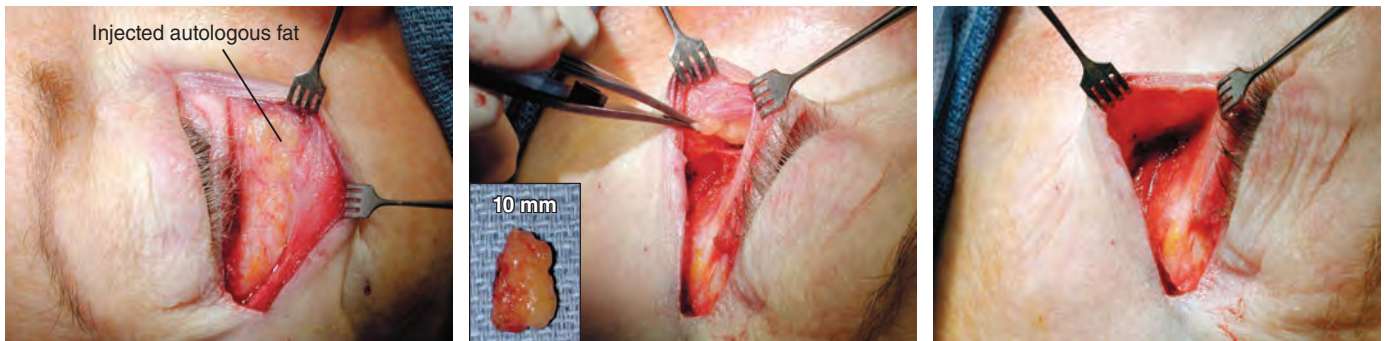
Correction of aging lower lids and blending of the lid-cheek junction with autologous fat microinjections is becoming increasingly popular. Although some of the results have been impressive, we have seen a number of patients in whom the fat has been injected superficially, subcutaneously, or in the superficial layers of the orbicularis, leading to unsightly “beading” of the lower lid. These problems may be difficult to correct. The fat may be removed through the transconjunctival approach. As with any complication or problem, avoiding the problem from the outset is preferable to correction. Injection of the fat deep and directly over the periosteum is best to prevent postoperative irregularities and beading.

Treatment Options

Steroid injections may induce atrophy of the injected fat but are not always successful and carry the risk of skin changes and telangiectasia. Suctioning the fat with a fine needle is not uniformly successful. Injections of phosphatidylcholine and deoxycholine may result in resolution but such treatments have not been established. Surgical removal of the injected fat is the treatment of choice. The fat may be accessed through the conjunctiva, transcutaneously, or with a skin-muscle flap.



This woman had undergone autologous fat injections into the lower lid in an attempt to improve lower lid aging and descent of the lower lid–cheek junction. The excess superficially injected fat is quite evident. She also had bilateral lid retraction that was worse on the right than on the left.



Through the skin-muscle flap approach, the autologous fat within and superficial to the orbicularis muscle was easily located. The excess fat was dissected and removed. After all the excess fat was successfully removed, the orbicularis was mobilized and redraped.

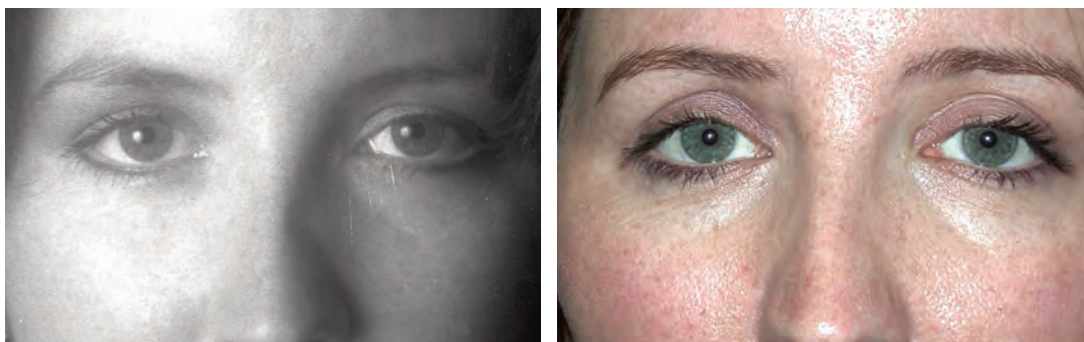


Preoperative and postoperative views demonstrate improved lid appearance, more effective lid-cheek junction blending after removal of the injected fat, orbicularis muscle flap redraping, and canthopexy. The split view shows the improvement on the left side.

AESTHETIC GOALS IN THE UPPER LID

Spacing and Definition

Harmony of positioning with the upper lid and brow is of the utmost importance for patient satisfaction. It is important to produce the desired contours of the eyelid crease, the position of the eyelid margin, and even the brow spacing the patient desires. In practice, the desired result can be highly individualized, and the same fixed formula of spacing and positioning should not be arbitrarily used in all patients. This aspect of the proposed surgery should be discussed with the patient in detail for surgical planning to determine the patient's preferences and to avoid dissatisfaction when the result does not meet the patient's aesthetic goals.



After upper lid blepharoplasty with a very high upper lid crease and a very wide “eye shadow space,” this woman was unhappy because her appearance was too dramatic a change from her previous appearance. Her previous eyelid spacing is seen on the left, before the upper lid blepharoplasty had been performed.

Old photographs of the patient may be helpful in defining goals and the amount of defined eye shadow space the patient desires. Preoperative planning is even more important in Asian patients, who may vary in their desire for a “Westernized” look. It is important to recognize the tendency for the upper crease to migrate upward in patients with prominent eyes, and this should be pointed out to the patient.

Position of Upper Lid Margin

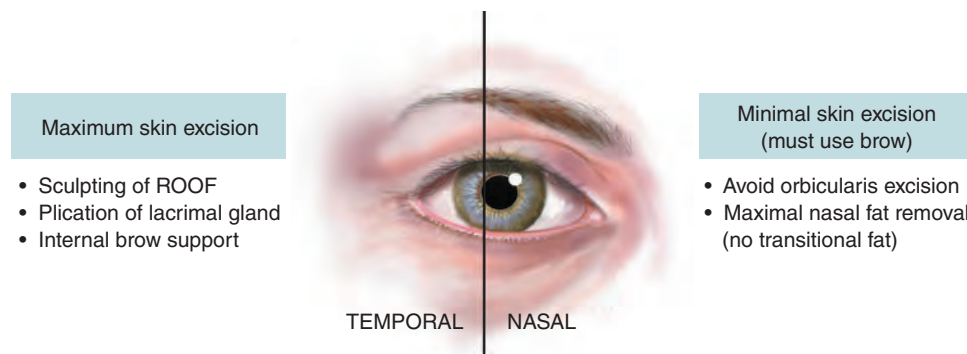
It is important to make note of the relationship of the upper lid margin to the pupil of the eye. How much color of the iris can be seen above the pupil? Compensatory brow arching or severe dermatochalasis may mask preexisting ptosis. True upper lid ptosis should be pointed out and discussed before surgery.

Prevention of Upper Blepharoplasty Complications

An important functional goal in upper blepharoplasty is that surgery should not compromise the strength and velocity of upper lid closure. Among patients who have poor eye moisture or reduced ocular motility, any lagophthalmos, however subtle, may cause distressing symptoms. Severe lagophthalmos in any patient can cause damage or disability of the eye as a result of corneal exposure.

Differences Between the Nasal and Temporal Upper Lid

Lagophthalmos in the nasal half of the upper eyelid is less well tolerated than lagophthalmos in the temporal half of the upper lid, either with symptoms or corneal changes. Cautious skin removal in the nasal half of the upper lid is advised. In some patients, skin laxity and unwanted fullness in this area can be improved by brow elevation and fat removal alone. Minimizing skin removal in the nasal half of the upper lid reduces the chance of symptomatic lagophthalmos.

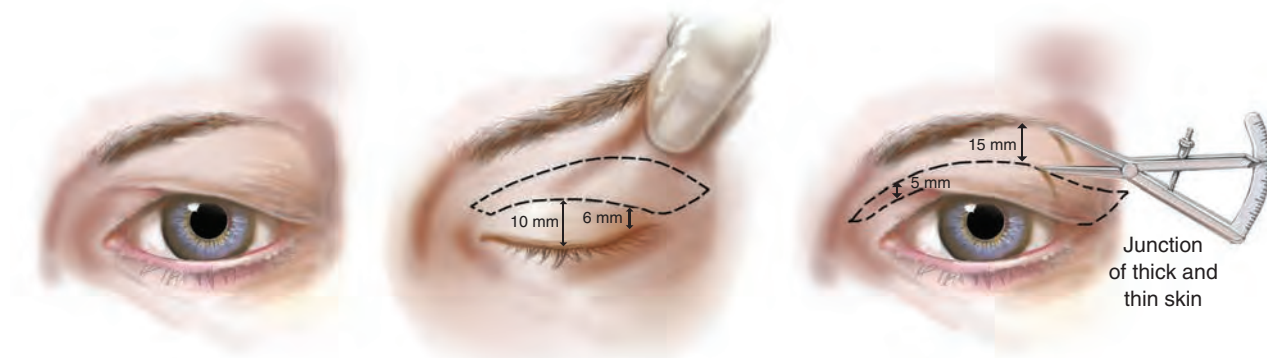


Considerations in the nasal half of the upper lid and the temporal half of the upper lid are illustrated with regard to problems, pitfalls, and corrective procedures. Stiffness in the outer half of the upper lid is much better tolerated by the eye, so more complete removal of redundant skin may be carried out in this area. Lateral brow stability influences the amount of residual folding that may occur in the lateral upper lid postoperatively. To avoid annoying residual folds in this area and ensure a continuous space with the pretarsal area, we recommend stabilizing the lateral brow, either with a temporal lift or an internal browpexy. It is our practice to include a transblepharoplasty internal browpexy with almost every upper lid blepharoplasty.

Techniques of Upper Lid Blepharoplasty

Design of the Upper Blepharoplasty Skin Excision

The amount of skin that is surgically removed in the upper lid is not as important as the skin that remains postoperatively in the lid. The general placement of skin markings for excision is shown below.

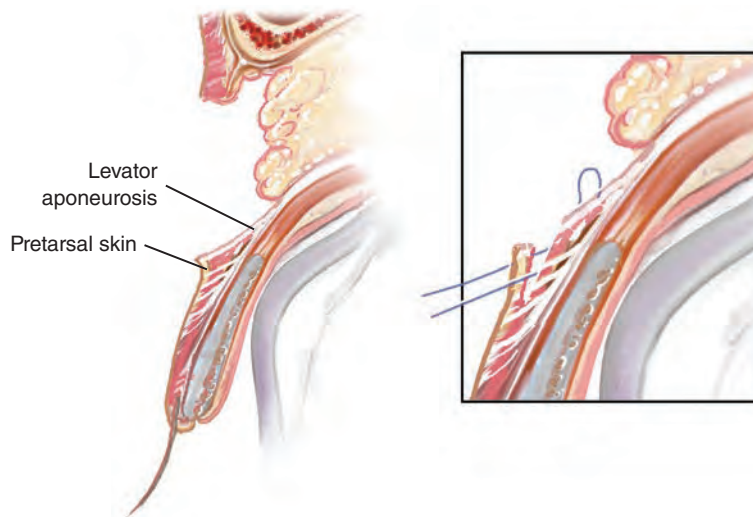


This illustration shows the recommended excision of skin and underlying orbicularis and septum in the so-called open-sky approach to upper lid blepharoplasty. This approach emphasizes the principle that the most important consideration in the upper lid is how much skin is left behind rather than how much is excised.

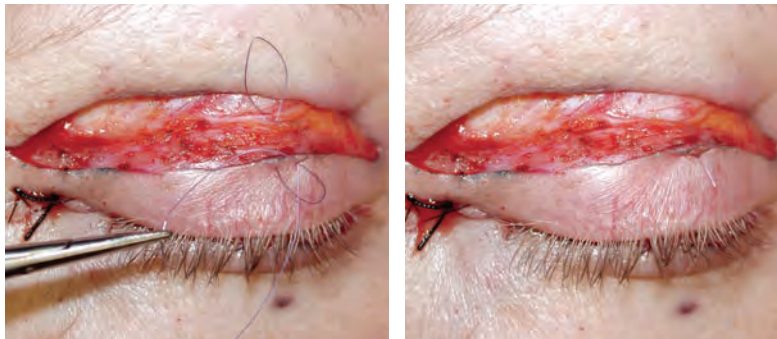
One should minimize the excision of skin in the nasal half of the eyelid, because, as previously described, nasal lagophthalmos causes the most severe exposure. Excessive laxity in this area can be addressed with cautious skin excision, but correction of any brow laxity may reduce the amount of skin excision needed. The open-sky technique, with removal of skin and the underlying orbicularis and septum, is safer and gives the surgeon more options at the time of upper blepharoplasty surgery. Debulking the subcutaneous tissue produces less skin tightness on closure, and the added exposure provided allows access to the levator aponeurosis if ptosis surgery is required. One should avoid creating scarring in any orbicularis or septal layers that remain. Postoperative upper lid lagophthalmos from middle lamella scarring is most difficult to correct. The open-sky technique of upper blepharoplasty may require excision of the orbicularis and septum near the insertion of the levator aponeurosis, which may in some cases, particularly in patients who are predisposed to ptosis, weaken the levator aponeurotic insertion and produce postoperative ptosis.

Aponeurotic Safety Stitch

When upper blepharoplasty is performed, even in patients in whom no ptosis is present, plication of the upper pretarsal skin edge to the aponeurosis is a safeguard against levator dehiscence and controls the position of the upper crease. This is easily performed with the open-sky technique.



This illustration demonstrates the “safety stitch” used in conjunction with the open-sky technique to ensure levator aponeurosis attachments and to control the position of the upper lid crease.



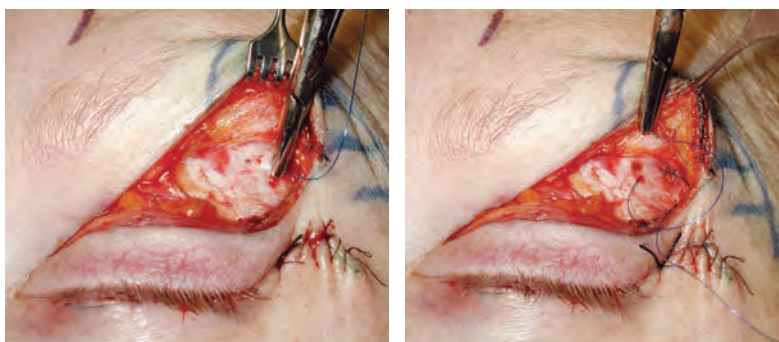
Surgical images show placement of the safety stitch using 6-0 Vicryl. The stitch is placed through the skin at the upper edge of the incision and then into the levator aponeurosis. The suture is tightened, but not enough to cause eyelid gapping.

Brow Treatment

For significant eyebrow laxity, the surgeon should use a formal brow procedure, endoscopic forehead lift, or temporal lift for stabilization of the eyebrow/eyelash distance. In milder cases, the problem can be addressed in the lateral upper eyelid with transblepharoplasty internal browpexy. Fixation of the subbrow fat pad (retroorbicularis fat) to the deep temporal fascia with permanent sutures can reduce or eliminate brow sagging and avoid residual lateral folding in many patients.



The steps in the internal browpexy are illustrated. On the left, the area to be undermined in the preperiosteal plane is shown, and on the right, the exposure of the deep temporal fascia is shown.



In these images of internal browpexy, the image on the left shows the fixing suture being placed in the deep temporal fascia. The image on the right shows insertion of the suture in the retroorbicularis oculi fat at the level of the inferior edge of the brow. The vector of pull is usually in an upward/outward direction.



This patient is seen after upper lid blepharoplasty with an internal browpexy. On the left, the temporal half of the upper lid and tail of the brow are shown preoperatively. The desired postoperative result is shown on the right. This includes firm support of the tail of the brow, an upper lid crease, and an eye shadow space that extends past the canthal angle without residual skin folds.

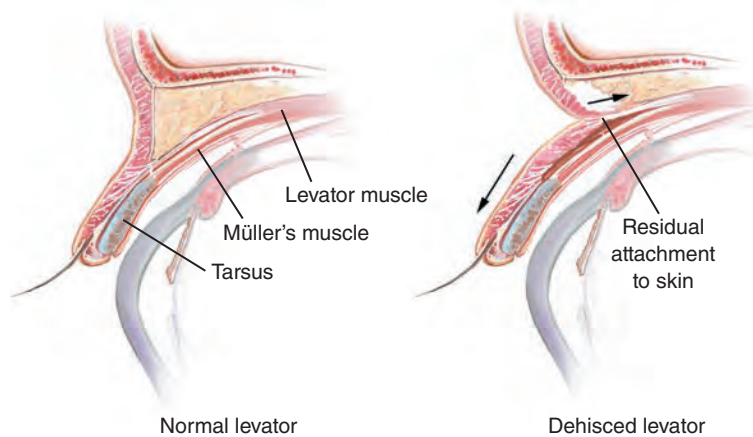
Prevention of Ptosis

Correction of Coexistent Ptosis

In a patient requesting upper lid blepharoplasty, the usual cause of ptosis is a dehiscence of the levator aponeurosis. Aponeurotic repair can easily be performed through the upper lid blepharoplasty incision if surgical exposure is adequate. The open-sky approach to upper lid blepharoplasty provides adequate exposure of the levator muscle and aponeurosis so that repair can be performed in these patients.

Mechanism and Cause of Levator Dehiscence

Levator aponeurotic attachments to the upper lid travel to the anterior surface of the tarsal plate and to eyelid skin in the crease area. With levator dehiscence, because of thinning and disinsertion, the aponeurotic portion of the levator pulls away from its tarsal attachments and with its retraction the upper lid becomes ptotic.



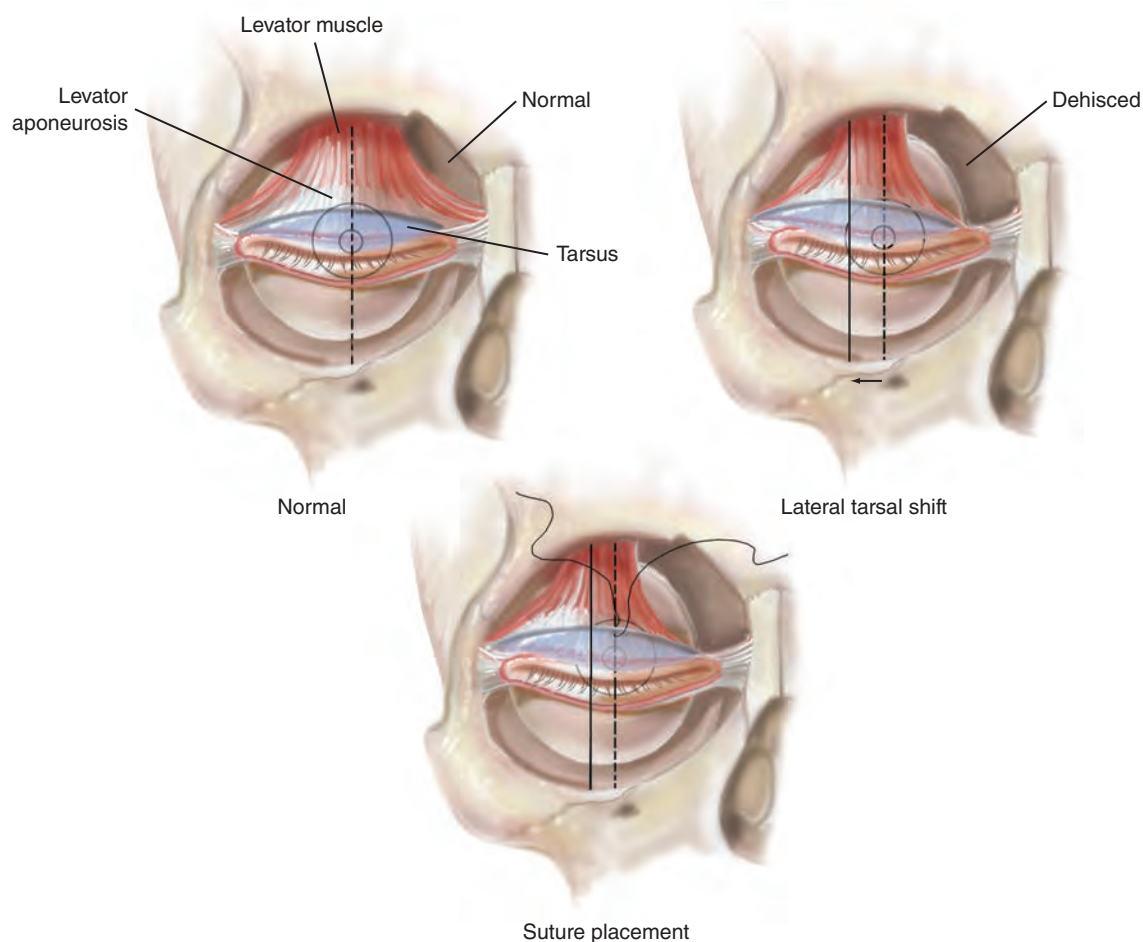
This illustration shows the normal levator on the left with its aponeurosis sending attachments to the anterior surface of the tarsal plate and to the eyelid skin to form the upper lid crease. With dehiscence of the levator aponeurosis, as seen on the right, the aponeurotic attachments dehisce, allowing the lid to relax downward and causing ptosis combined with upward pulling of the skin attachments; this produces a visibly high upper lid crease (unless there is severe dermatochalasis).



Persistent aponeurotic attachments to the upper eyelid skin may cause a characteristically high upper lid crease, depending on the fullness of the upper lid. In susceptible individuals, surgical trauma or the postoperative edema of surgery may cause levator dehiscence, resulting in postoperative ptosis, as seen in this patient.

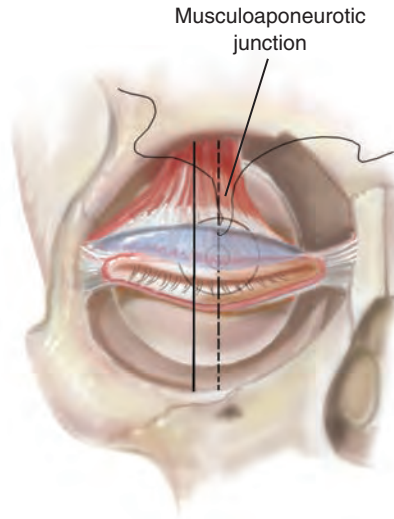
Correction of Ptosis

Ptosis repair can be performed in patients with preexisting ptosis while they are undergoing upper blepharoplasty, or it can be performed to repair ptosis, which may occur as a complication. The technique for ptosis repair in these patients is anatomic reattachment of the levator aponeurosis. A single suture is used for the attachment of the tarsal plate to the musculoaponeurotic junction of the levator. Other anatomic changes that commonly occur with age must be taken into account for proper contouring of the lid. With the use of the single-suture repair (double-armed 6-0 silk), suture placement must be in a vertical line with the midpupil near the superior edge of the tarsal plate.



The normal levator attachments and landmarks are illustrated. In most adults, because of dehiscence of nasal attachments of the lid, there is a lateral shift of the tarsal plate. To produce the desired contour in the upper lid, the required placement of the single lifting suture used in acquired ptosis (placed in the tarsus near the superior edge of the tarsal plate) must be in line with the pupil.

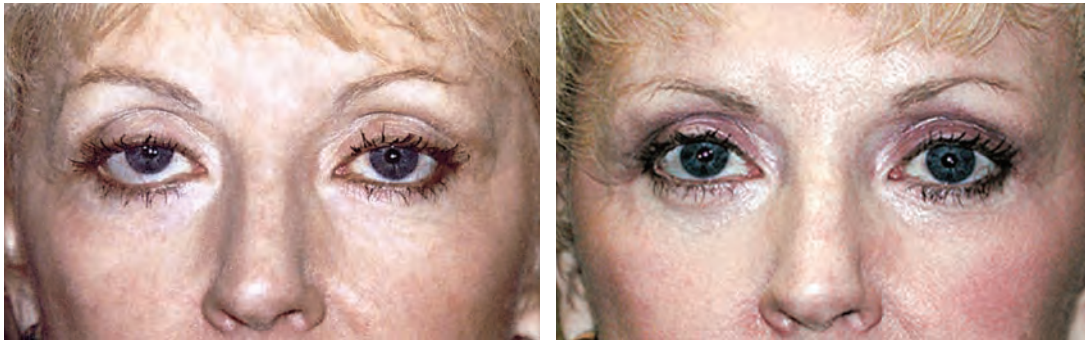
Suture alignment with the apex of the upper tarsal curve cannot be used because in patients of this age there is a lateral shift of the tarsus.



Placement of the lifting suture in the musculoaponeurotic junction of the levator muscle is illustrated. After suture placement in the tarsal plate, the suture arms are brought under the levator aponeurosis; the edge of the dehiscenced aponeurosis has been dissected free of Müller's muscle, and the suture is placed through the levator at the musculoaponeurotic junction.



In cases of bilateral ptosis, the anatomic placement of sutures should be symmetrical. Placement of the suture for ptosis at the junction of the muscular portion of the levator and its aponeurosis is illustrated.



This patient had bilateral levator dehiscence. She is seen after blepharoplasty and bilateral aponeurotic repair using the technique described. No secondary surgery for symmetry was necessary in this patient.

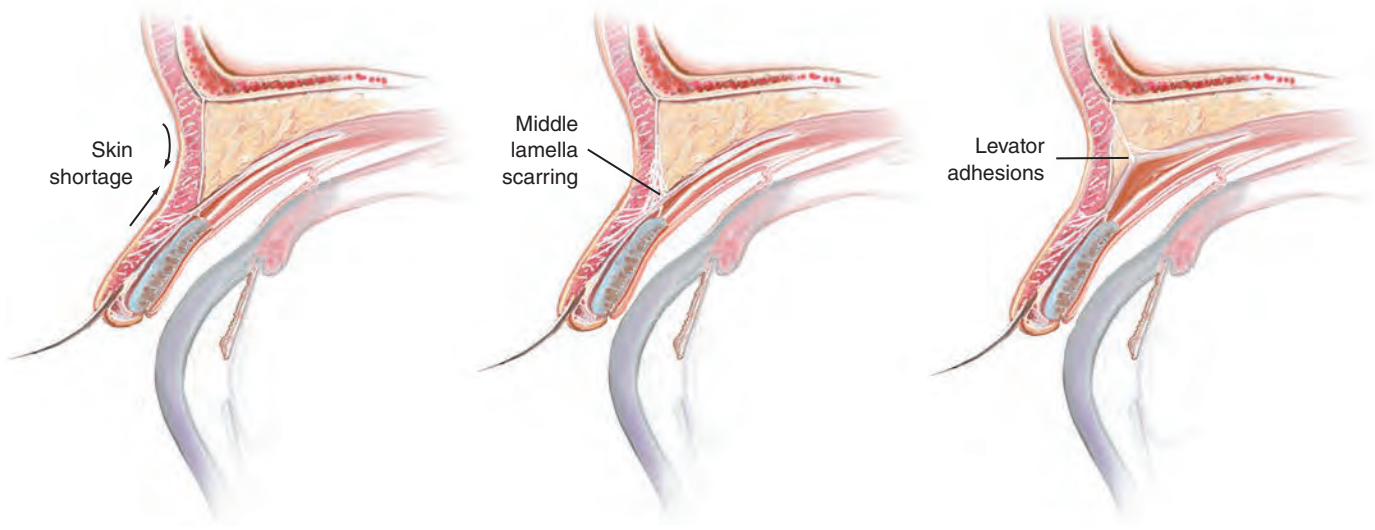
After suture placement and temporary tightening, adjustments should be made to ensure symmetry (in cases in which the ptosis is bilateral). This can be done under general anesthesia without patient cooperation. After the suture has been tightened, the intraoperative gapping of the lid fissure that occurs should be even between the lids. An additional test—the “spring-back test”—is needed to help achieve symmetry. When one of the upper lids is pulled closed and quickly released, the velocity of upward spring should be the same in each eye. If these adjustments are observed, in most cases there will be postoperative symmetry in the ptosis correction. Patients with unilateral ptosis may require postoperative adjustments.

Complications in the Upper Lid and Treatment of Postoperative Lagophthalmos

Poor upper lid closure after blepharoplasty can be attributed to these causes:

- Surgically induced upper lid stiffness
- Patients without stiffness, because of loss of lateral canthal anchoring
- Poor closure mechanics

Intrinsic upper lid stiffness can result from excessive skin removal causing skin shortage or from internal scarring.



The three possible areas of restriction are shown; these may cause lagophthalmos in the upper lid after surgery. In the top figure, poor closure resulting from a shortage of skin is represented, which, if it is not overcome by firm canthal reanchoring, will require skin replacement. In addition to a skin shortage, patients may have scarring of the middle lamella with adhesions of the orbicularis and septum to the superior orbital rim, as seen in the middle figure. These adhesions must be separated to restore closure of the upper lid. The most severe situation occurs when the levator is bound to structures at the superior orbital rim, as seen in the image on the far right. The levator adhesions can be released, but it is common to produce ptosis post-operatively in these patients.

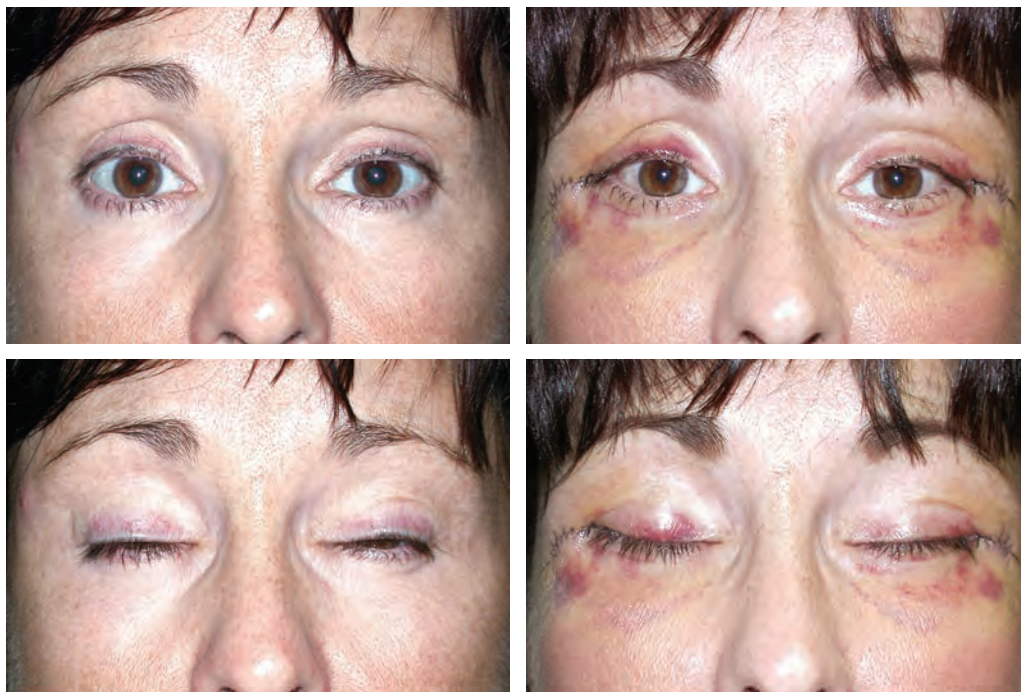
Corneal symptoms are more severe, with lagophthalmos occurring in the nasal half of the upper lid than in the lateral half, as mentioned earlier. The lateral half of the eye seems to be more forgiving of lagophthalmos because of lateral brow laxity.

Scarring in the internal structures of the upper lid, orbital septum, and fat pads (middle lamella scarring) produces lagophthalmos, which is more difficult to correct. Care should be taken to avoid scarring of the middle lamella by inappropriate cautery, particularly if the tissue is to be left behind in the upper lid. The orbicularis and orbital septum are best treated with excision using the open-sky technique as described earlier; however, one may leave varying amounts of orbicularis to avoid excessive crease formation, if indicated.

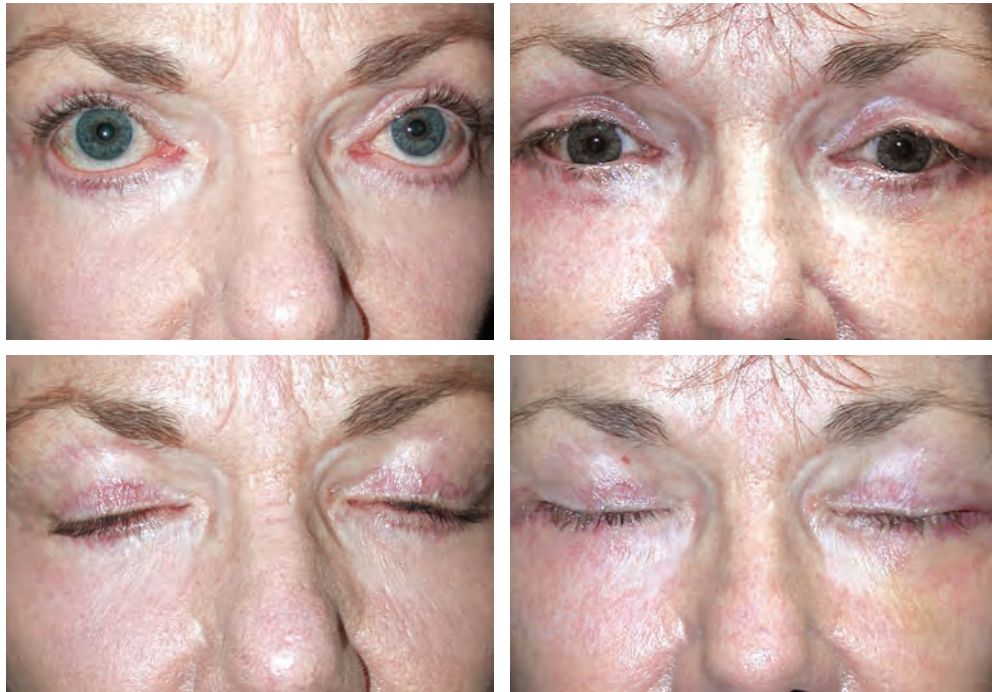
Approach to the Treatment of Upper Lid Lagophthalmos

Surgery in the upper lid directly to correct lagophthalmos after blepharoplasty can be problematic, because it usually requires skin grafts and can be upsetting to the patient who is undergoing a cosmetic procedure. Direct surgical intervention is restricted to patients who have vision-threatening problems and in whom all else has

failed. In patients with poor eyelid closure after blepharoplasty, every attempt should be made to relieve the problem by first attempting corrective surgery in the lower lid. It is important to ensure that canthal anchoring is firm, because deficiencies in that area can significantly contribute to poor eyelid closure mechanics. When faced with definite upper lid tethering from skin shortage or internal scarring, the surgeon can reposition the lid upward by the methods described in the previous section to help reduce the exposure by narrowing the eyelid separation. This approach often precludes the need for direct surgery on the upper lids. Improvement in eyelid closure mechanics, preferably by drill-hole fixation, as described earlier, can overcome some of the resistance of a stiff upper lid and improve upper lid closure. This is particularly true if lagophthalmos is accompanied by the fish-mouthing effect, a sure sign of inadequate canthal attachment.

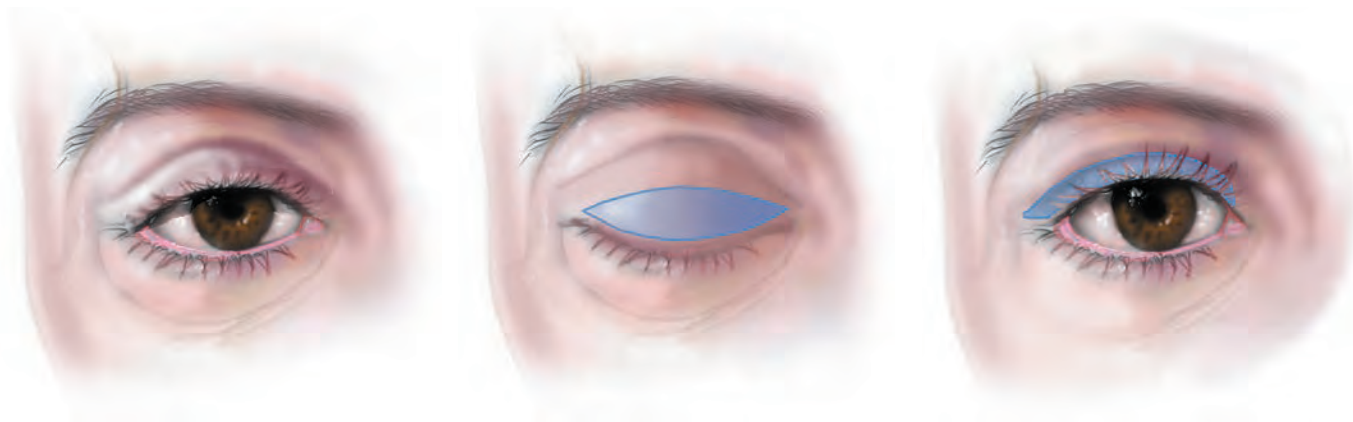


This woman is shown (*left*) after blepharoplasty with a reasonably normal eye fissure appearance but poor eyelid closure as a result of weakened canthal anchoring. On the right, the same patient is shown immediately after firm reanchoring of the lateral canthus with improved eyelid closure. The double drill-hole technique is indicated in such a patient if the eye is prominent.



This patient shows adequate restoration of eyelid closure with lower lid repositioning and canthal anchoring, even in the face of significant upper lid stiffness. She presented with retraction of the lower lid and lagophthalmos of the upper lids after blepharoplasty and laser resurfacing. Poor closure in the upper lids was caused by a skin shortage as well as canthal dehiscence, resulting in poor eyelid closure mechanics. After bilateral canthal anchoring with the use of drill-hole fixation of the canthal tendons, her situation is much improved. Lower lid repositioning was also performed with recruitment of skin, with orbicularis vertical reanchoring and spacer implants of autogenous dermis. No skin grafts were placed in the upper lid. Closure of the upper lid was restored by firm reanchoring of the lateral canthus and repositioning of the lower lid only. The upper lid stiffness resulting from the presence of a skin shortage was overcome by strengthening the eyelid closure mechanics by means of canthal reanchoring.

Only after restoring lower lid position and improving closure mechanics should one resort to direct surgery to the upper lid. However, some patients, because of the severity of upper lid stiffness from a skin shortage or internal scarring, may be improved by the approaches described but will still have inadequate closure and corneal exposure problems. In these patients, skin grafts to the upper lid are needed.



The proper placement of a full-thickness skin graft in the upper lid is illustrated for correction of lagophthalmos resulting from skin shortage. In most cases the skin can be released with an incision just above the lashes, allowing the skin edge to retract upward to the crease area. The graft can then be placed in the space between the lashes and the crease to maintain a standard eye shadow space and crease position.



This patient is seen after blepharoplasty (*left*) with extreme upper and lower lid retraction, poor eyelid closure, and corneal damage from exposure. The skin shortage in the upper eyelids was profound. The position of the lower lids was improved, with drill-hole canthal anchoring, but exposure problems were not totally eliminated. Upper lid skin grafting is needed. When skin grafts are indicated, they should be positioned so as not to alter the crease formation of the upper lid or disturb the aesthetic contours of the upper lid. Graft placement should not span the crease area, and grafts are best placed between the lashes and the crease or above the crease if a

second graft is needed. After the placement of upper lid skin grafts (*right*), this patient was able to achieve more normal eyelid closure. Middle lamella scarring was also encountered in this patient, and lysis of adhesions from the lid to the superior orbital rim was required.

In some cases, even after release of the skin between the lashes and the crease, the upper lid may still show resistance to closure. This is a sign of internal, middle lamella, or septal scarring, which requires release before the graft is placed. The patient on p. 1062 is seen after drill-hole canthal anchoring, a reconstructive cheek lift with autogenous spacers, and full-thickness skin grafts to the pretarsal area of her upper lids. She also had internal scar tissue adhesions in the middle lamella that required release.

Upper Lid Crease: Sulcus Abnormalities

The most common sulcus abnormality that causes distress to the patient is an excessively high upper lid crease or a hollowed-out appearance in the upper lid. Overzealous removal of fat from the upper lid in patients who are not used to a deep crease or do not want a high crease is a common cause of this problem and can produce an unwanted deep-set look. Even a standard amount of fat removal, if the eye is very prominent, can produce an unwanted high crease. Excessive removal of fat in the nasal third of the upper lid may produce a peaking of the crease in that area producing an “A-frame” deformity. Another uncommon but definitely occurring complication of aggressive fat removal in this area is injury to the superior oblique tendon, either by direct trauma or cauterization of bleeding in that area.

Restoration of fullness in these areas is difficult. The most fortuitous situation encountered is when there is still available preaponeurotic fat present in the upper lid that can be brought out and sutured forward to the crease area in the upper lid. An open incision through the orbital septum is necessary. This approach may not be available in many patients.

Attachment of dermis fat strips to the arcus marginalis for augmentation in this area has been helpful in some patients, but the possibility of tethering upper lid movement always exists if secondary fibrosis occurs and affects the levator muscle. Direct grafts that may adhere to the levator are ill advised.

An undesirable high upper lid crease can be seen in some patients with early dehiscence of the levator aponeurosis in which retraction of the aponeurotic skin crease attachments precedes the actual ptosis. In these patients, conservative repair of the levator aponeurosis may restore upper lid crease position and ward off an incipient true ptosis.

Clinical Caveats

Patients who have suspicious symptomatology or unusual findings on an eye examination, and those with a history of eye problems, should be evaluated by means of slit-lamp examination, tear tests, or consultation with an ophthalmologist.

The anatomic classification of the orbicularis into orbital, preseptal, and pretarsal orbicularis is convenient for surgical labeling, but a functional classification of the orbicularis into an inner canthal orbicularis and an extracanthal orbicularis should be adopted for better understanding of eyelid function.

Loss of eyelid innervation from the buccal branch of the facial nerve to the inner canthal area will cause profound changes in eyelid function, with reduction or absence of eyelid blinking, poor lower lid tone and position, and a weakening of the lacrimal pump mechanism causing tearing.

Firm anchoring laterally is needed for counterpull against canthal contracture to convert the vector of the blink movement into a vertical one for proper eyelid closure.

The skeletonization of the orbital rim area associated with age is a major contributor to the aging appearance in the midface area. Surgery that fails to address the eyelid and cheek area as an aesthetic unit falls short of producing a true reversal of aging changes in this area.

In persons with prominent eyes, a downsliding of the lower lid, scleral show, and enlargement of the lateral scleral triangle may occur. Proper canthal anchoring restores a more youthful look to the eye fissure by changing the shape of the fissure.

It has been shown mathematically that protrusion of the eye against the eyelid affects the shape of the eye fissure.

In cases of lower lid laxity, reinforcement with shortening of the lower lid is necessary.

In patients who have laxity of the tarsoligamentous sling, tightening only the orbicularis muscle will not correct internal lower lid laxity and can produce outward buckling of the lid because of the redundancy in the posterior lamella. Tightening of the tarsoligamentous sling itself must be performed.

The position of the lower lid changes in response to traction at the lateral canthus.

If skin shortage is a significant factor in lower lid retraction, vertical canthal anchoring of the inferior arc of the orbicularis muscle will recruit skin upward into the lower lid and will, in most cases, correct retraction without the use of a skin graft.

Spacer inserts in the lower lid (AlloDerm, ear cartilage, autogenous dermis) lengthen the posterior lamella and elevate the lower lid margin upward in patients with significant eye prominence.

Harmony of positioning with the upper lid and brow is of the utmost importance in terms of patient satisfaction.

It is essential to note the relationship of the upper lid margin to the pupil of the eye.

An important functional goal in upper blepharoplasty is that surgery should not compromise the strength and velocity of upper lid closure.

Lagophthalmos in the nasal half of the upper eyelid is not as well tolerated as lagophthalmos in the temporal half of the upper lid, either with symptoms or corneal changes.

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Annotated Bibliography

Codner MA, Wolfli JN, Anzarut A. Primary transcutaneous lower blepharoplasty with routine lateral canthal support: a comprehensive 10-year review. *Plast Reconstr Surg* 121:241-250, 2008.

This study reviewed the outcome of a surgeon's 10-year experience with primary lower transcutaneous blepharoplasty and lateral canthal support consisting of canthopexy, canthoplasty, and orbicularis suspension. The authors conclude that lateral canthal support should be considered a routine component of lower transcutaneous blepharoplasty to obtain the desired aesthetic result and maintain the natural appearance of the eyelid shape, and that the associated complication rate is acceptable.

Malbouisson JM, Baccega A, Cruz AA. The geometrical basis of eyelid contour. *Ophthalmol Plast Reconstr Surg* 16:427-431, 2000.

The authors derived a two-dimensional, frontal-view model of eyelid contour. After performing an observational study of palpebral fissure images from 110 normal subjects, they concluded that the parabolic shape of the upper ciliated contour seen in two-dimensional images can be justified geometrically in a simple way, allowing a precise quantification of its shape. The same was not true for the lower eyelid. The parabolic shape of the upper eyelid can be demonstrated, using the Taylor series, to be a close approximation of the arc of a circle.

McCord CD. The correction of lower lid malposition following lower blepharoplasty. *Plast Reconstr Surg* 103:1036-1039, 1999.

Lower eyelid malposition is the most common complication after lower eyelid blepharoplasty. When this problem occurs, it is imperative to correct the malposition by the most efficient method. The author presents methods for correcting minor as well as severe cases.

McCord CD, Boswell CB, Hester TR. Lateral canthal anchoring. *Plast Reconstr Surg* 112:222-237, 2003.

Any surgeon performing cosmetic or reconstructive surgery procedures on the lower lid or midface through the lower lid should be comfortable with canthal anchoring procedures. This article discusses the principles involved in canthal support for patients undergoing cosmetic and reconstructive surgery, variations in surgical techniques required to perform canthal anchoring in a variety of patients, the significance and techniques of canthal anchoring (canthoplasty and canthopexy) as they relate to cosmetic and reconstructive lower lid surgery, and the effect of canthal anchoring on the function of the upper and lower lids and eyelid fissure shape.

Pacella SJ, Codner MA. Minor complications after blepharoplasty: dry eyes, chemosis, granulomas, ptosis, and scleral show. *Plast Reconstr Surg* 125:709-718, 2010.

The authors discuss several of the most common minor complications, including hematoma, dry-eye syndrome, infections, atypical lesions, lid malposition, and scarring. In addition, preoperative assessment of risk factors, treatment, and management of these minor complications are presented.

Putterman AM. Regarding comprehensive management of chemosis following cosmetic lower blepharoplasty. *Plast Reconstr Surg* 124:313-314, 2009.

The author reports patient finger compression as an effective treatment method for conjunctival chemosis.

Weinfeld AB, Burke R, Codner MA. The comprehensive management of chemosis following cosmetic lower blepharoplasty. *Plast Reconstr Surg* 122:579-586, 2008.

This article focuses on chemosis associated with cosmetic lower blepharoplasty. The cause is multifactorial and includes exposure, periorbital edema, and postoperative lymphatic dysfunction. The incidence of chemosis was 11.5 percent of the 312 primary bilateral lower transcutaneous blepharoplasties reviewed. Chemosis presented intraoperatively or up to 1 week postoperatively; the median duration was 4 weeks, with a range from 1 to 12 weeks. Associated etiologic factors included conjunctival exposure, periorbital and facial edema, and lymphatic dysfunction. Successful treatment existed along a continuum from liberal lubrication to ophthalmic steroid preparations and ocular decongestants to eye-patching to minor surgical procedures such as drainage conjunctivotomy and temporary tarsorrhaphy. In all cases, chemosis ultimately resolved.

Suggested Readings

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Credits



Figure, p. 52: WHO Surgical Safety Checklist, available at http://whqlibdoc.who.int/publications/2009/9789241598590_eng_Checklist.pdf. © World Health Organization 2010.

Figure, p. 61: From the Malignant Hyperthermia Association of the United States (MHAUS). Sherburne, NY: The Association, 2008. Available at <http://medical.mhaus.org/PubData/PDFs/treatmentposter.pdf>.

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Box, p. 62: Modified from the Malignant Hyperthermia Association of the United States (MHAUS). Sherburne, NY: The Association, 2010. Available at <http://medical.mhaus.org/index.cfm/fuseaction/OnlineBrochures.Display/BrochurePK/B5DBDF12-20C3-4537-948C098DAB0777E3.cfm>.

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Table, p. 271: From Fitzpatrick TB. The validity and practicality of sun-reactive skin types I through VI. *Arch Dermatol* 124:869, 1988. Copyright American Medical Association, 1988. All rights reserved.

Table, p. 272: From Baumann L. The Baumann Skin Typing System. In *Cosmetic Dermatology, Principles and Practice*. 2nd ed., 2009. copyright © The McGraw-Hill Companies, Inc.

Figures, pp. 306, 312 (*bottom*): From Matarasso A, Shafer D. Botulinum neurotoxin type A-ABO (Dysport): clinical indications and practice guide. *Aesthet Surg J* 29:S72-S79, 2009. With permission from Sage.

Figures, pp. 514-519, 521-524, 527-529, 530 (*top*): From Bensimon RH. Croton oil peels. *Aesthet Surg J* 28:33-45, 2008. With permission from Sage.

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Figures, pp. 608, 609 (*top*): From Hair transplant surgery, by Norwood OT, Shiell R. Copyright 1984 by Charles C. Thomas, Publisher. Reproduced with permission of Charles C. Thomas, Publisher, via Copyright Clearance Center.

Figure, p. 609 (*bottom*): From Ludwig E. Classification of the types of androgenetic alopecia (common baldness) occurring in the female sex. *Br J Dermatol* 97:247-254, 1977.

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Figures, pp. 970, 973, 979, 983, 985 (*top*), 987 (*top and center*), 989 (*top*), 991 (*top and bottom right*): From Rosenfield LK. The pinch blepharoplasty revisited. *Plast Reconstr Surg* 115:1405-1412, 2005.

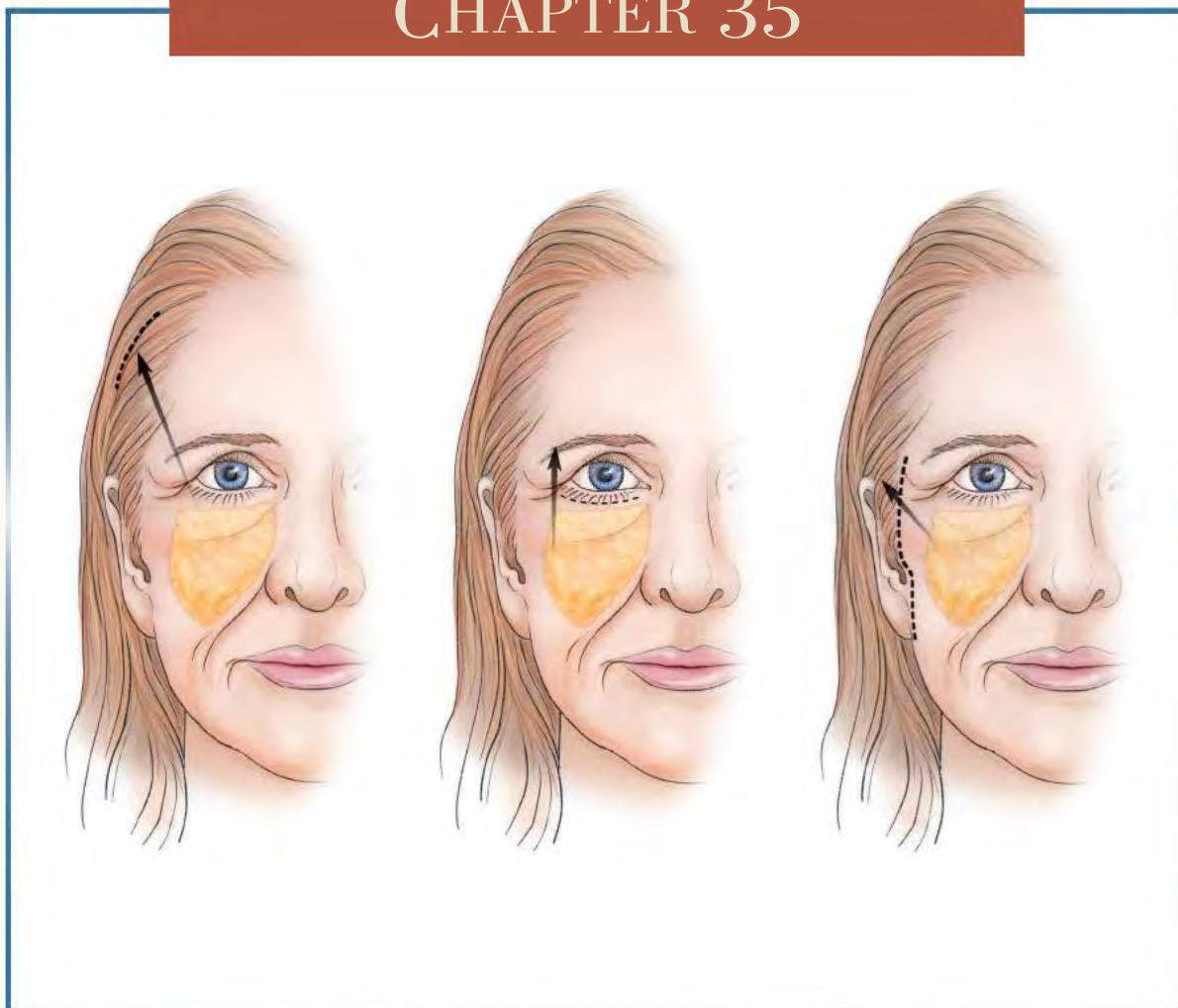
PART VII

MIDFACIAL REJUVENATION



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CHAPTER 35



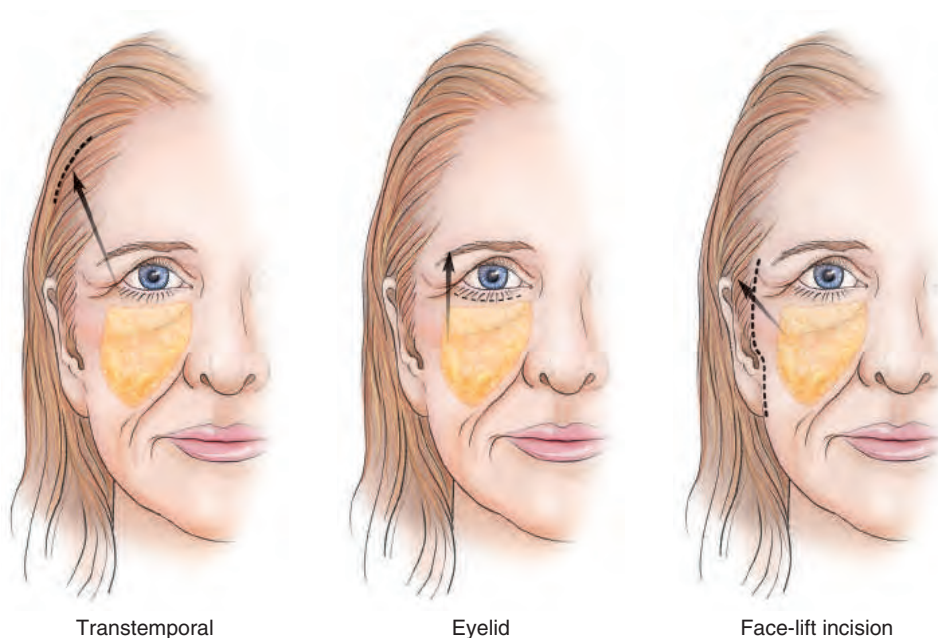
Clinical Decision-Making in the Midface

FOAD NAHAI

For most individuals, aging of the lower lid and midface is intrinsically interrelated; therefore the best treatment options rejuvenate both areas. There are many surgical and nonsurgical options for rejuvenation of the midface. The role of injectable fillers and fat continues to evolve but for most of us, rejuvenation of the midface is a surgical procedure.

Restoration of volume and repositioning of the malar fat pad is the foundation of midface rejuvenation. Approaches for surgical elevation of the malar fat pad include the following:

- Temporal approach
- Transpalpebral approach
- Standard or modified face-lift approach



Although all of these approaches elevate the midface, with the exception of the transpalpebral approach, the vector is usually diagonal. A true vertical vector of elevation is achieved only through the lower lid.

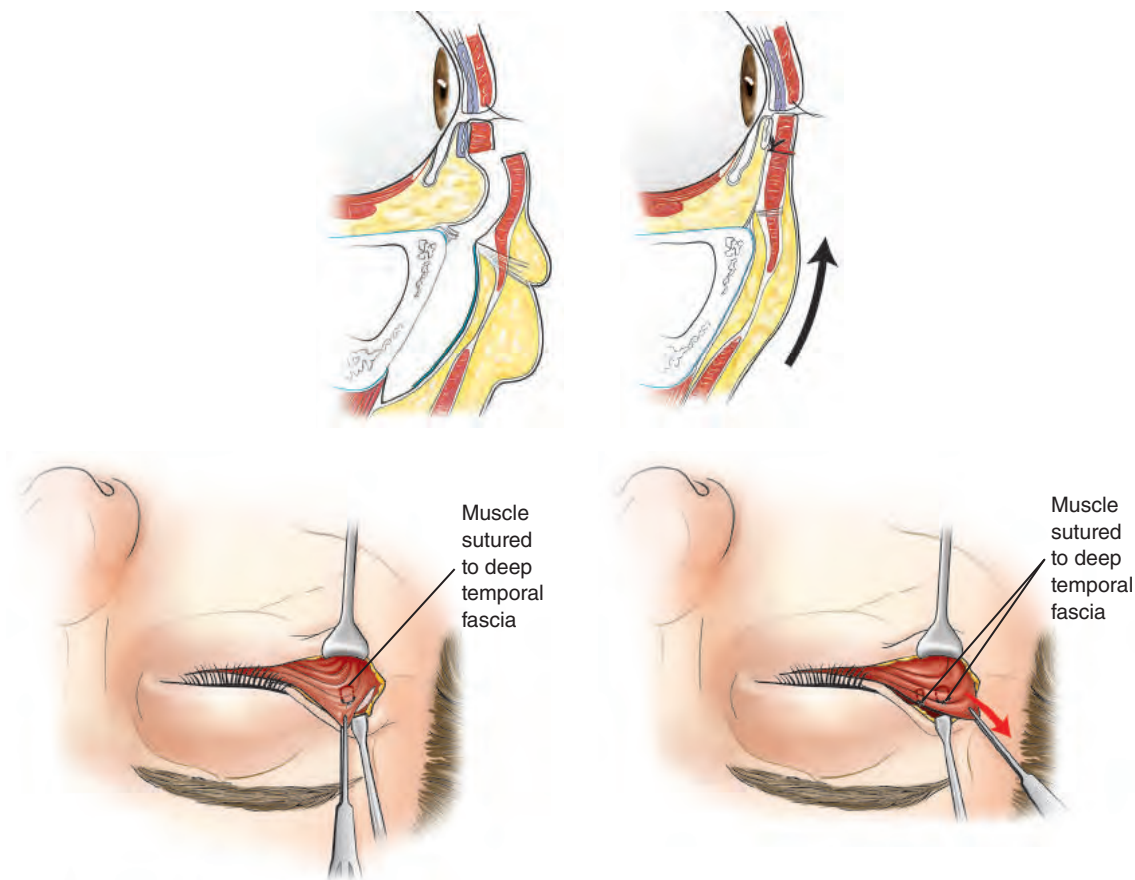
Temporal Approach

The temporal approach entails an incision in the temporal area and endoscopic dissection into the midface. Elevation and fixation of the midface are accomplished through long suspension sutures or fixation devices, such as the Endotine device (see Chapter 38).

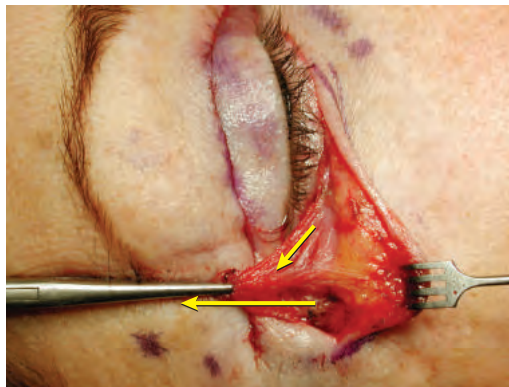
The advantage of the temporal approach is that the scar is well hidden within the hair. It is effective for elevating the midface (malar fat pad) and affords some blending of the lid-cheek junction. However, it only produces a diagonal vector for elevation of the midface and does not address aging of the lower lid or of the lower face. The temporal approach is best for individuals with isolated midface aging. It can be combined with blepharoplasty and a lower face lift in individuals with panfacial aging.

Transpalpebral Approach

This approach affords not only a diagonal vector but also the only true vertical vector for elevation of the midface, combined with lower lid rejuvenation. The major concern about this approach involves lower lid retraction. The approach can be modified to minimize the risk.



If manipulation of the lower eyelid fat is planned, a full-length skin-muscle incision is made and the skin-muscle flap elevated for access to the periorbital fat. The risk of lid retraction is minimized through the routine application of lid-anchoring techniques and a diagonal vector on the orbicularis oculi muscle to add extra support to the lower lid in addition to the aesthetic improvement.



Fixation vectors

If fat manipulation is not planned, a very limited incision is made laterally in the orbicularis, and midface mobilization is accomplished either with an endoscope, a headlight, or a small lighted Aufricht retractor. This alternative approach in which the orbicularis is not divided along the entire length of the lid carries a lower risk of lid retraction while offering the same vertical and diagonal vectors as the full open approach.

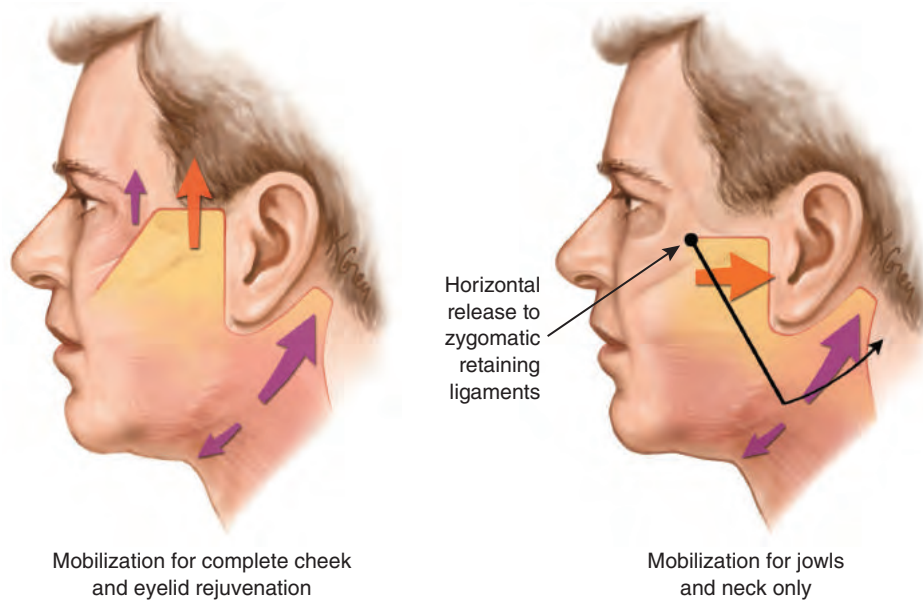
Face-Lift Incisions

Through the standard face-lift incision or the modified prehairline incision, the SMAS is easily accessed and can be manipulated to elevate the midface.

Surgical Options

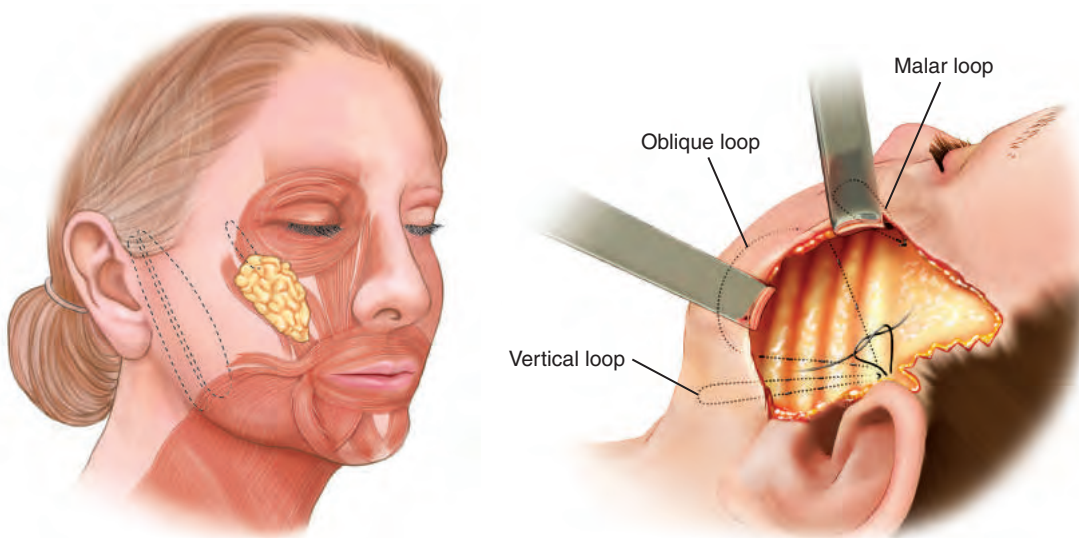
The high SMAS technique
The extended MACS lift
SMASectomy and SMAS plication

The High SMAS Technique



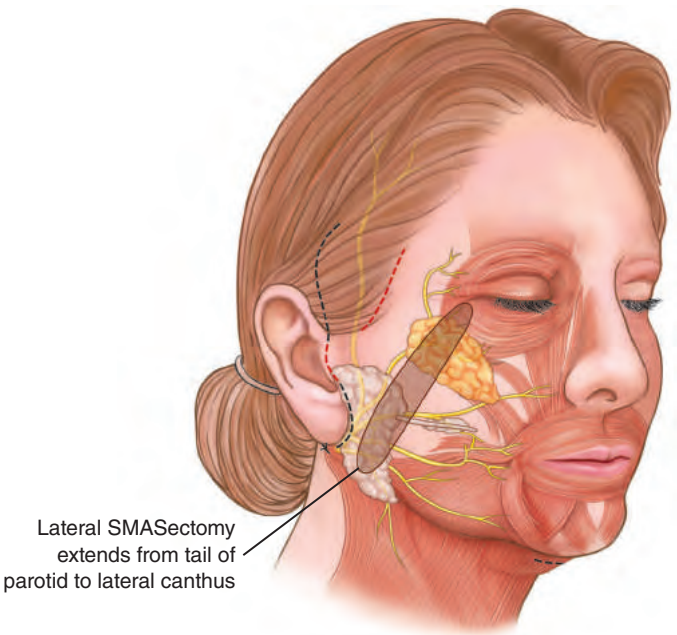
The incision in the SMAS at or above the level of the zygomatic arch combined with adequate mobilization of the SMAS facilitates effective elevation of the midface and malar fat pad with blending of the lid-cheek junction in a diagonal direction. When performed in isolation, it is not effective in dealing with the aging lower lid; it does, however, reliably rejuvenate the midface, lower face, and jaw line.

The Extended MACS Lift



The third and highest of the purse-string sutures described with the extended MACS-lift (see Chapter 42) effectively and diagonally elevates the midface with some blending of the lid-cheek junction. Tonnard and Verpaele combine this procedure with a skin pinch blepharoplasty to rejuvenate the aging lower lid.

SMASectomy



The upper part of the diagonal SMAS, when excised and sutured or plicated, does effectively elevate the midface with some blending of the lid-cheek junction. To fully rejuvenate the lower eyelid, the surgeon must perform a blepharoplasty to deal with the eyelid, skin, and orbicularis muscle.

Choosing the Best Option

For patients who require a blepharoplasty to address the skin, orbicularis muscle, and fat pads, the transpalpebral route offers midface lifting and full rejuvenation of the lower lid. If the lower lid rejuvenation requires only lid-cheek blending without extensive skin, muscle, or fat manipulation, the temporal and face-lift approaches are suitable options.

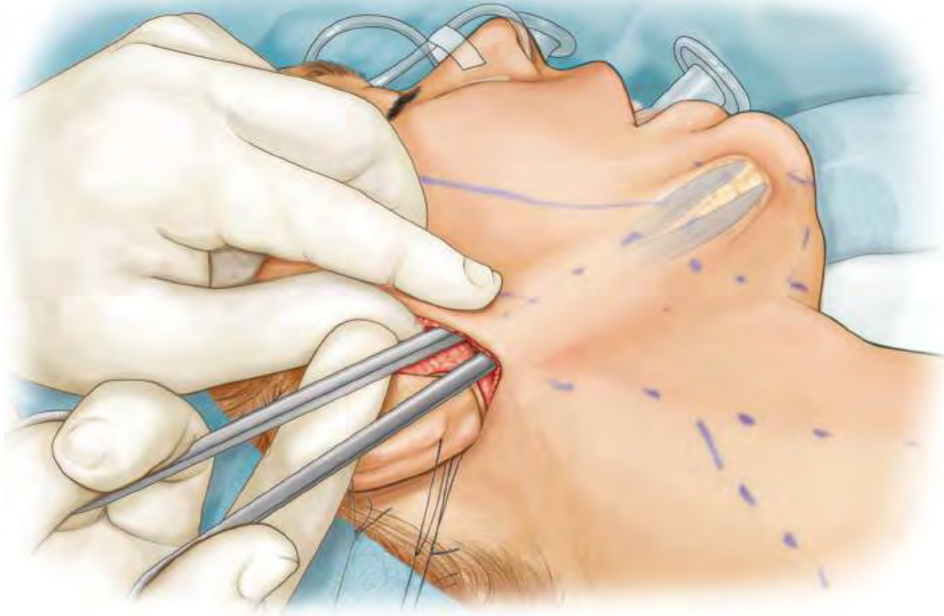
Choosing the Best Option						
	Vectors		Rejuvenation/Lift			
	Vertical	Diagonal	Eyelids	Midface	Lower Face	Jaw Line
Transpalpebral	++++	++++	++++	++++	—	—
Transtemporal	+	++++	++	+++	+	—
Face-lift approach	+	++++	++	++++	+++	+++

Although the transpalpebral approach affords a more direct midface lift with unlimited opportunities for eyelid rejuvenation, it is also the only approach that poses a risk of eyelid retraction and its consequences. Some surgeons think that this risk is not adequately offset by the advantages. The eyelid approach also involves longer recovery, as does any complex procedure in this area.

Alternative approaches involving the percutaneous insertion of barbed sutures have been advocated, but their efficacy and long-term outcomes remain in question.

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CHAPTER 36



Cheek Lift

JOEL J. FELDMAN

My approach to facial rejuvenation is a regional one. Out of 100 patients, I will perform a cheek lift without a neck lift in about 20, because these patients either do not need or do not want a neck lift. A good many will have already had the neck tended to one way or another, and now it is just the cheek that is in need of attention. Others simply find that for the first time a nasolabial or labiomandibular fold has become unacceptable, while the signs of aging in the neck still remain tolerable. Then there are others with only a small amount of soft tissue laxity in the submental neck that might well snug up nicely to an *isolated cheek lift* if it is done well.

On the other hand, in approximately 50 of every 100 patients that I operate on for facial rejuvenation, I will perform a neck lift without a cheek lift—the so-called *isolated neck lift*—because, in the same way, these patients do not need or do not want a cheek lift. Then in the remaining 30 patients, I will do a combined cheek lift and neck lift—a more conventional undertaking—commonly referred to as a *face lift*. In this chapter I will describe my approach to cheek-lifting—either done alone or as part of the cheek-neck combination. Either way, the surgical maneuvers I employ are the same. I have not included management of the neck in this chapter, because that material has been published in detail elsewhere.

Brief mention should be made here regarding the difference between a *cheek lift*, a *midcheek lift*, and a *lower cheek lift*. A *cheek lift* is, at its best, capable of correcting soft tissue laxity in all areas of the face—upper, central, medial, lower, and lateral. In that regard, a more accurate term for the subject of this chapter might well be the *complete cheek lift*. It is, of course, performed through a preauricular incision. The *midcheek lift*, on the other hand, is usually performed through a lower eyelid incision, and its surgical objectives are considerably more modest—namely, a resuspension of the slumping perimalar tissues in the area of the lid-cheek junction and upper nasolabial fold. That procedure would not be expected to produce very much, if any, improvement beyond the upper cheek. The *lower cheek lift*, as I envision it, is aimed primarily at improving the lower nasolabial fold and labiomandibular fold. It is often combined with a neck lift in patients who do not want or do not need an accessory lower eyelid lift or temporal lift (discussed later), so in those patients, I may do a little less flap undermining in the uppermost areas of the cheek.

Evolution of Technique

The Extensively Undermined Point-Tensioned Subcutaneous Cheek Lift

I completed my plastic surgery residency in 1976, the year that Mitz and Peyronie published their seminal paper on the anatomy of the SMAS, and only a few years after Skoog of Sweden had dazzled the attendees at the 1973 Baker-Gordon Symposium in Miami with a live demonstration of his new and revolutionary sub-SMAS

face-lift operation. Those two events produced a seismic change in the basic assumptions of face-lifting, and the old-fashioned subcutaneous flap technique that I had been taught became more or less passé. Most plastic surgeons thought that an undermining and lifting of the SMAS would make for a better face lift.

Soon, however, there were two kinds of SMAS lift procedures to choose from—a two-flap model and a one-flap model. The two-flap method employed a separate skin flap and a separate SMAS flap, each carrying about half the thickness of the subcutaneous fat. The assumption was that it was better to lift the malar and jowl fat attached to the SMAS in a more vertical direction than the skin with its attached fat, which was best lifted along the traditional vector, perpendicular to the nasolabial crease. That concept made sense to me, so a few years after starting out in practice, I decided to try the two-flap SMAS lift technique. I tried out several versions over a period of several years and found that with all of them, a thin SMAS flap often tore easily when I tried to suture it under tension. In addition, a thin skin flap in a thin patient at times had a precarious blood supply, particularly in patients who smoked. What's more, having two slightly different vectors of lift, one for the skin flap and one for the SMAS-fat flap, produced little if any noticeable benefit in my hands.

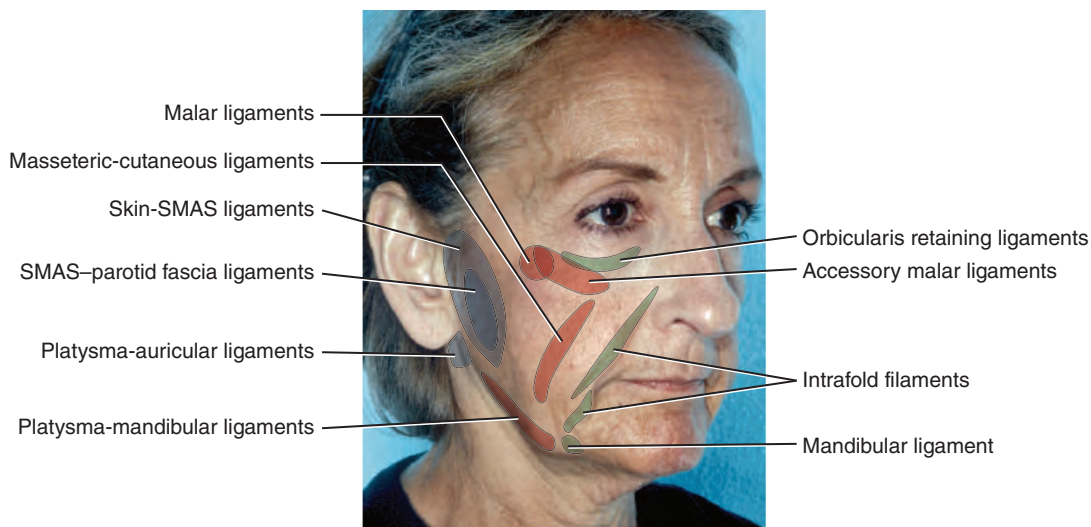
Then I tried the one-flap SMAS lift procedure, better known as the *deep plane face lift*, a technique developed by Hamra. I really liked that operation. The sub-SMAS dissection plane was nice and dry, with very little intraoperative bleeding and a very low incidence of postoperative hematoma, even after I had done an extensive medial undermining, which I learned was important in terms of consistently producing a high-quality result. In my modified version of the deep plane lift, I started the deep plane dissection 1.5 cm preauricularly. Then, along the lateral border of the zygomaticus major muscle in the upper cheek, where the SMAS becomes the invisible epimysium of that muscle, I entered the subcutaneous plane again to continue the dissection almost to the sidewall of the nose in the upper medial cheek and over to the nasolabial crease in the central medial cheek. In the lower half of the cheek, after releasing the sub-SMAS masseteric-cutaneous ligaments, I would break through the medial SMAS to enter the subcutaneous plane and then continue the dissection over to the corner of the mouth and the side of the chin. That change of tissue planes from superficial to deep and then back to superficial left the cheek flap with only a narrow jawline-based peninsula of SMAS on its underside. In reality, my deep plane lift had in large part become a subcutaneous lift.

However, the deep plane flap was thicker than the usual subcutaneous flap, providing a robust blood supply that allowed me to anchor it safely at multiple points under considerable tension—which I did—because I had become increasingly appreciative of the importance of holding the well-mobilized flap securely in the lifted position during the 6 to 8 weeks needed for solid healing to begin. Overall, my results with this modified deep plane lift were quite good, so I continued to use it in most cases for more than 20 years.

During that time, however, I also occasionally performed a subcutaneous cheek lift—mostly on patients with chubby cheeks on whom I wanted a wide-open access for thinning of the subcutaneous fat and in patients who had had a previous sub-SMAS face lift and who at the time of a secondary lift were found to have a deep plane that was too scarred or distorted to allow me to continue safely at that level. But unlike the subcutaneous lift that I had done many years earlier, the subcutaneous lift that I was by then using incorporated three elements that I had learned from doing the deep plane lift were critical to a first-rate result.



One of those important factors was a very extensive flap undermining, as seen here, which was done to release all of the skin and fat-retaining ligaments and filaments in the medial cheek that might inhibit the unrolling of a nasolabial fold or labio-mandibular fold (*marked in red and green in the illustration below*).



The second important factor needed for a consistently good result using the subcutaneous cheek lift was a very secure fixation of the lifted flap to counteract, as much as possible, both the *stress relaxation* and *viscoelastic creep* of stretched skin, and the pull of gravity, which urged the flap to slide downhill along a yet-to-heal dissection plane.



The third important element was having a single point of flap fixation situated precisely at the convergence of all the important vectors of lift required for a complete cheek lift—the vectors needed for improvement of the upper and lower nasolabial fold, the labiomandibular fold, the jowl, and the jawline. That specific fixation point was located at the immobile periosteum over the lateral zygomatic arch just in front of the upper ear (*circled X*)—a particularly safe place for a deep anchoring suture, well behind the frontal branches of the facial nerve. At that one point of flap fixation, a controlled amount of tension could be applied to the body of the flap—enough to hold the flap up securely—but not so much that it would compromise the blood supply of this skin flap that has a less-robust blood supply than the deep plane flap. Equally important, none of the tension on the flap itself was transferred to the skin incision line closure, so there was no forward traction on the ear, earlobe, or tragus, and the incision scars were able to heal kindly. In contradistinction to what some plastic surgery colleagues imagined, I found that placing a moderate amount of tension on the cheek skin flap did not at all produce a flattening of the facial plane.

After having acquired considerable experience using both the extensively undermined point-tensioned subcutaneous lift and the deep plane lift, a few years ago I thought it would be interesting to compare my results between those two methods. I looked at hundreds of preoperative and postoperative photographs of patients I had operated on using one method or the other, and although the analysis was far from scientific in its methodology, I came away with an unambiguous conclusion: at 1 or more years after surgery, I could not tell the difference between the results in the two groups of patients.



For example, the patient above and the one shown on p. 1085 are shown before and 3 years after surgery. The first patient (*above*) had a subcutaneous lift, and the second patient (*p. 1085*) had a deep plane lift. To my eye, the results are of equal quality.

However, the two procedures did differ in some other ways. Compared with the deep plane lift, the subcutaneous lift was a little easier for me to perform, and because the facial nerve branches were less vulnerable, the subcutaneous lift was also potentially a little safer (even though I never had a facial nerve injury using the deep plane method). And because the subcutaneous flap was not attached to the mandibular periosteum the way the SMAS-platysma layer usually is, it was often easier for me to smooth out the tissues along the jawline when performing the subcutaneous lift.



Furthermore, once I had adopted two simple technical maneuvers, the subcutaneous lift became nearly as “dry” as a deep plane lift, with a very low incidence of post-operative hematoma. With these considerations in mind, a few years ago I switched to the subcutaneous lift as my primary method of cheek-lifting.

One of the two simple hemostatic tactics I incorporated into the subcutaneous lift was to use electrocautery for a good deal of the flap dissection. The other tactic was aimed at avoiding the *late rebound bleeding* that is encountered when the local anesthetic solution contains epinephrine in the usual dilution of 1:200,000 to 1:400,000, which at times leads to the development of recurrent bleeding and possible expanding hematoma formation *after* the skin incisions have been closed. For that reason, for several years I completely eliminated the use of epinephrine (as advocated by Drs. Barry Jones and Rajiv Grover), which I found beneficial. Recently, however, I have begun to use epinephrine again, but now in a very dilute concentration of 1:4,000,000 (1 to 4 million), which seems to provide just enough vasoconstriction for an acceptably bloodless flap dissection, along with a short enough duration of vasoconstriction to allow secure hemostasis *before* the skin incisions have been closed.

When performing a subcutaneous cheek lift, occasionally I will imbricate the subcutaneous fat or the platysma-SMAS layer to fill in a volume-deficient area, such as a hollow submalar zone, or to improve the neck and jawline when I perform a cheek lift without a neck lift, as Little does routinely. However, in most cases, I do no plication of the subcutaneous fat or SMAS in the cheek. I have found that sutures that gather tissue together under the skin of the cheek can at times produce visible bumps and irregularities, distort the corner of the mouth, or create an asymmetry between the two sides of the face. At a recent symposium, Little and Baker, who both do no sub-SMAS flap dissection in the cheek, concurred that a subcutaneous fat or SMAS plication may produce a better-looking and longer-lasting result in many patients and that the disappointing track record of subcutaneous plication observed by Aufrecht, Tipton, and others many years ago could be attributed to the use of sutures that were too few in number, or too small in diameter, or were put in the wrong place. That said, perhaps I will do more subcutaneous plication in the future.

Adjuncts to the Cheek Lift: The Subgaleal Lower Eyelid Lift and the Subgaleal Temporal Lift



When the cheek is lifted upward and backward, excess skin often piles up in the lower eyelid and pretemporal areas. To blend the lifted cheek smoothly with the tissues in the periorbital area, and to prevent the so-called *lateral sweep* that Hamra described, I often perform an auxiliary lower eyelid lift and temporal lift.



This patient is an example of a cheek lift that was done with a complementary temporal lift and a lower eyelid lift. The temporal lift, in addition to preventing pretemporal skin bunching, nudged up the tail of the eyebrow and corrected the small amount of lateral upper eyelid hooding that the patient had. The lower eyelid lift consisted of nothing more than a simple skin excision superficial to the orbicularis oculi muscle and a transconjunctival removal of the excess lower eyelid fat. Because nothing in the eyelid was actually lifted, the apparent elevation of the lid-cheek junction (seen on oblique and lateral views) might better be termed a *virtual lift*.

I have come to appreciate that almost anything that I do that smoothes out the surface or the contours of the lower eyelid will make it appear as if the eyelid had been vertically shortened—whether through removal of excess eyelid skin alone, or a simple redraping of the eyelid skin without removing any skin, or a transconjunctival removal of excess fat alone, or a transconjunctival fat transposition alone to simultaneously improve puffiness and tear troughs, or some combination of those things. This observation is an important one, because for years now, many plastic surgeons have said that to elevate the lid-cheek junction, the surgeon must vertically lift the malar soft tissues as part of a SMAS face lift or as part of a transblepharoplasty mid-cheek lift, and I do not think that is necessarily true.

That said, there are many patients in whom I do a real vertical lifting of the lower eyelid by actually shortening and tightening the lateral orbicularis oculi muscle using a *muscle hitch* stitch or two. At times, I also tighten the lid margin horizontally with a *double-loop muscle-tuck canthopexy*. I will illustrate both of those maneuvers in the section on operative technique (p. 1118). But whether the eyelid lift is a real or virtual one, it is often an important component of a truly successful rejuvenation of the face.

As for the temporal lift, whose purpose is simply to lift the pretemporal skin and the skin at the tail of the brow and lateral orbital area, the question that is frequently asked is: why do it, as I do, by way of a subgaleal dissection, when a subcutaneous dissection would be more direct and more efficient? My answer has five parts. First, if the scalp incision were to be placed behind the hairline and a subcutaneous dissection were to be done, there is a small but real risk of alopecia. Second, I prefer to avoid a skin incision along the temporal or frontal hairline, where it may leave a visible scar. Third, excising hair-bearing scalp behind the hairline (which I rarely do with my temporal subgaleal lift) can noticeably elevate the hairline. Fourth, the subcutaneous plane in the forehead may not be an easy plane of dissection, and it is always well-vascularized. Obtaining a satisfactory hemostasis can take a good bit of time, and should a hematoma develop under a thin forehead skin flap, there is some risk to the flap's blood supply. Fifth, the sensory nerves in the lateral forehead lie on the surface of the frontalis muscle, and they can be easily injured during a subcutaneous dissection.

The subgaleal temporal lift that I do is quick and easy. It is performed under direct vision without the endoscope and takes about 15 minutes on each side. Alopecia, numbness, flap viability, and incision scar visibility are of little concern, and because I rarely remove skin, the position of the hairline is minimally altered.

Preoperative Evaluation and Indications

Making the case for a cheek lift is an interaction of subjective patient aspirations and objective physical findings that is done on a case-by-case basis. From my point of view, there are nine indications—each alone may be reason enough for a lift, but they often appear, naturally, in some combination: a bothersome nasolabial fold; an unattractive labiomandibular fold; wrinkled, sagging cheek skin; inferior displacement of the soft tissues from over the malar eminence; an age-related submalar hollow; increased visibility of the lateral infraorbital rim; a cluttered appearance to the jawline; a pronounced jowl; and a chubby lower cheek. Of course, the cheek lift may be combined with a neck lift, a temporal lift, a small-incision brow lift, a blepharoplasty, or some other ancillary procedure.

Patient Profiles



This 48-year-old woman was bothered by mild nasolabial folds and short labio-mandibular folds. When I lifted her cheeks with my hands during the preoperative examination to simulate the effects of a cheek lift, something I always do, those early signs of medial cheek relaxation were completely eliminated without producing an associated bunching up of the skin in the lower eyelid or pretemporal area. Her neck needed no intervention. Together we decided on isolated small incision cheek lifts and upper blepharoplasties.



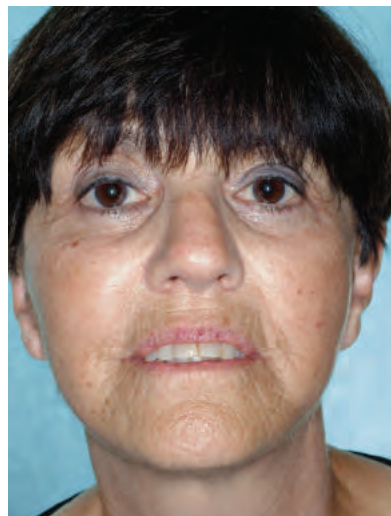
Preoperative



1 week postoperatively



Preoperative



1 year postoperatively

This 64-year-old patient was quite certain that she wanted a cheek lift without a neck lift because of the perceived complexity of the combined procedure. However, her lower eyelids were puffy and tired looking, so she acquiesced to having them rejuvenated at the same time. Because the preoperative simulated cheek lift produced skin bunching in the pretemporal area, I felt that a temporal lift was mandatory, as was an undermining of the skin of the neck just below the earlobe to prevent a vertical skin fold from forming there (see the description of the *pushup maneuver* in the section on the cheek-lift skin incision), both of which the patient also accepted. She understood that the cheek lift would not improve the wrinkle lines in her lips at all. The procedure that was done for her was an isolated subcutaneous cheek lift, along with a temporal lift, and a lower eyelid lift (a transconjunctival fat removal, a vertical *muscle hitch*, and a skin strip excision). The jawline skin was undermined 2 fingerbreadths below the lower mandibular border so the jowl could be trimmed under direct vision. She is shown 1 week (*top right*) and 1 year (*bottom right*) after surgery. All of the improvement in her neck resulted simply from lifting the skin in her cheek.



In the 5 years preceding her consultation, this 52-year-old woman observed a gradual downward drift of the tissues in her brows, eyelids, cheeks, jawline, and neck, which together bestowed a tired appearance. I performed a subcutaneous cheek lift, along with small incision endobrow lifts, upper blepharoplasties with ptosis correction, lower eyelid lifts, and a neck lift. The cheek lift restored a youthful fullness over the malar eminence, which can be seen as a more generous ogee curve (*yellow arrow*) on the postoperative oblique view. Although the cheek was actually lifted obliquely upward toward the upper preauricular fixation point along a vector perpendicular to the nasolabial crease, it seems as if the malar fat pad actually had been lifted vertically upward. The small jowl that was present preoperatively (*white arrow*) was also lifted obliquely upward as part of the cheek flap. However, I have found that if the jowl is any bigger than this small one, the most effective and stable treatment is a surgical trim of the excess jowl fat under direct vision, as was done for the previous patient.



This 58-year-old woman disliked her lower nasolabial folds and labiomandibular folds, her jowls, and the small wattle under her chin, but she was content with the appearance of her upper cheeks and periorbital areas. When I lifted her lower cheeks during the preoperative examination, the lower eyelid and upper cheek did not display a *lateral sweep*. Therefore a *lower cheek lift* was done in conjunction with a neck lift. No temporal lift and no lower eyelid skin excision were necessary—only a transconjunctival removal of some excess lower lid fat. A lower cheek lift is done using the same incision as that used for a full cheek lift, except that a bit less undermining is done across the upper malar zone and lid-cheek junction over toward the side of the nose than I usually do for a full cheek lift.



In some patients, recontouring the subcutaneous tissues is the component of the cheek lift that is most responsible for rejuvenating the face. In this patient, a carefully tapered excision of excess lower cheek and jowl fat was done under direct vision, which transformed the patient's lower face from a square shape to a more attractive and youthful-appearing oval.

At the preoperative consultation, patients often ask, "How long will the lift last?" I tell them, "The most unpredictable part of any face lift is the durability of the flattening of the nasolabial fold or the labiomandibular." In my practice, the average time is 8 years—but it can be as short as 2 to 3, or as long as 10 to 15. That's because there are three factors at play, and I can influence only one of them—which is how the surgery is done. The other two factors are genetically determined and out of our control: how easily the skin stretches back after it has been tightened, and

how well the scar bond that glues everything back together holds up. In some people that bond is tight and does not allow the tissues to slide downward again easily. But in other people, that scar is thin and slippery. So I turn the clock back, but then it starts to tick again, and how long it takes to get back to where we started is anyone's guess. That said, you'll still always look better and younger having had the lift than if you had not. For example, I may make you look 50 instead of 60, so when you're 70, perhaps you'll look 60; when you're 90 maybe you'll look 80. But I do not freeze you at 50." Most patients then say, "Okay, I get it."

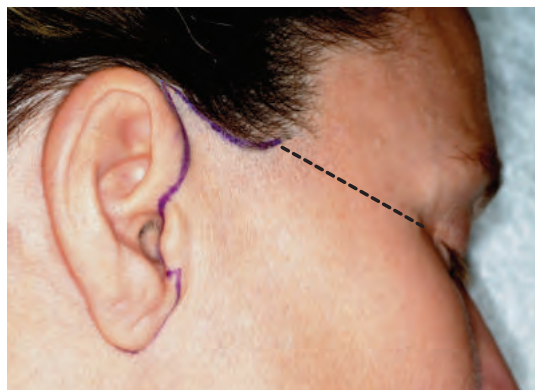
One last comment regarding the indications for various methods of cheek-lifting. If the patient is a smoker or has diabetes or some other kind of microangiopathy, or if there are scars on the patient's cheek that might interfere with the blood supply to the flap, then at the least I would perform a less-extensive undermining of the cheek flap and anchor the flap under less tension than I usually do. Or I might play it even safer, and elect to do a deep plane lift.

Sequencing the Procedures

I find it convenient to perform the temporal lift or endobrow lift first, before the cheek lift. If a procedure is to be done on eyelids, I first complete the cheek lift and neck lift to minimize the bruising around the eyes. A light dressing and/or cold compresses are applied to the periorbital area immediately after the surgery is completed.

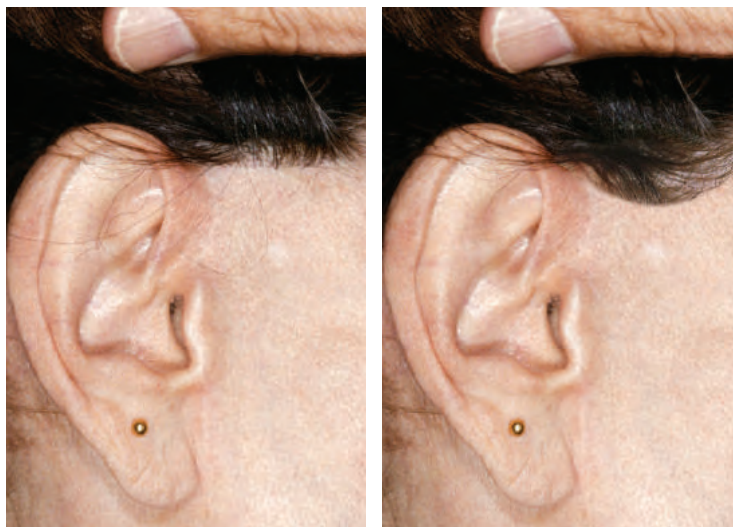
Planning

The Cheek-Lift Skin Incision



With rare exception, I use the same skin incision in every female and male patient. At the level of the lateral canthus, the marked incision runs barely above the lower edge of a short sideburn, or through a longer sideburn, in a lazy-S fashion that fol-

lows the natural sinuous curve of the hairline. I always place the lateral centimeter of the incision along the very top edge of the little hairless triangle that separates the sideburn from the front of the upper ear—not a little farther down, where some surgeons place it, because that little bit lower can make the scar visible if the hair there is pulled up. Placing the incision no higher than the lower edge of the sideburn rather than running it up into the temporal scalp prevents the sideburn and the hairless triangle from being shifted upward, which is an unnecessary and often undesirable result. With the design described, the cheek lift can be repeated any number of times with the sideburn and its hairline remaining in their original position.



Incorrect

Correct

It is best generally to avoid using the word “never” when talking about aesthetic surgery. However, in regard to cheek-lift incisions, there are some things I never do. In a first-time cheek lift in a woman, I never draw and cut the incision as a straight line, as seen here (*left*), which has produced a sawed-off, unnatural appearance. A straight incision can be acceptable in a male patient, either because the scar is hidden within an endless sideburn and would not determine its final shape, or because most men shave their cheeks in a way that purposely leaves a straight rather than curvy edge. In a female patient, a high, flat border seems artificial, and since it is just as easy to leave the patient with a nice U-shaped sideburn, as suggested in the photo (*right*), why not do that?

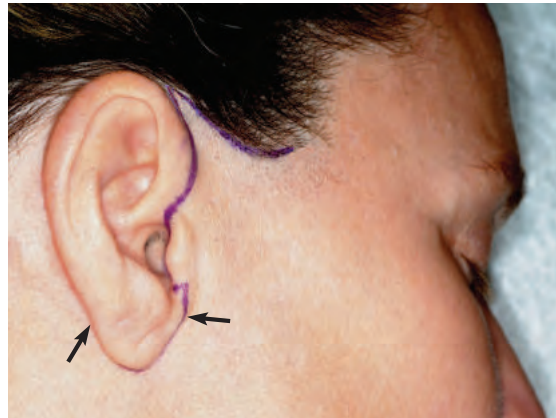


I also never put a new incision at the front of the sideburn—not even a little—unless there is one there already. One or 2 years after surgery, a mature scar along the front of the sideburn often will have turned white in color, making the scar visible and possibly bothersome to the patient, as it was for the two patients seen here. Because the direction of hair growth in the sideburn is backward, the hair there cannot naturally conceal a pale scar. I find that cutting a zigzag incision edge and placing it a bit behind the hairline for camouflage is not particularly helpful. And while other maneuvers, such as beveling the incision and foregoing the electrocautery to protect the hair follicles and melanocytes, thinning the trimmed edge of the overlying skin flap to allow the hair to more easily grow through the scar, and avoiding tension on the closure, do produce inconspicuous scars in some cases, those maneuvers are not always successful. For that reason I think it is best to avoid a scar at the front of the sideburn in every case, since there are other technical maneuvers that can be used that entirely obviate the need for an incision there.



I avoid a scar at the front of the sideburn by doing two things. First, I rely on the temporal lift to clear away any excess skin that the cheek lift may deposit in front of the sideburn (*left*). Second, I compromise just a little on the amount of vertical lift

I apply to the cheek flap by adjusting the flap's swing around its pivot point at the anterior end of the incision at the lower edge of the sideburn (*white X in the photo, right*). This sometimes shifts the flap's dog-ear from the front of the sideburn to the base of the earlobe, but I would rather chase the dog-ear behind the ear, where a short scar in the sulcus will be completely hidden, than chase the dog-ear to the front of the sideburn, where the scar might be visible.

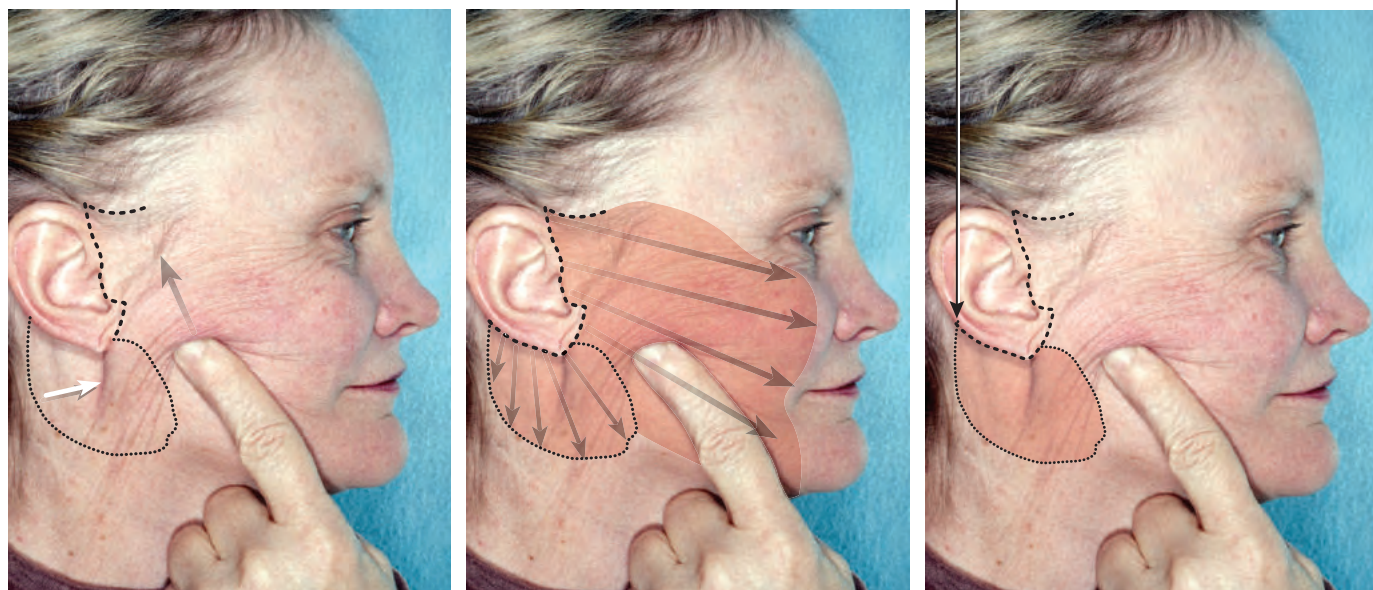


The incision may end at the anterior base of the earlobe or in the postauricular sulcus.

Below the sideburn, the incision continues downward, tightly hugging the front edge of the upper ear. Then it dips just behind the crest of the tragus (not on the crest) where it will not be seen. Even when I am doing a secondary or tertiary cheek lift, I almost always try to end up with a retrotragal incision scar. Usually I can create a small superiorly based transposition flap from the excess skin in front of the earlobe to swing over the tragus in reoperative cases. Pretragal scars may at times be hard to see, but they may also be noticeable—it's a roll of the dice. If a nice pretragal depression is created, and if the tragal flap is cut to fit, properly thinned, and set in place under absolutely no tension, a retrotragal scar is a much better choice than a pretragal scar in almost every case. Once in a while I will see a male patient for a secondary face lift who had a pretragal incision positioned along the posterior edge of his whisker line in front of the ear—something I personally would not do. But if that scar happened to heal imperceptibly, with an excellent color match, I probably would use that same incision again for the patient's secondary procedure to preserve the glabrous strip in front of the ear, but that is an unusual situation.

At the lower apex of the tragus the incision jogs out at a right angle for a few millimeters to create a definite visual endpoint to the tragus (an important detail described by Bruce Connell), and then the incision nestles into the crease at the top end of the earlobe. If I am performing an isolated cheek lift (that is, a cheek lift without a neck lift), the incision ends either at the anterior base of the earlobe or behind the earlobe in the lower postauricular sulcus.

Preoperative Pushup Maneuver

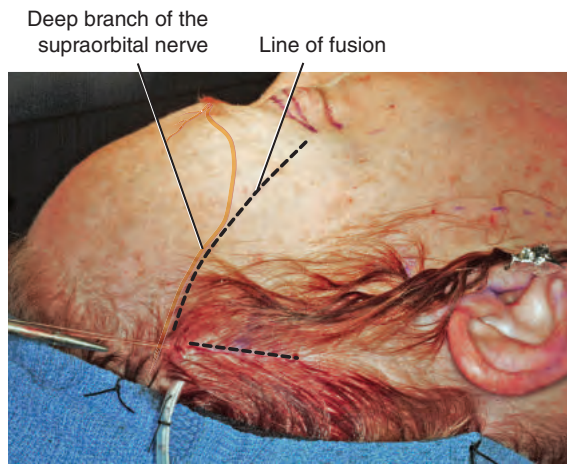


I can determine exactly where the isolated cheek-lift incision needs to end behind the ear using a simple preoperative test that I call the *pushup maneuver*. I put a finger on the lower cheek just above the angle of the jaw and push upward, simulating the effect of the cheek lift on the skin around the ear. Usually that pushup produces a vertical skin fold below the earlobe (*white arrow*). I draw a circle on the skin around that fold, which indicates the additional area of skin that I will need to undermine in continuity with the undermined cheek flap to redistribute the skin there (*center*). That will prevent a skin fold from forming below the ear when the cheek is actually lifted. It is obvious then to see how far up behind the ear the skin incision will need to run to easily and adequately release and redrape the skin within the outlined circular area.

Sometimes the preoperative pushup maneuver produces no skin fold below the earlobe, usually in a younger patient who has relatively snug cheek and neck skin to begin with, or in a secondary cheek lift case. In that situation, the cheek-lift incision can end at the anterior base of the earlobe without extending around behind the ear, which makes for a real *short-scar cheek lift*.

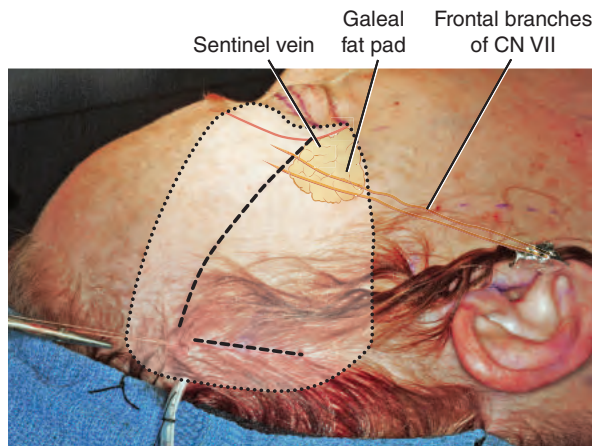
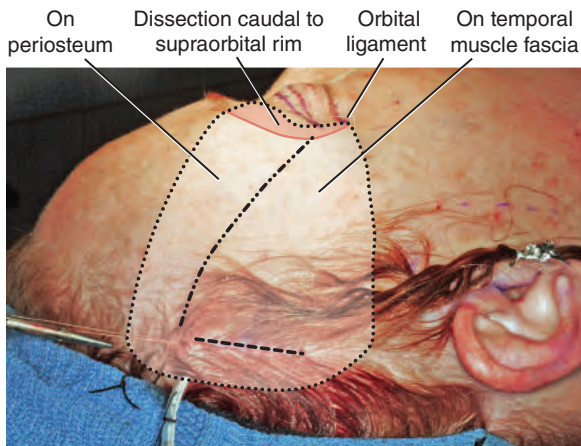
OPERATIVE TECHNIQUE

Temporal Lift Incision



The temporal lift incision is 3.5 to 4 cm long and is placed 2 to 3 cm behind the temporal hairline, with the central point located 5 cm from the superior otobasion, which places the medial end of the incision just lateral to the line of fusion and the path of the deep branch of the supraorbital nerve. The hair is parted but not shaved.

Subgaleal Dissection

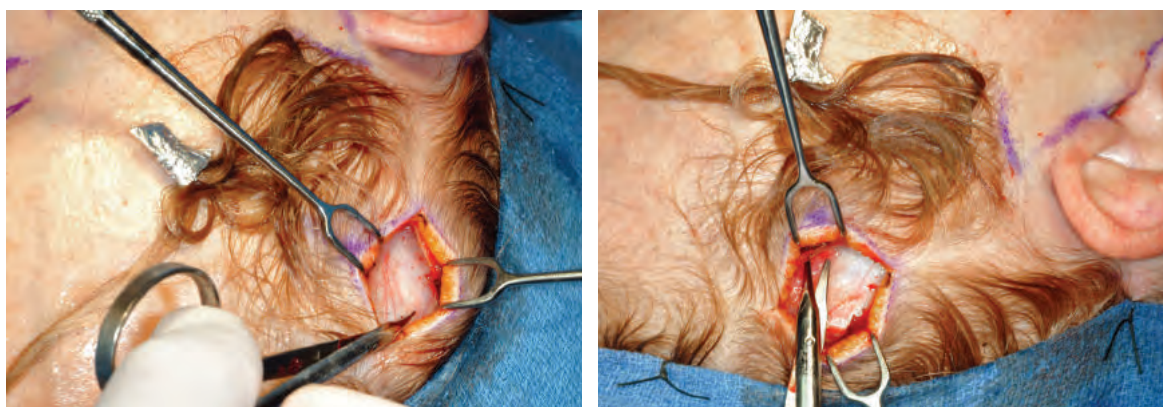


The area of the subgaleal dissection is highlighted above in white. To adequately release the tail of the brow for lifting, the dissection must break through the galeal attachments to the periosteum along the lateral orbital rim to enter the retroorbicularis oculi fat (ROOF) of the upper eyelid below the rim. The dense *orbital ligament* at the junction of the superior and lateral orbital rims should also be divided. The frontal branches of the facial nerve run within the galeal fat pad that hangs down from the ceiling of the dissection pocket. Therefore the lower portion of the pocket dissection should be done under direct vision, with the dissecting scissors staying

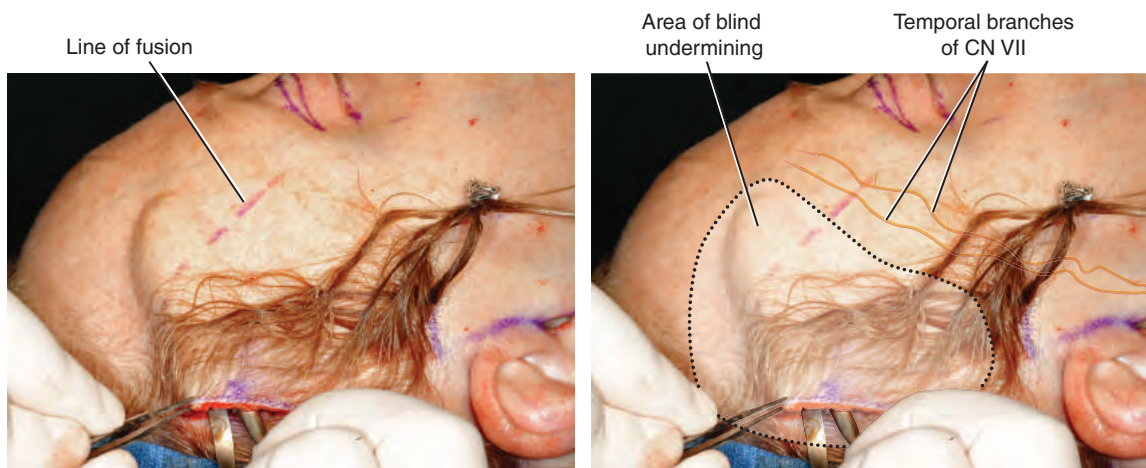
right on the surface of the white temporal muscle fascia and lateral forehead periosteum. The surgeon should appreciate that once the so-called sentinel vein has been reached, the scissors are close to, but also beyond, the facial nerve branches.



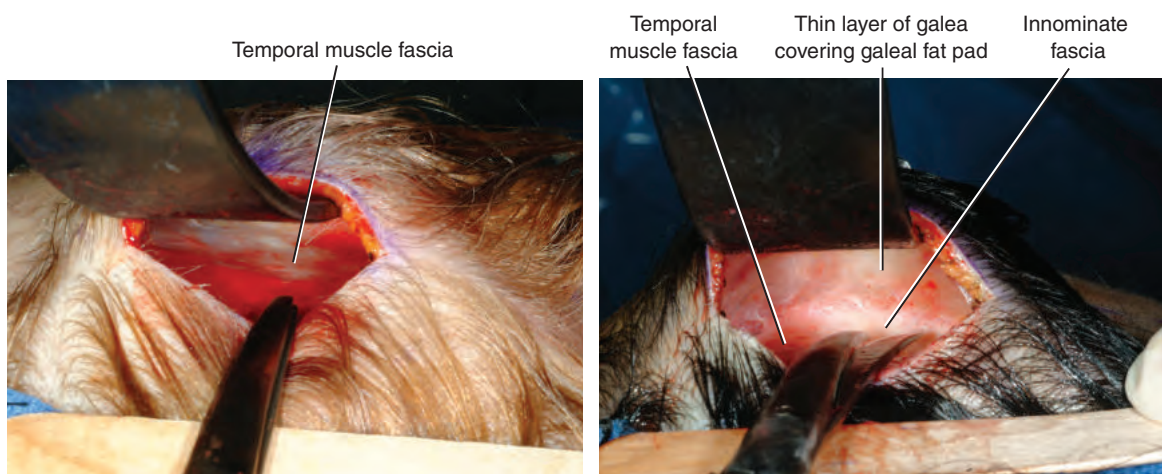
The local anesthetic solution I use for the face and neck is 0.25% lidocaine with epinephrine 1:4 million. The anesthetic I use everywhere in the forehead is 0.25% lidocaine with epinephrine 1:4,000,000 (1 to 4 million). I inject the solution into the subgaleal plane of the area to be dissected as well as into the skin and subcutaneous fat along the incision line and directly down to the periosteum along the lateral half of the supraorbital rim and the lateral orbital rim. The incision is made with the scalpel and then deepened down through the subcutaneous tissue and galea with microneedle tip electrocautery.



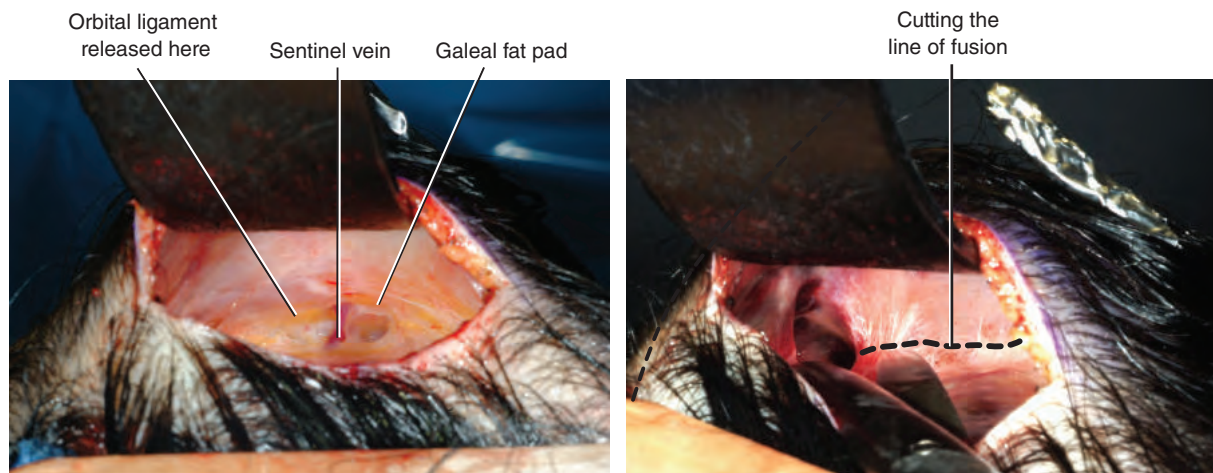
I undermine a few centimeters behind the incision (*left*) so the scalp can shift upward slightly to accommodate the lifted flap when it is hiked up, thereby avoiding a transverse hump, because I will be removing no scalp skin with this procedure. I then start the dissection downward (*right*) just on top of the temporal muscle fascia, using the little blunt-tipped iris scissors to push and cut through the wispy *innominate fascia* that lies between the galea and the white fascia covering the muscle.



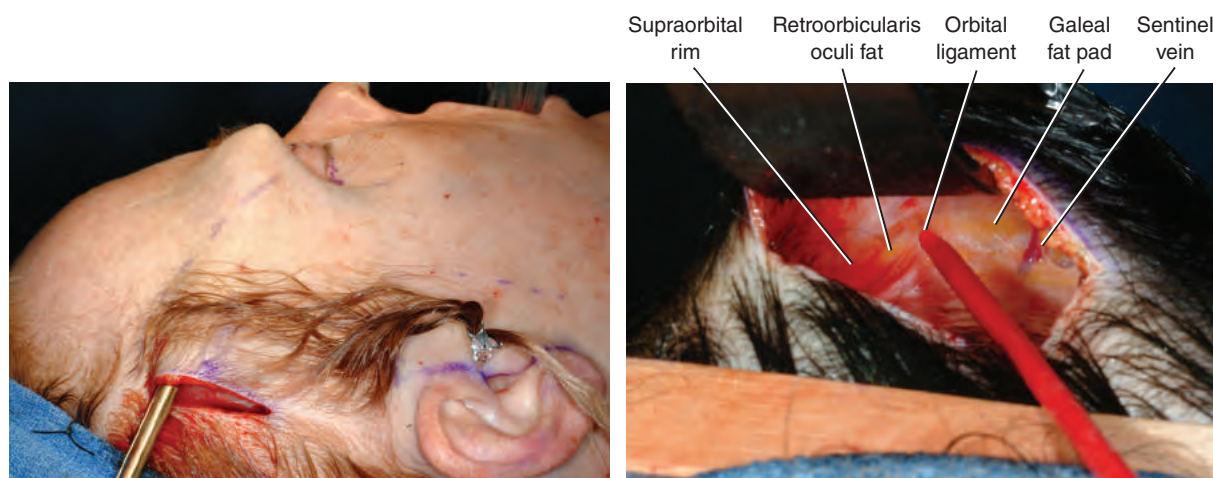
The little iris scissors are pushing and cutting through the line of fusion onto the lateral forehead periosteum. The extent of blind undermining is shown (*right*) about halfway down toward the supraorbital rim, but no farther, to avoid possible injury to the frontal nerve branches. Farther caudally, I dissect under direct vision until I reach the orbital rim.



With the back of the operating table tilted up, a long, narrow Deaver retractor inserted, and a xenon headlight for illumination, I gently spread horizontally and vertically with the long Metzenbaum scissors directly on the surface of the temporal muscle fascia, keeping the galeal fat pad above the tips of the scissors.



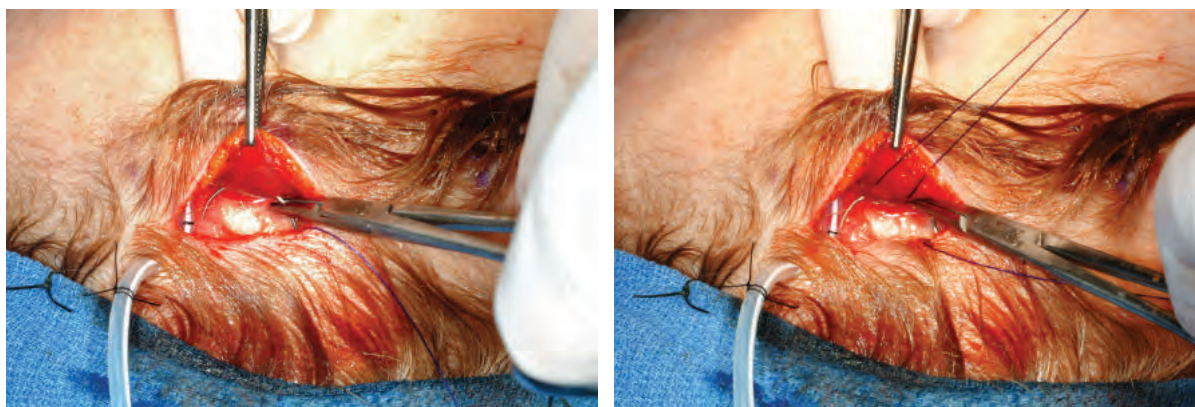
I also watch for the sentinel vein (*left*) so that I do not inadvertently cause it to bleed. It is usually seen 1 cm above the upper lateral corner of the orbital rim. In most cases I preserve the vein and work around it, but if it gets in the way, I cauterize and divide it. Farther medially in the pocket (*right*), I cut through the line of fusion, which I progressively divide as I extend the pocket downward over the lateral forehead to the bony rim.



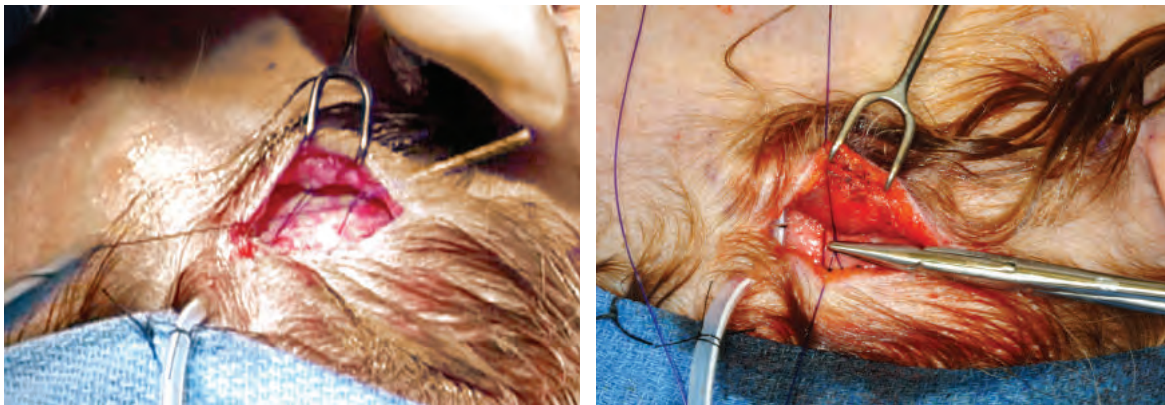
When I reach a point just above the supraorbital rim, I proceed with the dissection, looking down at the patient from outside the pocket. I spread the scissors open horizontally to tear through the galeal attachments to the periosteum along the lateral half of the supraorbital rim to enter the ROOF of the upper eyelid (*left*). Then I look into the pocket (*right*) to confirm the break-through. The long cautery tip indicates the location of the orbital ligament, which needs to be divided if the tail of the brow is to be lifted.



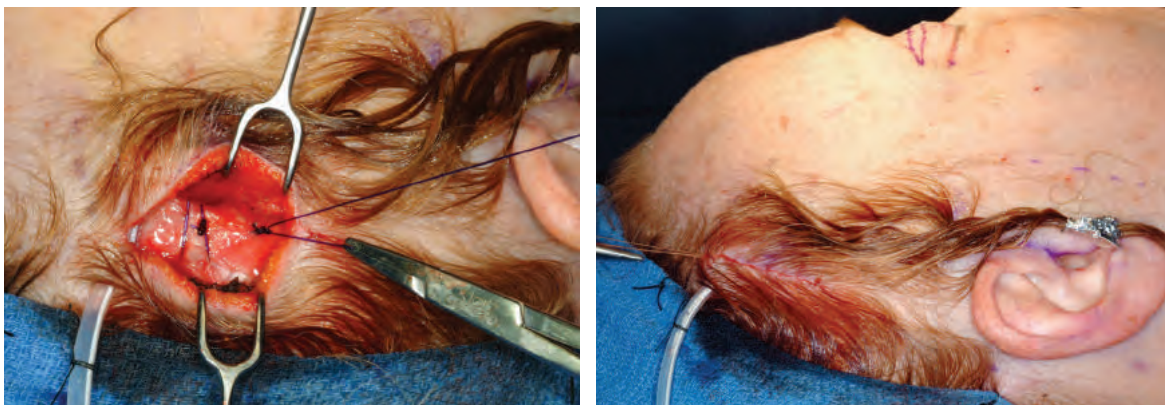
Sometimes I use the long cautery device under direct vision to open through the galea–periosteal adhesion and the orbital ligament with the aid of a thin suction cannula to aspirate the smoke so I can easily visualize the inside of the pocket. More often, I simply spread and cut blindly with the scissors over to the outside corner of the orbital rim and then around the corner (*right*) to be certain that any attachments there that could inhibit the lift have been adequately released. However, if the intention of the temporal lift is just to prevent lateral orbital and pretemporal skin bunching produced by a cheek lift while maintaining the position of the tail of the brow where it is, then of course, I do little if any dissection at the lateral orbital rim.



I always insert a suction drain. Then I grab the galea and a little fat securely with a small Kocher clamp, evert the flap over my fingertip, and take a nice deep bite of galea and subcutaneous tissue with a 2-0 PDS suture on a taper SH needle in the midportion of the flap about 2 cm from the edge. I find that it is easiest for me to put this stitch in backhand. Then I pass the suture a second time so that I have a generous double-loop bite of tissue that will not tear out when the suture is tied up under tension.



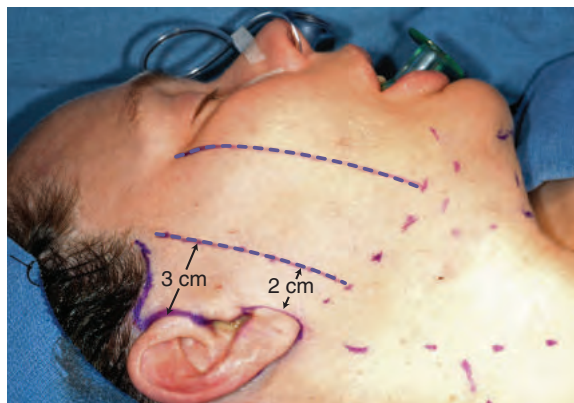
Next I take a big transverse bite of the temporal muscle fascia cephalad to the double-loop bite in the flap; then I tie this horizontal mattress suture up very tightly. To do this I grasp the short end of the first throw of the knot with a small needle holder and pull it straight upward toward the top of the head, while applying countertraction straight downward at the knot with the tip of my other thumb. When that first throw has been cinched up as snug as I can make it, my assistant grabs the knot with the tips of a smooth needle holder so it will not slip before I add the nonslip second square throw. Three more square throws follow. I have found that in most patients it is hard to overdo this temporal lift, because there is always a little downward settling of the tail of the brow as time goes on.



I put in one or two more simple nonmattress sutures laterally between the galea and temporal muscle fascia to increase holding power. For the closure (*right*), the cut edges of the galea are approximated with a running 3-0 Vicryl suture that is hemostatic and prevents scar widening, then the skin is closed with a running 4-0 plain catgut intradermal suture. The suction drain is usually removed after 24 hours. I have found that use of a drain significantly reduces periorbital ecchymosis.

Cheek Lift

Anesthesia and Markings



Next I move on to the cheek lift itself. I inject a solution of 0.25% lidocaine with epinephrine 1:4,000,000 (1 to 4 million) along the incision lines and into the subcutaneous tissues of the cheek. Of course, I also inject the subcutaneous tissues of the neck if I am going to be working on the neck. I then draw two vertical lines on the cheek, the first line 2 to 3 cm in front of the ear and the other line dropped down from the lateral orbital rim to the jawline. I use the cautery to elevate the flap out to the first line, then dissect with small scissors out to or somewhat beyond the second line. Beyond that, I use a combination of cautery and scissors dissection into the far medial cheek.

Flap Elevation



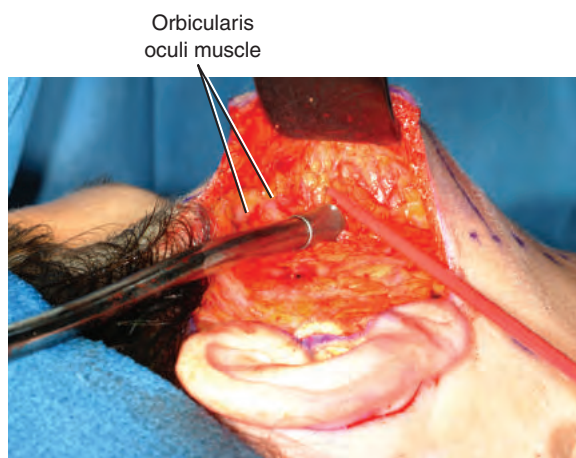
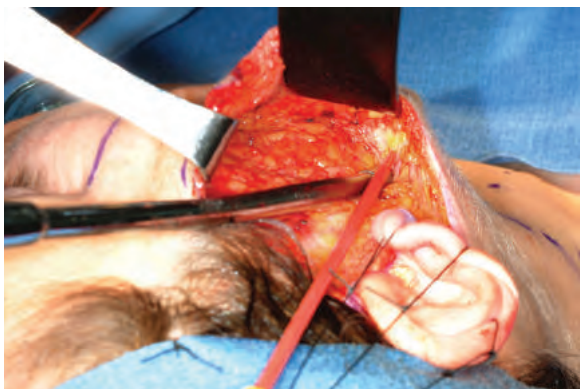
After lightly scoring the incision lines with the scalpel, I use the microneedle tip electrocautery on coagulating current to elevate the flap out to the first blue line without bleeding in the subcutaneous plane superficial to the SMAS; in the process the tragal cartilage is skeletonized and a pretragal depression is created.



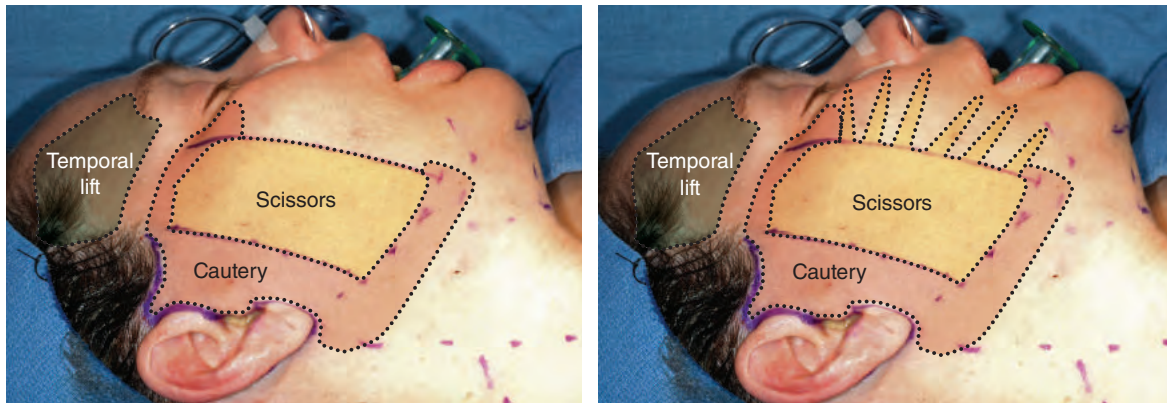
In the zone between the two vertical lines, where the skin is held down rather tightly by the lateral and central cheek-retaining ligaments, I use the little curved, blunt-tipped iris scissors (*left*) to first cut a little into the superficial subcutaneous fat under direct vision, then I perform the rest of the dissection using the *blind push-cut technique* (*right*), seeing the tips of the scissors through the skin, which keeps me from dissecting too deeply or too superficially. I have used this push-cut method of flap dissection for 35 years and find it to be the safest, easiest, and quickest way to elevate the flap.



It takes only a few minutes with the Yankauer suction and the long needle-tip cautery to obtain good hemostasis.



Next I undermine down to or somewhat below the jawline with the cautery, taking care to stay superficial to the SMAS-platysma layer. Then I extend the pocket superiorly with the cautery, staying just superficial to the orbicularis oculi muscle, which brings me well up into the territory of the lower eyelid.

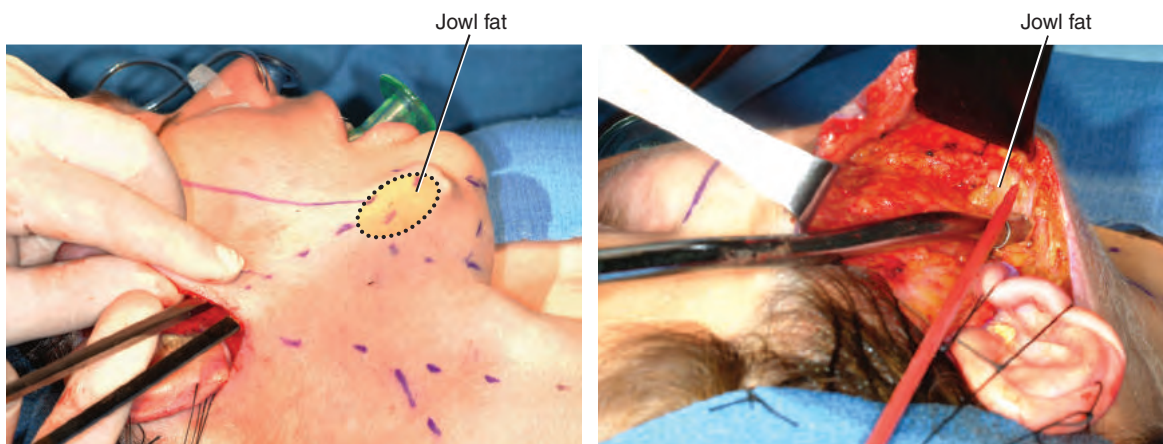


The overlay map (*left*) shows what has been done so far with the cautery and with the scissors. Then I use either short iris scissors or long Metzenbaum scissors to blindly make a series of tunnels just under the skin into the medial cheek (*right*), which again keeps me from dissecting too deeply or too superficially.

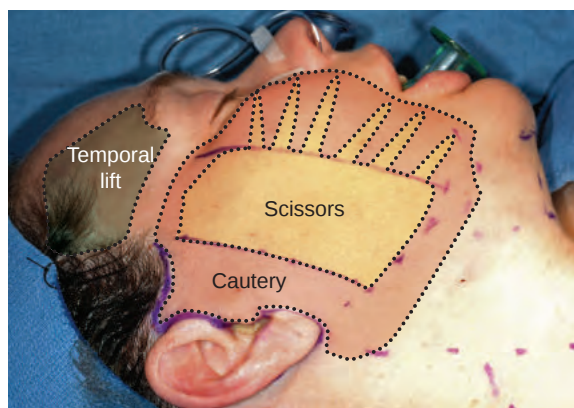


These tunnels extend almost to the side of the nose, nasolabial crease, corner of the mouth, and side of the chin.

Trimming Jowl Fat

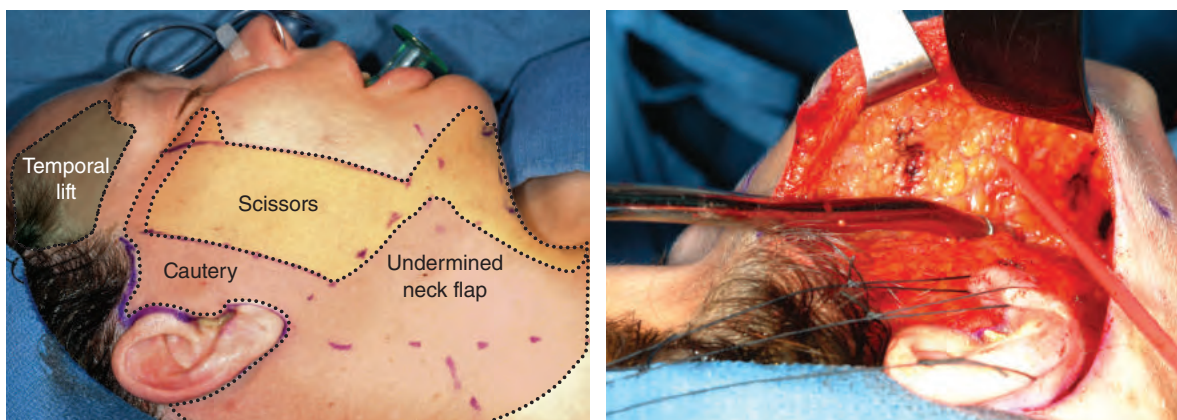


If there is jowl to be trimmed, I undermine the skin for about 2 fingerbreadths below the jawline with the scissors, leaving a 2 to 3 mm cushion of fat on the underside of the skin; then the excess jowl fat can be removed with the cautery after the medial cheek dissection has been completed.



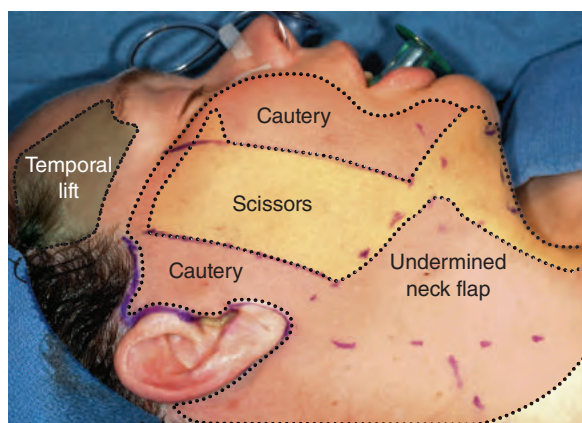
Isolated cheek lift

To complete the medial dissection of the flap, I connect the scissors-made tunnels with the cautery while looking inside the pocket and controlling whatever bleeding was instigated by the scissors dissection. The overlay dissection map above shows how the completed dissection is usually accomplished with cautery and scissors for an isolated cheek lift. Occasionally, however, if the subcutaneous fat in the medial cheek is soft and opens up easily and safely with cautery, I may do most, if not all, of the medial cheek dissection with electrocautery alone. At other times, I may do almost all of the medial cheek dissection with scissors, using the push-cut technique without first making disconnected tunnels.



Combined cheek-neck lift

When I perform a cheek lift with a neck lift, I usually wait to do the medial cheek dissection until after I have elevated the neck flap and joined the subcutaneous pocket in the neck with the subcutaneous pocket in the lateral two thirds of the cheek across the jawline. Once that has been done, the cheek flap tents up much more easily (*right*), allowing me to quickly and safely dissect all of the medial cheek using just the cautery, with no scissors. Thus there is no bleeding at all, even when the fat of the medial cheek contains a lot of fibrous tissue and is quite vascular.



This overlay map summarizes the dissection done with the cautery and scissors for a combined cheek-neck lift.

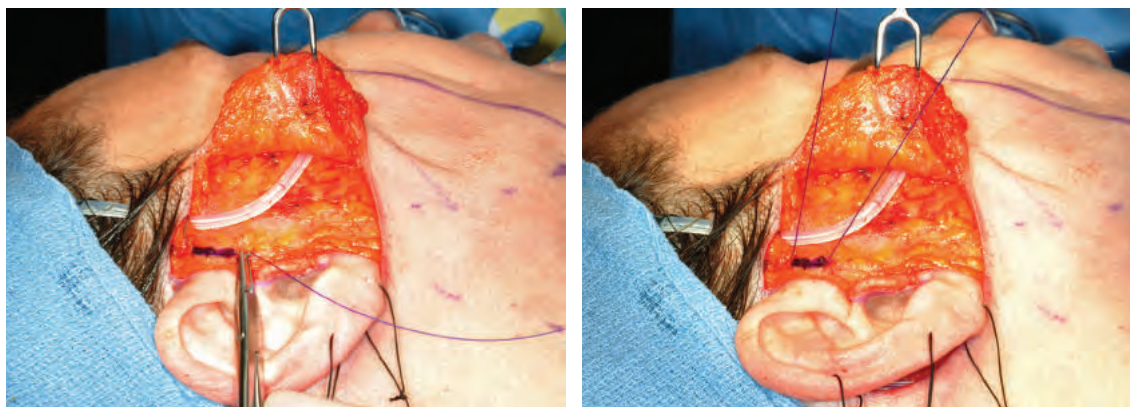
Flap Fixation and Incision Closure

My final assessment for hemostasis is done with the patient's blood pressure at or above his or her preoperative systolic baseline. If it is below that level as I near the end of the operation, titrated amounts of ephedrine are given intravenously until the patient's normal or supranormal level has been reached.

Regardless of how dry the wound may seem after that last look, I always leave a suction drain in each cheek. If I am performing an isolated cheek lift without a neck lift that does not require skin undermining below the earlobe or below the jawline, the TLS drain (size 10 Fr) that I use exits through the lower temporal scalp above the front of the ear and lies obliquely under the cheek flap with its end close to the corner of the mouth. If I do undermine the skin below or behind the ear or below the jawline with an isolated cheek lift, I place a second drain into the small infraauricular pocket that exits through the skin of the upper postauricular sulcus behind the ear. I've found that using one long drain that curls upward above the jawline to also drain the cheek area, placed into the small pocket below the ear, does not work very well. If either area should develop a collection of blood or a hematoma, resulting in occlusion of the single drain, the other area would also be deprived of drainage. Two separate drains are always better than one. When I perform a combined cheek and neck lift, I always use one drain for the cheek and another separate drain for the neck on each side. Cheek-lift drains are often removed 24 hours after surgery. Neck-lift drains, on the other hand, usually need at least 48 hours before removal.

I have listed here the objectives and considerations that I have in regard to the fixation of the cheek flap. Put simply—I want it tight, but not too tight:

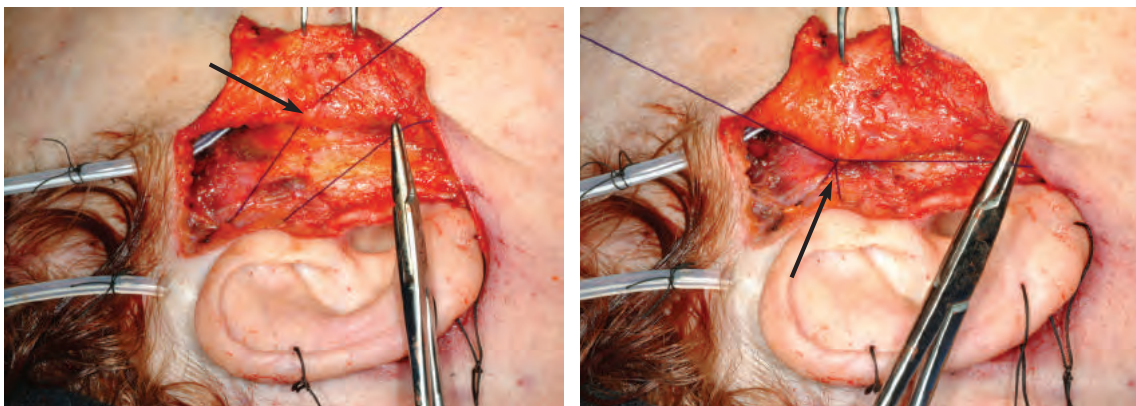
- Capture the benefit of the extensive flap undermining.
- Counteract elastic skin stretch-back and flap slippage.
- Hold the lift until solid healing has taken place.
- Place tension on the flap, but none on the skin closure.
- Avoid compromising the blood supply of the flap.



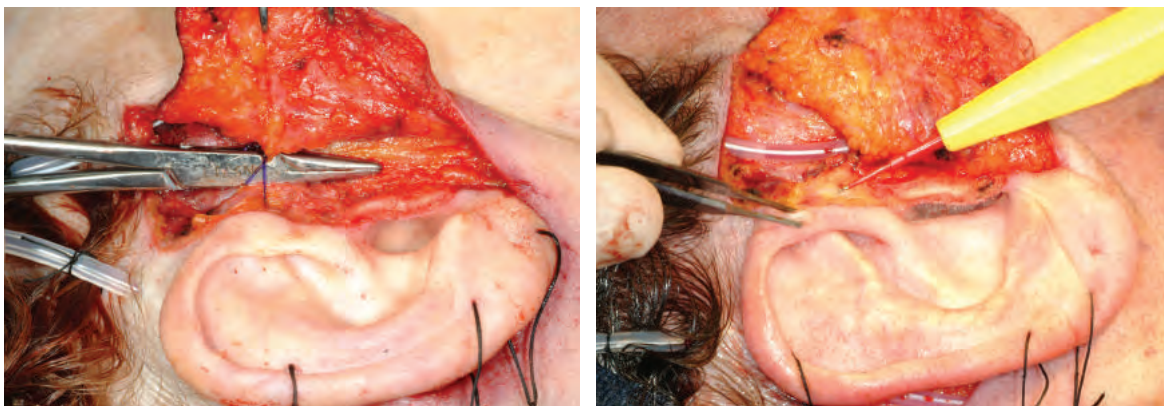
For the flap fixation, a 2-0 PDS suture on an SH taper needle is used. As shown (*left*), I take a deep bite where the blue line has been drawn, which should catch something solid, so that when I lift up on the suture (*right*), the ear does not move and I can tell that I am into periosteum and not just deep fascia.



The cheek flap is grasped with both hands, thumbs under the flap, index fingers on top. I pull the flap firmly backward and upward in a direction that makes the jawline and medial cheek tissues look their best, and I mark the place where the flap touches the fixation point with the tip of my left index finger. Then I turn the flap over, and at the tip of my index finger I take a small but solid bite of fat, along with a little deep dermis. I have found that I do not need a big bite of tissue here to keep the suture from tearing out when it is tied under tension.



An economical bite of tissue is taken into the lining of the flap (*arrow*). Because I make both passes of the suture needle in a forehead direction—one pass into periosteum at the fixation point, and the other into the flap—this suture is really a figure-of-eight stitch. I tie that suture so that the flap is pulled up quite snug, but I never cinch the knot down all the way. As can be seen (*right*), I purposely leave some space under the knot to prevent strangulation of the small blood vessels in the surrounding skin and to retain some play for final positioning of the flap, which I will want when I close the skin incision to avoid a dog-ear in front of the sideburn. In both photos above, notice that the cheek drain was placed under the flap before the fixation suture was inserted.



The needle holder has been placed beneath the tied suture loop (*left*). This one fixation suture functions as a very *short leash*—it does all the work of holding up the flap. I always release the tissue a little just under the skin edge in front of the upper ear with the cautery (*right*) to ensure that the ear has not been pulled forward at all by the anchoring stitch.



The skin incisions have already been closed, as shown, but before that, I examined the flap to see whether a skin dimple had been created by the fixation suture. A shallow dimple, like the one seen here (*arrow*), will not compromise the blood supply to the flap and will disappear in a few months as the fixation suture dissolves. If there had been a deep dimple or a blanched line in the skin radiating downward from the dimple, I would have known that I had either tied the suture too tightly, or taken too deep a bite of tissue on the underside of the flap. A deep dimple will often result in some superficial skin necrosis in its depth, leading to crusting and a little scarring, while a blanched line in the skin may well portend more extensive tissue loss. That being the case, if I see a deep dimple or a blanched line, I cut out the suture and insert a replacement, taking a bite in the flap that grabs less fat and dermis, then I tie the suture down less tightly, leaving a bigger loop below the knot. I have learned that a little less tension on the flap can avoid problems and will not noticeably diminish the quality of the result. Because this is a skin flap, not a thicker composite flap or SMAS flap that is hidden from sight, it cannot be safely tied up as tightly.

Before beginning the closure, I inject all of the exposed skin edges and the subcutaneous tissue on the underside of the flap a few centimeters in from of the flap edge with the lidocaine-epinephrine solution so there will be very little bleeding when I cut and trim the flap.



A small Kocher clamp grasps the top point of the flap and a second clamp grasps the upper crest of the small flap that once covered the tragus. The two clamps are fanned out and the flap rotated upward as much as possible without creating a dog-ear—not even a small one—at the front of the sideburn. A dot is made on the skin at the cephaladmost point of the preauricular incision (*arrow, left*), and the flap is cut down to that point. A curved line is then drawn on the skin (or in the surgeon's mind) that mimics the undulating lower edge of the sideburn, and the excess flap overlying the sideburn is trimmed along that line. The electrocautery is used to seal new bleeding vessels along the cut edge.



A 4-0 Prolene tacking skin suture has already been placed at the superior otobasion (*left*), and the excess flap overlying the earlobe is being carefully cut over to the lower apex of the tragus at the front of the ear so that there will be enough flap skin rotated upward to cover the tragus, while also leaving some excess flap at the base of the earlobe to allow a perfectly tailored inset.



Two or three small crescents of skin are carefully and incrementally carved from the flap just below and just in front of the earlobe (*left*) to allow the earlobe to sit comfortably in its normal position with the raw skin edge at its base abutting the raw skin edge of the just trimmed cheek flap without the help of any sutures. Nonetheless, I usually insert a stabilizing 5-0 PDS subcuticular suture there (not shown in the photos). Then the excess skin flap overlying the front of the ear is splayed out and pulled gently backward with the two small Kocher clamps, and while peering under the flap, I make a dot on the skin at the upper apex of the tragus, then cut the flap carefully down to that point, making small course corrections as I go. I do not want to overcut past the notch at the upper end of the tragus, because I do not want to create any tension at all on the skin closure at the front of the tragus.



The skin flap that will cover the tragus is then turned back and thinned by excising most of the underlying fat almost down to the dermis.



Small bleeding vessels under the thinned flap are judiciously controlled with the cautery, and a 5-0 nylon skin suture is placed above and below the tragus. I never use a buried suture at the front of the tragus to hold the flap into the pretragal depression; that suture could easily jeopardize the blood supply to the little flap and is entirely unnecessary. The flap will settle and stick down nicely on its own into the excavated hollow I made for it there. A small, curved skin flap is then designed and cut to drape over the tragus without tension. After I remove the excess skin there, I grasp any fat poking out from under the back edge of the tragal flap with a small forceps, and as I gently pull the fat out from under the flap, I trim it off with the small iris scissors while lightly pressing the blades of the scissors up against the undersurface of the flap. This thins the little flap safely just a bit more. Then the remaining excess skin flap draped over the front of the upper ear is trimmed away.

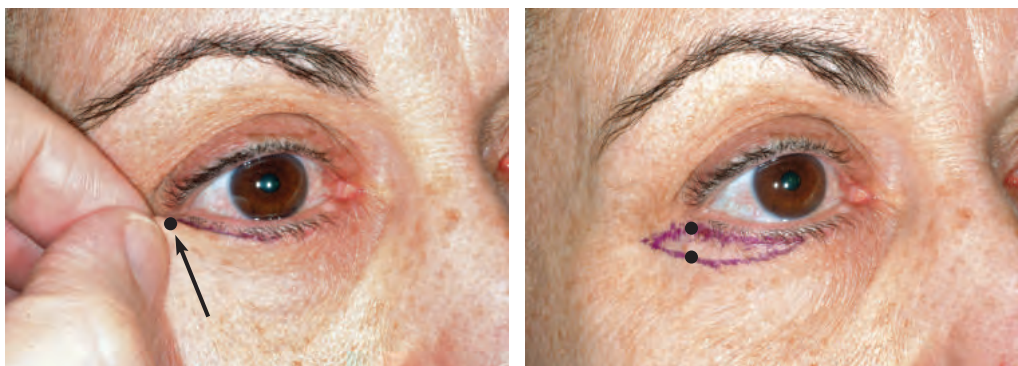


The entire periauricular incision line is then closed with a single running 4-0 plain catgut intradermal suture with the knots tied outside. If these catgut knots have not fallen away on their own by the first postoperative office visit 1 week after surgery, I snip them off at that time and remove the 5-0 nylon skin suture above and below the tragus and the 4-0 Prolene suture at the top front of the ear.

Lower Eyelid Lift

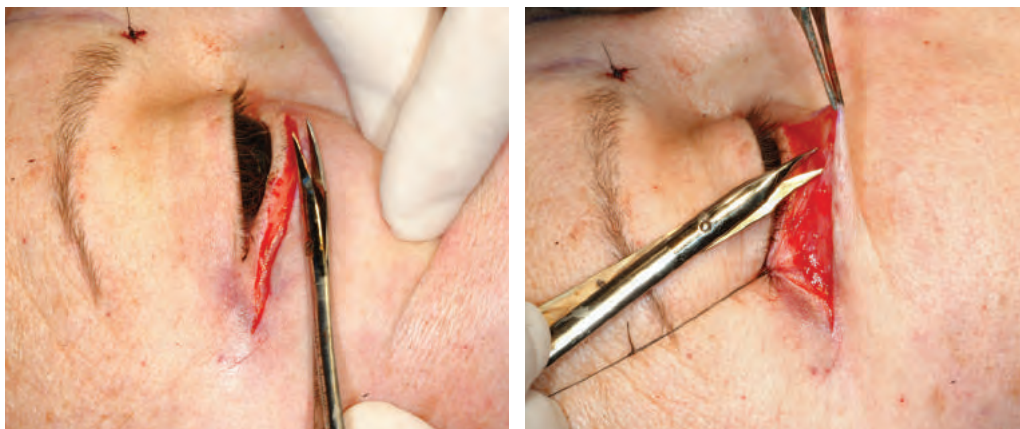
Now that the cheek lift has been completed, and perhaps a neck lift as well, I want to illustrate the lower eyelid lift that I so often do with the cheek lift. I have used intraoperative photos of several different patients for this sequence to ensure that each step is clearly demonstrated. However, I am not going to describe here how I manage excess lower eyelid fat, except to say that it is usually done by a transconjunctival removal; nor how I treat a bothersome *tear trough* at the lid-cheek junction, except to say that it is usually managed with a transconjunctival fat transposition. As a general rule, if I work on the eyelid fat, I approach it through the conjunctiva, and if I work on the eyelid skin or the orbicularis oculi muscle, I do that without cutting into the orbicularis oculi, not because I think that denervates the pretarsal muscle (I do not think that it does), but because empirically I have experienced a lower incidence of postoperative lid retraction problems if the integrity of the muscle is strictly maintained.

Estimating Amount of Lower Lid Skin Excision



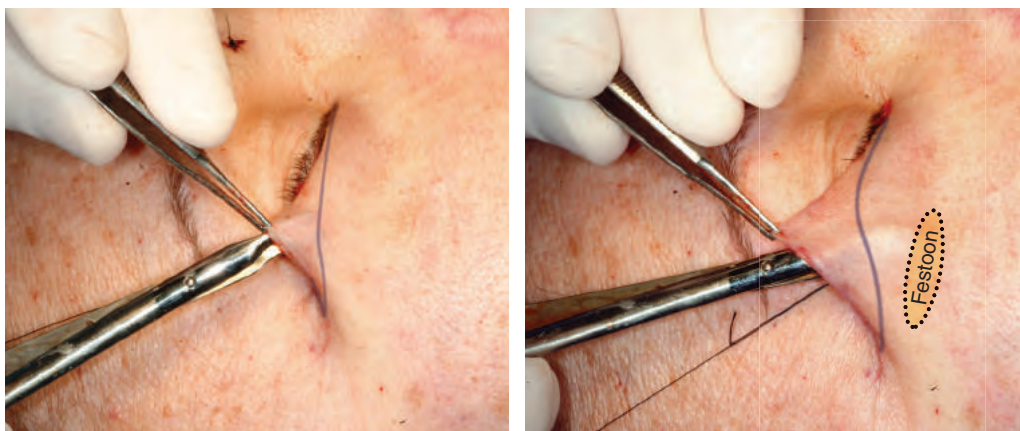
I like to estimate preoperatively the amount of skin that I am likely to excise. Lifting the lower eyelid skin with my fingers creates a skin fold just under the eyelash margin, indicating the required length of the subciliary incision. I then draw out that subciliary incision line, along with a short lateral limb that extends beyond the lateral canthus in one of the crow's-feet lines. The lateral eyelid skin is again pinched and lifted, and the excess skin is rolled under. Where the upper edge of the rolled-under skin touches the lateral canthal point, I make a dot with the marking pen (*black dot at the arrow*). Then the medial and lateral ends of the subciliary incision are connected with a gently curved second lower line that runs through the lower black dot.

Anesthesia and Incision

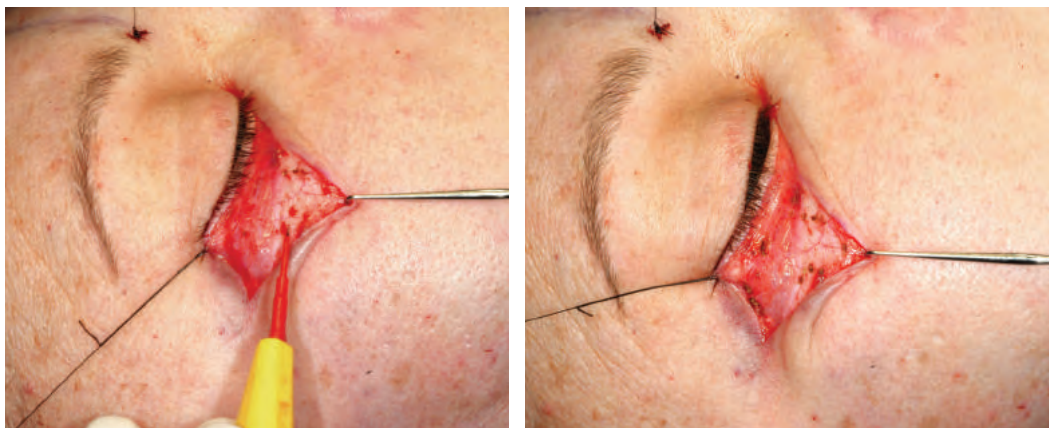


I use a solution of 1% lidocaine with epinephrine 1:100,000 for local anesthesia when performing a blepharoplasty. All eyelid procedures are performed with corneal shields temporarily in place. The lateral segment of the skin incision is lightly scored with the scalpel and the subciliary segment cut with small sharply pointed scissors superficial to the underlying orbicularis oculi muscle. A suture is placed laterally along the lid margin for countertraction, and the separation of the muscle from the skin is begun—at first under direct vision (*right*), and then by seeing the tips of the scissors through the eyelid skin—which is a good way to dissect quickly under the thin skin without creating a buttonhole.

Dissection

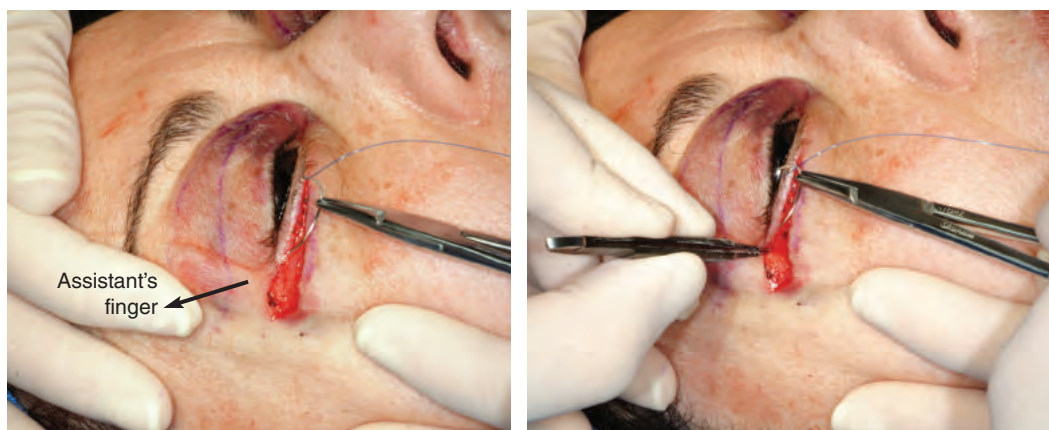


I always dissect beyond the blue estimation line, freeing up the skin as far caudally as needed to eliminate all of the skin wrinkling. If there is a malar festoon present, I separate the skin from the muscle down to the upper edge of the festoon.

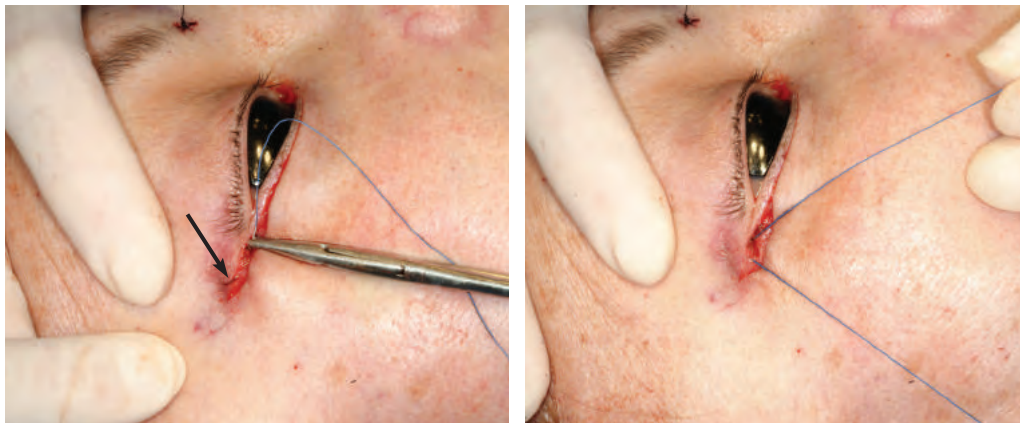


Hemostasis is obtained with the electrocautery on a low setting.

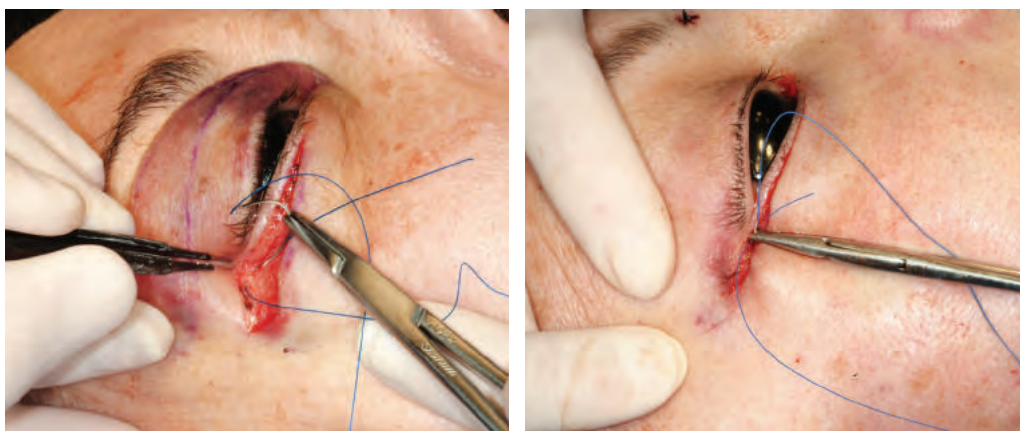
Lateral Canthopexy



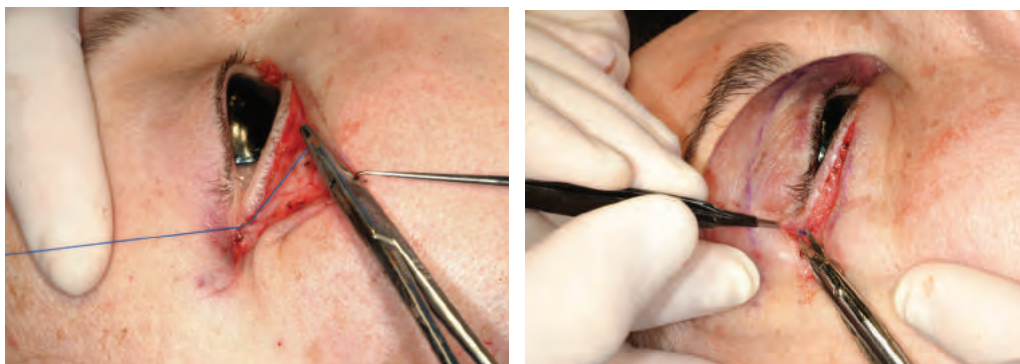
If the patient has a hypotonic lower eyelid, often manifested by a downward rounding of the lateral lid margin or some degree of increased scleral show, I perform a lateral canthopexy—one that I call the *double-loop muscle-tuck canthopexy*—which tightens the pretarsal muscle and the lid margin in a horizontal direction. For this, a permanent 4-0 Prolene suture on a taper SH needle is used. With my assistant's fingers gently pulling the mobile soft tissues at the lateral orbital area upward and outward, I locate the inside edge of the lateral orbital rim with the tips of the forceps.



I then insert the needle into the orbicularis oculi muscle just below the skin of the lateral lower eyelid margin and just medial to the lateral canthus, catching hold of the periosteum on the inner edge of the lateral orbital rim at or just slightly above midpupillary level. The tip of the needle can be seen emerging through the periosteum and muscle laterally (*arrow*). When I pull up on the suture (*right*), it should feel solidly engaged in the periosteum.



I pass the needle a second time exactly the same way, creating a double-loop of the suture. When this suture is tied, the muscle within the double-loop is gathered and tucked up against the bone just inside the lateral orbital rim, where it is meant to heal securely. It is important that the needle pass through the periosteum on the inner edge of the lateral orbital rim both times, not the outer edge, to avoid an “air space” between the lateral lid margin and the globe. It is also important that the suture not pass through the tarsus, which could kink the lateral lid margin when the suture is tied. This is a muscle-tuck canthopexy, not a tarsal-tuck canthopexy.



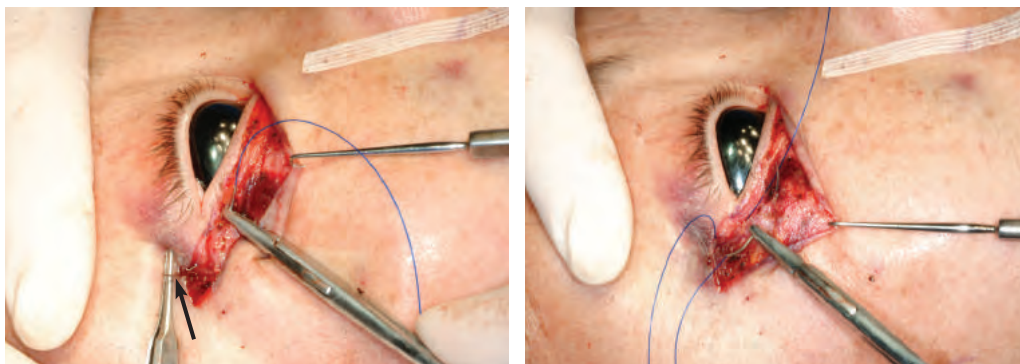
My first tie is a surgeon's knot, followed by two more square throws. The ends of the suture are cut flush with the knot. Usually the lid margin above the knot is puckered or pulled down a little by having the muscle crimped just below it. It is very important that I correct that distortion, even if it is minor, by snipping just above the knot with the little scissors to set the lid margin back in a perfectly normal position.

Muscle Hitch Procedure

I do a vertical tightening of the lateral orbicularis oculi muscle, a *muscle hitch*, for one of several reasons: if I simply sense that a muscle lift will impart a smoother appearance to the lower eyelid or the lid-cheek junction; if the lower eyelid seems hypotonic—characterized by a lateral rounding of the lid margin or an increase of scleral show; if I want to increase the stability and security of the muscle-tuck canthopexy; or if I want to correct a malar festoon, which is often a combination of skin laxity and muscle laxity.



The muscle hitch is a horizontal mattress suture anchored to the immobile periosteum of the lateral orbital rim. The amount of vertical muscle lift obtained depends on how far below the rim the suture is placed into the muscle. The more the lift that is desired, the farther downward the skin will need to be separated from the muscle. Just a little lift requires just a little undermining of the skin. More lift means more undermining—often 1 to 1.5 cm below the lateral canthal area.



For the muscle hitch, I use an absorbable 4-0 PDS on a taper SH needle. As was done with the canthopexy, the periosteum on the inside edge of the lateral orbital rim is captured with the needle (*arrow* indicates the emerging needle tip). Then a wide transverse bite of muscle is taken almost as far caudally as the skin has been undermined (*right*). This must be a generous and solid bite of muscle that will securely hold in the fragile muscle. When this suture is tied, I can clearly see the entire lower eyelid move upward with it.

Once again, if the skin edge has been pinched down a bit by the muscle hitch, it must be freed by cutting the muscle just a little right under the skin.



I then insert a second hitch stitch, much smaller than the first, to add a bit more lift and security to the muscle fixation. This second mattress suture also smoothes out any irregularities along the upper edge of the muscle that was rolled under by the first hitch. This time, however, the needle grabs hold of the periosteum on the outer edge of the lateral orbital rim (*left*), then picks up a small bite of whatever muscle is still available for lifting just under the cuff of skin (*right*).



And once again, I make sure that the skin edge is not distorted (*left*). With the combination of two muscle hitch sutures, I have usually lifted and secured the muscle just about as much as possible (*right*).

For me, eyelid skin excision or skin redraping is the last step—done as the one and only lower blepharoplasty maneuver, or after a transconjunctival fat removal or fat transposition, or after a muscle hitch and/or canthopexy. If there was just one place in plastic surgery to exercise restraint, excising skin from the lower eyelid would be that place. It is much better to leave a little bit of extra skin behind than to remove a bit too much and risk even a hint of lid margin retraction.

For a smoother and more refreshed appearance, some wrinkled lower eyelids just need to have the skin separated from the underlying muscle and then redraped without removing any skin at all—even when more skin has been brought up into the eyelid with a cheek lift. This is particularly true if the eyelid margin was lifted upward with a muscle hitch and/or a canthopexy.



The freed skin flap of the lower eyelid is laid out without any tenting or tension. If there is some excess to remove, it is conservatively marked and trimmed. In the patient on the left, that amounted to only a tiny triangle; in the patient on the right, it was a good bit more. In most cases, the preoperative estimate will come close to the new mark.



I close the subciliary incision with a 4-0 Prolene intradermal pull-out suture, taking only tiny, wispy bites under the skin. The short medial and lateral tails of the pull-out suture and the lateral crow's-feet extension of the incision are covered with a small piece of 1/4-inch Steri-Strip, and then 1/2-inch Steri-Strips are applied to the skin of the lower eyelid to provide vertical support; in addition, the little bit of pressure that the tapes apply to the skin somehow reduces postoperative bruising and swelling.

After the pull-out suture has been removed 1 week after surgery, with the patient sitting upright, I place the tips of my thumbs under the lower edge of the lateral tarsal plate on the left and right sides and push the lower eyelid margins straight up, somewhat forcefully, to stretch out the eyelid tissues. This simple maneuver corrects any pleating along the eyelid margin that may have been produced by the running intradermal suture, and this allows the lid margin to once again hug the globe.

Postoperative Care

My office operating suite is physically connected to an inpatient hospital, so I keep all cheek-lift patients in the hospital at least 24 hours. If they also had a neck lift, the patients stay for 48 hours, because that is when I usually remove the subcutaneous drains. Occasionally, however, a patient will go home or to a hotel with a drain or two left in and then return to my office a few days later to have the drains removed. When told that leaving a drain in longer than expected means less bruising and less swelling and a quicker recovery, most patients readily except the short period of inconvenience.

If eyelid surgery was part of the face lift, cold compresses to the eyes are used for at least 12 hours after surgery, and beyond that, only when the patient wishes to use them for comfort. I remove the light wrap-around face-neck-forehead gauze dressing the morning after surgery so that I can have a look at things, and also because

most patients are more comfortable without the dressing. At that time I clean all the suture lines so they are crust free, including those along the lower eyelid margins. The morning after surgery, the eyelashes of the upper and lower eyelids are often stuck together, making it difficult for the patient to see. The nurses, understandably, do not do a very good job of separating the glued-together top and bottom lashes, so I do that myself with cotton swabs moistened with peroxide while the patient, at first, keeps the eyes closed. At home, however, patients are told not to use peroxide, but only warm water and perhaps a little Johnson's Baby Shampoo—which will not sting the eyes.

I tell patients that as soon as they get home, and as long as they do not feel dizzy, they can get in the shower and wash their hair using any kind of shampoo and hair conditioner, can also blow-dry their hair, and this can be done as often as they wish. Nothing makes a patient feel better than a clean head, and the soap and water running over the incision lines helps to keep them crust free. Since the incisions are by then nicely sealed, there is no increased risk of infection. I do not routinely have the patients apply an antibiotic ointment to the suture lines: it is a bit messy and usually unnecessary.

Most patients take a prophylactic oral antibiotic for 1 week after surgery. If they have a history of ever having had a cold sore, they also take an antiviral medication for 1 week, such as valacyclovir.

During the week after surgery, a walk around the block, some fresh air, or perhaps a movie can all be good for the patient's spirits. Of course, the usual admonition of "keeping the head above the heart level" is recommended for 1 or 2 weeks, with no strenuous exercise for at least 3 to 4 weeks.

Suture removal is done 1 week after surgery. The next office visit after that is usually at 3 months, but if either the patient or I have any concern about anything, the patient is encouraged to return as often as necessary for treatment or reassurance.

The majority of patients are comfortable returning to work and most of their social activities at 2 to 3 weeks after surgery, but an occasional patient will need longer. Every patient is told that the amount and duration of postoperative swelling and bruising is quite variable.

Complications and Outcomes

The reason I particularly like the technique described in this chapter is that the incidence of associated problems is quite low, while the quality of the results is consistently good to excellent. In other words, the risk-to-benefit ratio is a very favorable one.

The incidence of postoperative hematoma has been kept well under 1% because a good deal of the flap dissection and all of the fat excision is done with the electrocautery; late *rebound bleeding* is avoided for the most part by using a very dilute solution (1:4,000,000) of epinephrine. Maintaining or regaining a normal or supra-normal blood pressure during the final hunt for hemostasis before closure has helped as well. The routine use of closed suction drainage for at least a day or two following surgery has, for the most part, avoided the puddles under the flap that produce swelling and ecchymosis.

To achieve an effective temporal brow lift, the necessary freeing of the soft tissues to the periosteum along the supraorbital and lateral orbital rims has produced a 6% incidence of temporary brow elevator (frontalis muscle) dysfunction, which may take several months after surgery for complete resolution. All patients are apprised of this possibility during the preoperative consultation. I have not had a single case of permanent frontalis muscle dysfunction. There have been no buccal branch, zygomatic branch, or marginal mandibular branch facial nerve injuries, temporary or permanent, associated with the subcutaneous flap technique in my hands.

A visible dimple in the skin in front of the upper ear is a frequent sequela of the skin-to-bone method of skin flap fixation. The dimple is usually a shallow one that in most cases can be camouflaged by the hair. Typically, the dimple disappears in 3 to 4 months as the absorbable fixation suture dissolves.

Because the small, crescent-shaped skin flap that is made to fit over the tragal cartilage has its subcutaneous tissue thinned almost to dermis, there have been some instances of superficial skin loss along the edge of this little flap. An optimistic expectation of outcome transferred to the patient, along with a dab of antibiotic ointment and a little time, is all that is usually needed for the scar there to become unnoticeable.

Results



For this 60-year-old woman, I did a subcutaneous cheek-neck lift and temporal lifts. An extensive undermining of the cheek flap was done with a point-tensioned fixation of the flap. The jowls were trimmed under direct vision. Her more youthful-looking complexion resulted from the skin lift alone. The postoperative photos were taken 1 year after surgery, as were the postoperative photos in the other patient examples to follow. I operated on this patient many years ago, before I had come to appreciate the value of a concomitant lower eyelid lift in improving the quality of many cheek lifts. In this case, flattening, smoothing, and lifting the lower eyelids with an apparent elevation of the lid-cheek junction would have further improved her nice result.



This 48-year-old woman underwent a combined cheek and neck lift, along with temporal brow lifts, a narrow skin strip excision from just the right lower eyelid, skin redraping without skin excision in the left lower eyelid, and dermabrasion of the upper lip. The patient reported that even as a young woman she had full upper nasolabial folds, and despite my having undermined beyond the folds over to the lower sidewall of the nose and onto the lateral upper lip to release the *intrafold filaments* that are often primarily responsible for maintaining the humped shape of the folds, the shape of these particular folds persisted, because they were simply a mound of localized fat that had always been there. Had the patient said to me at the preoperative consultation that she would like to have her upper nasolabial folds diminished, I would have done a closed liposuction there at the beginning of surgery before the cheek flaps were elevated.



Aside from her full, firm, oblique neck, this 57-year-old woman was bothered mostly by her chubby lower cheeks and prominent jowls. She had a subcutaneous cheek and neck lift that included lower cheek subcutaneous lipectomies, buccal fat pad excisions, and a jawline clean-up. For the neck, an extensive subcutaneous fat removal was done, along with a subplatysmal fat excision, a perihyoid fascia release, a low release of the anterior digastric muscles, partial resection of the right anterior digastric muscle, partial resection of enlarged submandibular salivary glands, a corset platysmaplasty, and correction of pixie earlobes. Temporal brow lifts prevented soft tissue from bunching in the lateral orbital areas when the cheeks were lifted and also corrected the slight ptosis of her lateral brows. Transconjunctival removal of excess lower eyelid fat was done, and skin strips were excised from both the lower and upper eyelids. As with the previous patient presented, this woman also had unyielding upper nasolabial folds caused by excess fat. In both cases, those folds could have been reduced by narrow-cannula closed liposuction.



At her consultation with me, this 63-year-old woman reported that 4 years earlier she had had lower blepharoplasties and a perioral dermabrasion done elsewhere. She was now discontented with the persistent puffiness in her lower eyelids, the development of jowls, vertical webbing at the front of her neck, and soft tissue relaxation in the lower cheeks—especially the labiomandibular folds.

I performed a subcutaneous cheek-neck lift, jowl fat excision, temporal brow lifts, bilateral transconjunctival fat excisions, and a unilateral right lower eyelid double-loop muscle-tuck canthopexy to lift and tighten that one eyelid margin a bit. Today I would have added a muscle hitch or two on top of that. I had thought that I would also excise a very narrow skin strip from the lower eyelids as well, but at surgery I found that both lower lids needed all of the existing skin, so the eyelid skin flap on each side was simply elevated and then redraped.



This 54-year-old woman came to me still looking younger than her age—but a subtle and yet discernible downward displacement of the soft tissues of her face had begun to tell its tale. The fullness that once enriched her malar eminences had diminished. Some portion of the mid cheeks had settled near the jawlines, leaving a shadowed submalar hollow. Even the lower eyelids had lost a measure of tonicity, where a trace of lateral rounding had become evident. Prominent glabellar frown lines imparted an angry expression, particularly since they were paired with her actively arched lateral brows—an expression that was not at all softened by a pursed-looking upper lip with a stingy vermillion.

I performed a subcutaneous cheek-neck lift, along with low temporal lifts to prevent skin bunching in the pretemporal regions, but done in a way that entirely avoided lifting the lateral eyebrows—not even one millimeter. In the neck, a slim strip of upper midline interplatysmal fat was excised to make room for the joined platysma edges rolled inward with a corset platysmaplasty. The excess neck skin was widely undermined, allowing it to shrink and slide to the sides without the need for any neck skin excision.



For her thin and somewhat puckered upper lip, a direct vermilion lift was done to create a more generous red lip topped by a much prettier cupid's bow. She is seen (*right*) 1 week after surgery.



In the lower eyelids, vertical tightening muscle hitches were used, along with the excision of a narrow bit of skin. Her glabellar frown lines were improved by transpalpebral corrugator muscle resections. En route to the corrugators, a little excess fat in the medial aspect of the upper eyelids was trimmed. Thin strips of preauricular SMAS and fat were also tunneled under the dermis of the frown lines through tiny stab incisions in the skin. Her appearance at 1 year after surgery displays a subtle improvement in all of the treated areas, which, taken together, provided her with a rejuvenated appearance and a refreshed spirit.

Concluding Thoughts

In my thirty-fifth year in practice, I find myself having come full circle in my cheek-lift technique, beginning with a subcutaneous lift, then moving on to various iterations of a SMAS-included lift, before returning to a subcutaneous lift. Over the years, however, I added some things that I believe make the procedure I do now more effective and the results longer lasting: a more generous flap mobilization, a sound method of flap fixation, and an accessory lift to the lower eyelid and temporal zone. This may be an easier, safer, and highly gratifying approach for other plastic surgeons as well.

Clinical Caveats

Inclusion of the SMAS in a compound cheek-lift flap was found to offer no long-term benefit.

Far-reaching subcutaneous undermining is routinely done to release all of the skin and fat-retaining ligaments that might inhibit successful unrolling of the nasolabial fold and the labiomandibular fold and repositioning of sagging malar and jawline soft tissues.

Despite the extensive amount of tissue dissection, a very low incidence of postoperative hematoma is expected because a weak concentration of epinephrine is combined with the local anesthetic, producing relatively weak vasoconstriction of relatively short duration, and because a good deal of the dissection is done with the electrocautery rather than with scissors.

Tension on the flap takes up the slack, while a stable method of flap fixation counteracts the elastic and gravitational forces working against the lift.

The degree of tension must be gauged for safety. A deep dimple or a blanched line in the skin at the site of the fixation suture indicates that less tension must be reapplied.

The locus of flap fixation, high up and far out in the cheek, is ideally situated at the point of convergence of all the vectors needed for a *complete* cheek lift.

A temporal lift and lower eyelid lift are often done in conjunction with the cheek lift to prevent pretemporal and lower eyelid skin bunching and the appearance of a *lateral sweep*.

The best short- and long-term improvement of a prominent jowl is obtained by direct excision of excess or ptotic medial jawline fat.

Small details of skin incision placement are emphasized to avoid postoperative scar visibility and a dislocation of the hairline.

This cheek lift can be done as an independent *short-scar* procedure without a neck lift, or as part of a combined cheek-neck lift.

Annotated Bibliography

Friedland JA. The cutaneous rhytidectomy. In Bernard RW, ed. *Surgical Restoration of the Aging Face*. Boston: Butterworth-Heinemann, 1996.

While most of his colleagues had adopted a SMAS flap face-lift technique, this experienced surgeon stuck with a subcutaneous method, involving extensive undermining, along with a superior and lateral cheek SMAS plication, because of its safety and efficacy. The skin flap was “redraped under tension.”

Gillies H, Millard DR Jr. *The Principles and Art of Plastic Surgery*, vol II. Boston: Little Brown, 1957.

In regard to face-lifting, the senior surgeon noted “the necessity of wide undermining,” saying that it should extend “over the cheek, outer portion of the upper and lower lips and chin,” while observing that “the skin over the malar is often quite adherent and demands a little more care.”

Gosain AK, Amarante MT, Hyde JS, et al. A dynamic analysis of changes in the nasolabial fold using magnetic resonance imaging: implications for facial rejuvenation and facial animation surgery. *Plast Reconstr Surg* 98:622-636, 1996.

This MRI study found that an increased prominence of the nasolabial fold over time was caused by “progressive thickening of the dependent portion of the cheek fat pad and overlying skin, with no appreciable change in the muscle plane” and concluded that “to diminish the nasolabial fold, surgery for facial rejuvenation should be directed to the skin and subcutaneous tissue planes.”

Hamra ST. *The Facelift Letdown*. New York: MDP, 2009.

The developer of the deep plane and composite face lift techniques has abandoned the sub-SMAS dissection in the cheek, saying that “while I originally lifted the SMAS with the cheek fat and eye muscle, I have concluded that it is best left untouched, as moving it toward the ear actually inhibits upward motion of the cheek fat.” His current approach focuses on a strong vertical lift to the tissues of the upper cheek, periorbital area, and lateral orbicularis oculi muscle, which is done through a lower eyelid incision—along with a subcutaneous cheek-neck lift done through a periauricular incision.

Hoefflin SM. The extended supraplatysmal plane face lift. *Plast Reconstr Surg* 102:2513, 1998.

In this letter to the editor, the author says the following: "I do not feel that a platysma aponeurosis or SMAS dissection is necessary and, at times, I think it is contraindicated. Long-term results much too frequently show SMAS banding, overlying 'sweep,' and animation abnormalities. These problematic results, often seen and published, caused me to pursue techniques other than a subplatysma technique. I believe that the platysma aponeurosis (SMAS) has a very important function in not only uniformly supporting, but also finely coordinating, the facial mimetic muscles and normal facial animation. Although many excellent surgeons continue to successfully use a two-level dissection, I do not."

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The author observed that "the results of a SMAS face lift, a skin face lift, or a combination lift may be indistinguishable."

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This was the very first article on face lift surgery to appear in Plastic and Reconstructive Surgery. The authors stated that "the longevity of the result is directly proportional to the extent of the undermining."

Suggested Readings

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CHAPTER 37



Midface Recontouring

T. RODERICK HESTER, JR.,
J. NICOLAS MCLEAN

Surgical rejuvenation of the aging face has become one of the most frequently performed surgical procedures in the United States. Loss of volume and gravitational descent combine to create an appearance of facial aging that is evident in all facial features. The youthful eyelid's almond-shaped horizontal palpebral fissure, with its slight upward slant from the medial to lateral commissure, changes and elongates with aging, creating a rounder shape with increasing scleral show. As the malar fat pad descends, cheek prominence is lost, and malar bags may occur. The nasolabial fold deepens, and the tear trough deformity may appear. In summary, the vertically short youthful orbit elongates with aging.

Correction of aging changes in the lower lid and midface is essential for producing a balanced, natural-appearing result after surgical facial rejuvenation. Options for achieving these rejuvenative goals include endoscopic procedures through a temporal approach with suspension sutures to reposition midfacial tissue, open face-lift procedures with superficial musculoaponeurotic system (SMAS) plication, and direct repositioning of the malar fat pad.

Our preferred technique for correction of aging in the critical zone encompassing the lower lid and midface is based on three basic principles:

1. Direct vertical elevation and fixation of midfacial descended soft tissue
2. Orbicularis oculi superolateral redraping with suturing to the periosteum of the lateral orbital rim and temporalis fascia
3. Volume replacement and fat repositioning

Our approach to lower lid and midface rejuvenation includes the following:

- A lateral lower lid incision with minimal myotomy to allow for endoscope-assisted subperiosteal dissection
- Release of malar soft tissues
- Orbicularis oculi muscle redraping

Evolution of Technique

The senior author (T.R.H.) has been using the trans-lower lid blepharoplasty, subperiosteal midface dissection for rejuvenation of the lower lid and midface since 1994. Our approach to transorbital midface rejuvenation has been influenced significantly by the work of others. The subperiosteal approach in facial rejuvenation

was first described by Tessier. Psillakis and Ramirez expanded and further described the use of subperiosteal dissection and release of the midface. Hamra emphasized the importance of vertical elongation of the aged orbit, and both Ramirez and Hamra emphasized the importance of vertical elevation of midfacial soft tissue as more appropriate for correction of midfacial aging. McCord, Codner, and Jelks et al have significantly influenced our own technique for rejuvenation of the lower lid component while minimizing the risk of complications.

The senior author's experience with transorbital midfacial rejuvenation has been previously documented. Since the original description more than 16 years ago, it has evolved from an "open" lower lid approach to an endoscopically assisted approach that avoids dissection and trauma in the plane between the orbicularis oculi and orbital septum, reducing the chance for postoperative lower lid malposition.

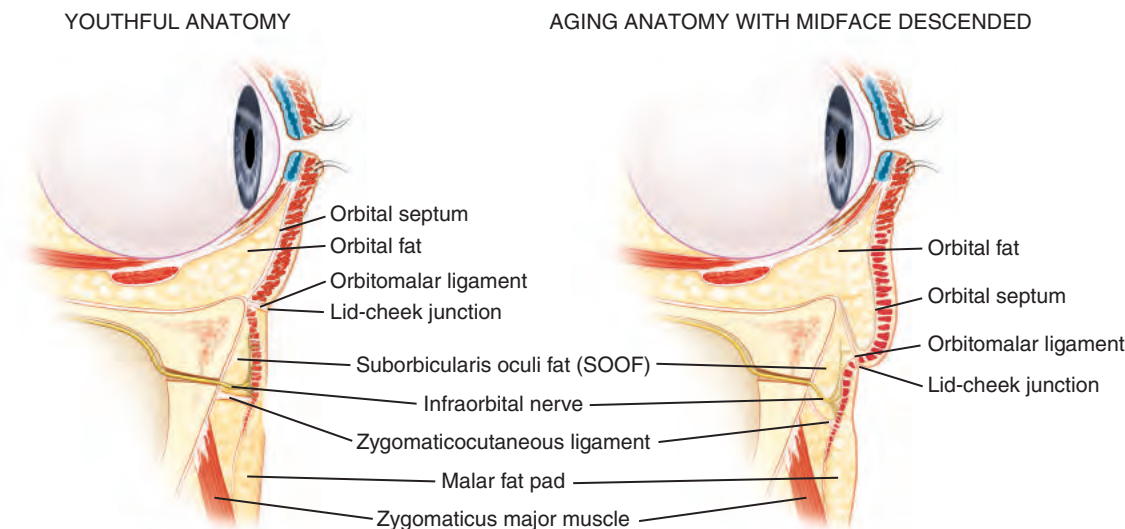
Indications and Contraindications

Any patient with aging of the lower lid and midface is a candidate for this procedure. In our experience, the direct vertical elevation of the midface and redraping of the orbicularis that occur with this technique result in a more pleasing and natural appearance than could be obtained with traditional lateral-vector techniques. The senior author now uses this procedure in all face lifts, thereby eliminating the need for extensive lateral to central deep-plane or sub-SMAS dissection. We have found, however, that patients with more severe degrees of facial volume loss, especially when this is accompanied by malar bony retrusion, will have less than ideal outcomes unless the volume deficiency is addressed. In these patients, autologous fat grafting and/or appropriate facial implants will significantly improve results.

The midface lift is not used to improve the aging changes inferior to the oral commissure and along the inferior mandibular border. In this situation, a traditional face lift with a more lateral-vector preauricular and postauricular approach is used to better correct aging in these areas, including the lower neck.

Pertinent Anatomy

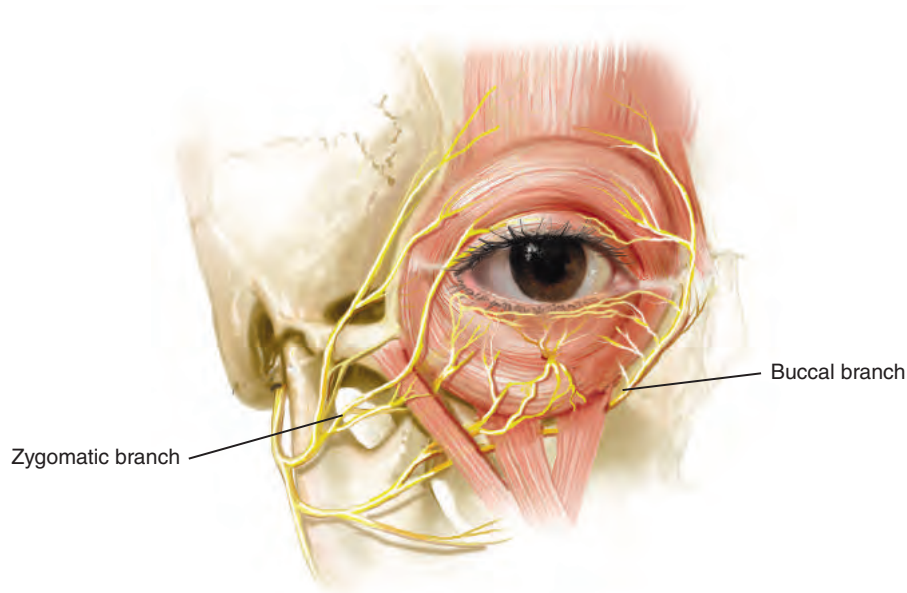
Familiarity with the anatomy of the face, specifically the lower lid and midface, is essential for a successful outcome with this procedure. The following anatomic principles apply.



In this difficult zone of the face, it is important to understand the anatomic changes associated with aging and have a clear vision of what needs to be accomplished for correction. Surgically, the midfacial area moves as a unit, behaving as a composite structure because of the firm attachments of the suborbicularis oculi fat and malar fat to the orbicularis muscle. The orbicularis–facial fat complex is invested with the SMAS, which emanates from bony periosteal attachments at the inferior orbital rim and zygoma. It penetrates through the orbicularis fibers outward and extending to the malar subcutaneous fat, where it permeates and divides the anterior fat. This system of cheek attachments allows full cheek movement and repositioning by upward tension and supraplacement of the orbicularis arc of muscle.

The malar fat pad is superficial to the SMAS. The deep suborbicularis oculi fat (SOOF) lies beneath the SMAS and orbicularis oculi. This anatomic relationship allows the SMAS, orbicularis, and periosteum to be used as a “musculoligamentous carrier” to reposition midfacial fat superiorly, rather than depending on sutures in the structurally weakest component of cheek soft tissue—the fat.

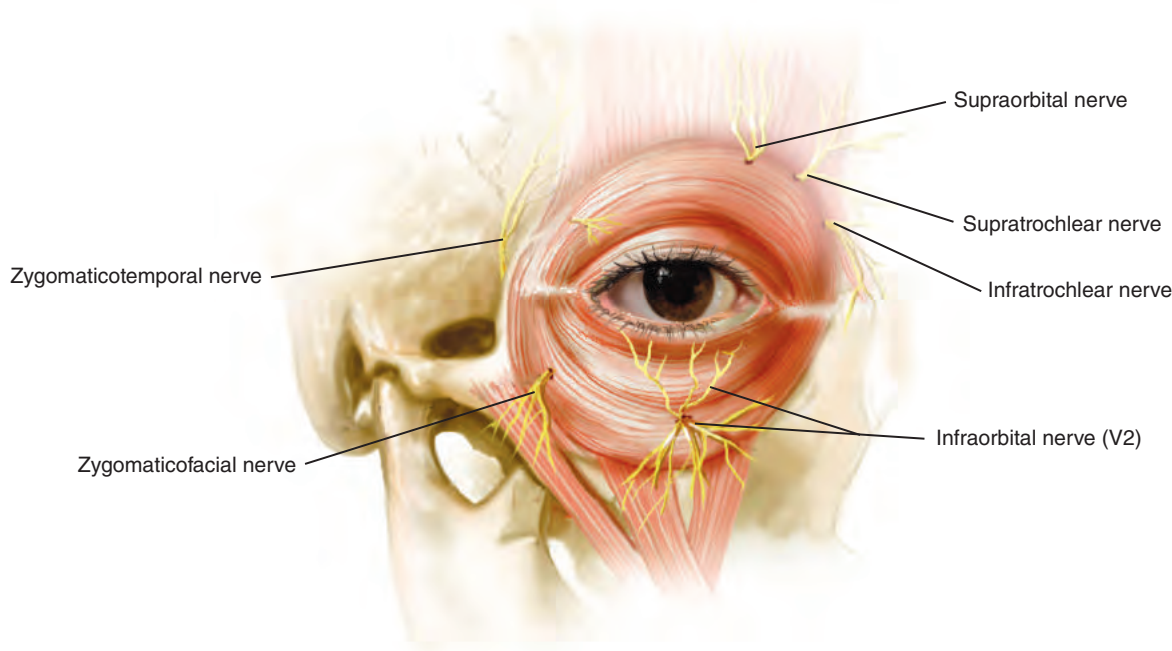
As aging occurs, the more lax lower lid skin, muscle, and fat descend over the relatively fixed orbitomalar ligament, creating a malar bag. Likewise, with descent of cheek soft tissue over the relatively fixed nasolabial retaining ligaments, the fold may deepen.



A major component of lower lid and midfacial aging is laxity of the orbicularis muscle. The orbicularis derives innervation from the zygomatic branch of the facial nerve laterally and the buccal branch medially. It appears from our studies that the pretarsal orbicularis, the critical segment responsible for the blink reflex, derives its innervation nasally via the buccal branch. The remaining body of the orbicularis is responsible for tight closure of the lids and serves to protect the globe from trauma.

The lower lid is highly intolerant of misguided surgical trauma. Traditionally, lower lid rejuvenation is performed using open preseptal dissection. In our technique, the septum remains attached to the orbicularis when the muscle is redraped superolaterally, eliminating the need for excision or other manipulation of the septum and decreasing the possibility of traumatically induced scarring and lid retraction.

Because dissection and release of midfacial soft tissue are done in the subperiosteal plane with the use an endoscope, anatomic concerns related to sensory or motor nerve damage are minimized. All motor branches of the facial nerve are above the plane of dissection and “out of harm’s way,” and there is no denervation of the orbicularis muscle.



The infraorbital nerve (V2; the maxillary division of the trigeminal nerve) is the most important sensory nerve encountered during subperiosteal cheek dissection. It emerges through a foramen in the malar bone approximately 2 cm below the infraorbital rim and 2 cm lateral to the nasomaxillary fissure. This nerve provides sensation to the body of the cheek, lateral nasal skin, and lateral upper lid. Surgical trauma can result in significant, prolonged paresthesia over these areas.

The zygomaticofacial nerve emerges through a small foramen in the zygoma approximately 4 cm below the lateral canthus and provides additional sensation to the lateral malar skin and cheek. This nerve is usually small and is often divided during the dissection. In our experience, division of the zygomaticofacial nerve is of little consequence, occasionally resulting in a minor temporary paresthesia (see Chapter 40 for a detailed discussion of facial anatomy).

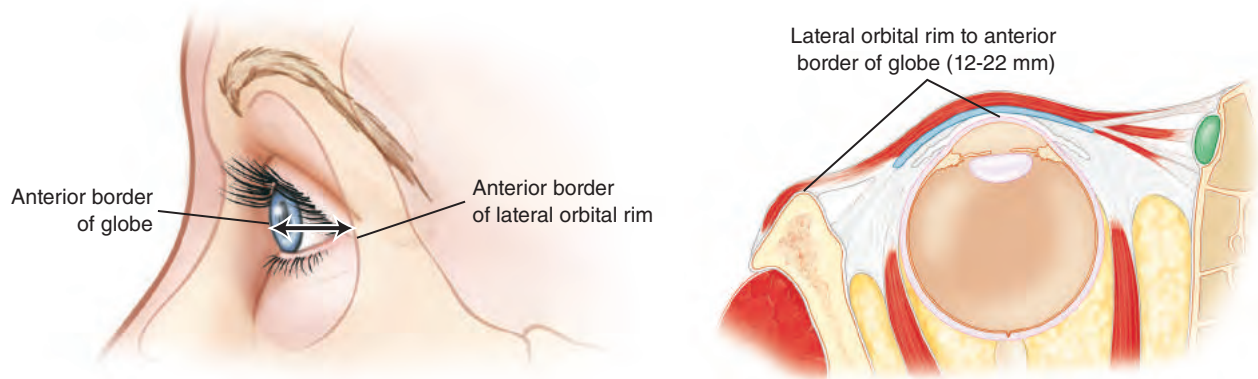
Preoperative Assessment

Preoperative assessment should include a detailed history of any medical problems, but focused to general eye health, dry eyes, personal or family history of glaucoma, LASIK procedures, and a physical evaluation of lid tone. As a safety measure, we wait at least 6 months before performing any eyelid procedure in a patient who has recently had LASIK surgery. We have a low threshold for requesting an ophthalmology evaluation when there is any question.

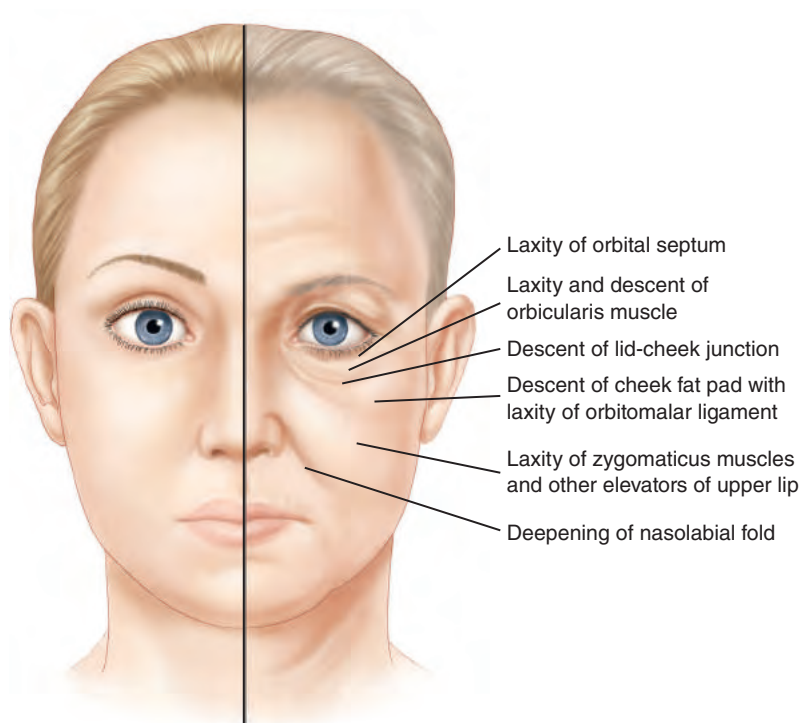
As is true for all areas of the face, the cause of periorbital aging is multifactorial and necessitates a comprehensive approach if correction is to be optimal. A full evaluation of the face is performed, including the entire periorbital area and the lower face. Particular attention is paid to the lower lid, the lid-cheek junction, and the midface. Aging of the lower lid and midface is characterized by both descent and, in patients who are not obese, some degree of soft tissue deflation. Such changes are looked for and noted.

Important anatomic components of lower lid and midface aging include the following:

- Laxity and descent of the orbicularis muscle
- Laxity of the orbital septum and pseudoherniation of the orbital fat
- Eyelid tone and laxity
- Descent of the lid-cheek junction
- Horizontal laxity of the tarsal plate component of the lower lid
- Descent of the cheek fat pad with laxity of the orbitomalar ligament
- Laxity of the zygomaticus muscles and other elevators of the upper lip
- Loss of soft tissues volume
- Bone deficiency
- In some cases, some degree of deepening of the nasolabial fold



Orbital morphology was determined before surgery by using the Hertel exophthalmometer. This instrument measures the distance in millimeters from the anterior-most point of the lateral orbital rim and the anterior border of the globe.



Loss of soft tissue volume exaggerates the effects of soft tissue descent. In fact, some surgeons think that volume loss is the most important component of facial aging. There is certainly thinning of the tear trough, with deepening of the nasojugal groove. As the midface descends and deflates, there is concomitant lengthening and thinning of the upper lip and subtle descent of the lateral oral commissure. Finally, actinic skin changes with accompanying collagen degradation result in surface aging, with skin thinning and increasing numbers of both static and expression-induced wrinkles.

Patient Education

Patients should be informed of potential morbidity after lower lid rejuvenation combined with midfacial rejuvenation. Potential morbidities include the following:

Swelling: Periorbital swelling is most significant in the first 3 to 4 days after surgery. Head elevation, ice, and occasionally a diuretic are the most effective treatments. More chronic, lesser degrees of swelling in the lateral orbital area can require 3 to 5 weeks to totally resolve. Total surgical maturation can require several months.

Incisions: The lateral extensions of the upper and lower lid incisions will be obvious for the first 3 to 4 weeks. These gradually fade into lateral orbital creases, but in a few patients these may require revision (laser, dermabrasion, or surgical).

Nerve injury: Sensory paresthesia related to surgical manipulation of the infraorbital nerve occurs in a few patients and is usually minimal and short lived. There is near-zero chance of motor nerve injury when the procedure is done properly using the subperiosteal plane of dissection.

Lower lid malposition: When the technique is performed properly, the chance that significant ectropion will occur is extremely low. However, older patients with horizontal lower lid laxity of 6 mm or greater with an exophthalmometer measurement of 18 mm or less should have appropriate horizontal lid shortening and canthal support to prevent lesser degrees of lower lid malposition.

Operative Technique

Markings and Incisions



The proposed incision in the upper eyelid is marked according to the patient's morphologic and aging changes. A subciliary lower lid incision is marked on the lower eyelid with a short lateral extension within the preexisting skin line (if present).

Patient Positioning and Anesthesia

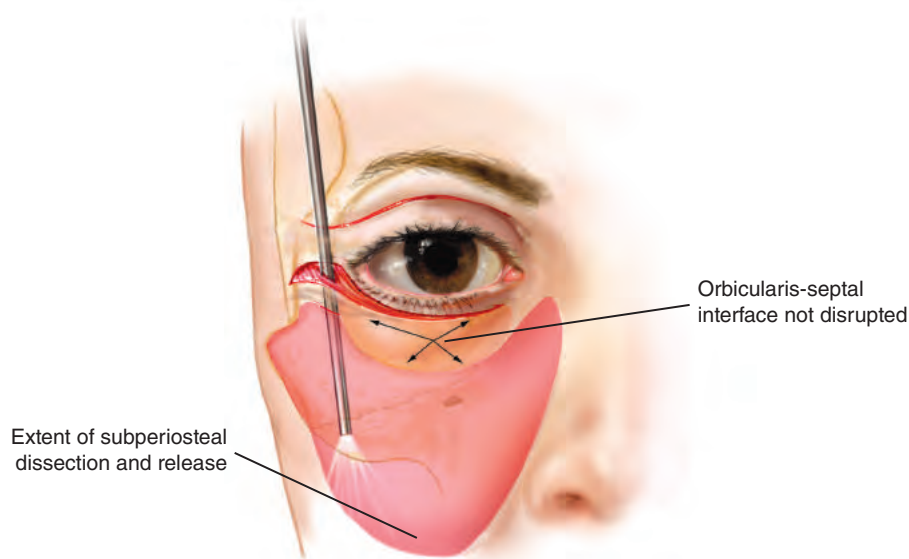
The operation is performed with the patient supine and the head slightly elevated. The corneas are protected with either ointment or plastic protectors, according to individual preferences. We usually perform this operation with the patient under general anesthesia, because it is combined with other aesthetic procedures.

Upper Lid Blepharoplasty: Exposure of the Lateral Orbital Rim and Temporal Fascia

If required, an upper blepharoplasty using an open-sky technique is performed to remove skin and muscle of the upper eyelid and to expose the lateral orbital rim and temporal fascia. Laterally, the orbital rim is identified; here it is very important to leave the periosteum intact, because it will serve as the point of midface fixation. Laterally to the orbital rim, the temporal fascia is exposed sufficiently to allow eventual midface fixation. Selectively, if needed, conservative fat excision from the upper eyelid is performed.

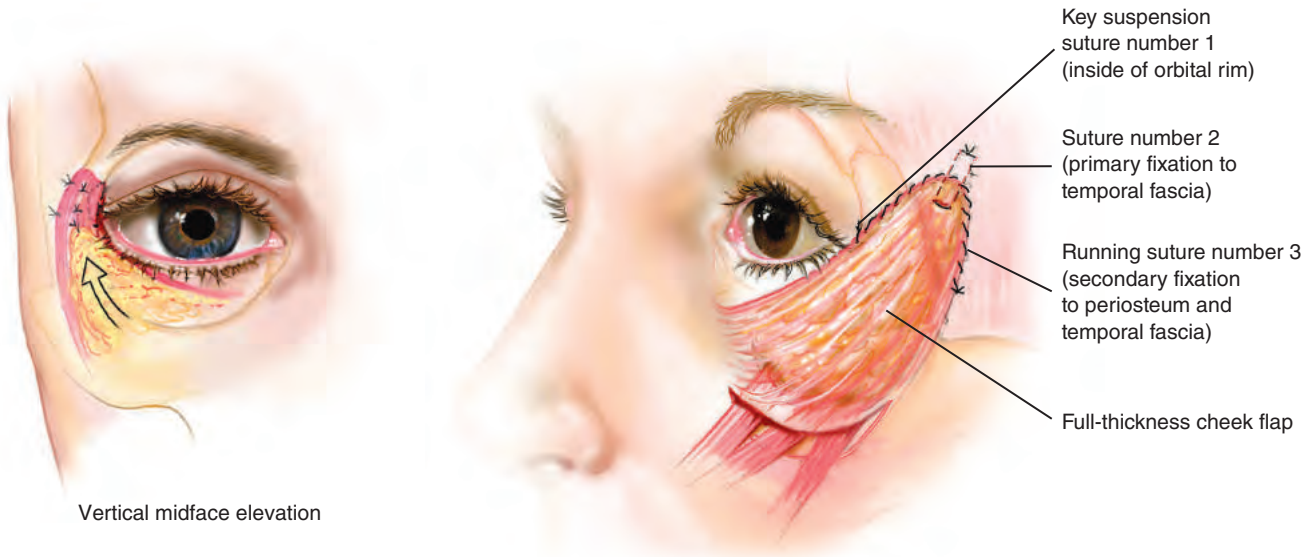
Midface Dissection

A subciliary lower lid skin-only incision is made extending 10 to 12 mm lateral to the lateral canthus. This incision will be parallel and located approximately 5 to 7 mm inferior to the lateral extension of the upper blepharoplasty incision. Through the lateral extension of the incision, a small myotomy large enough to pass an endoscope is performed in the orbicularis muscle to allow a preperiosteal dissection of the inferolateral orbital rim, connecting superiorly with the dissection previously performed through the upper lid. The pretarsal orbicularis is not divided.

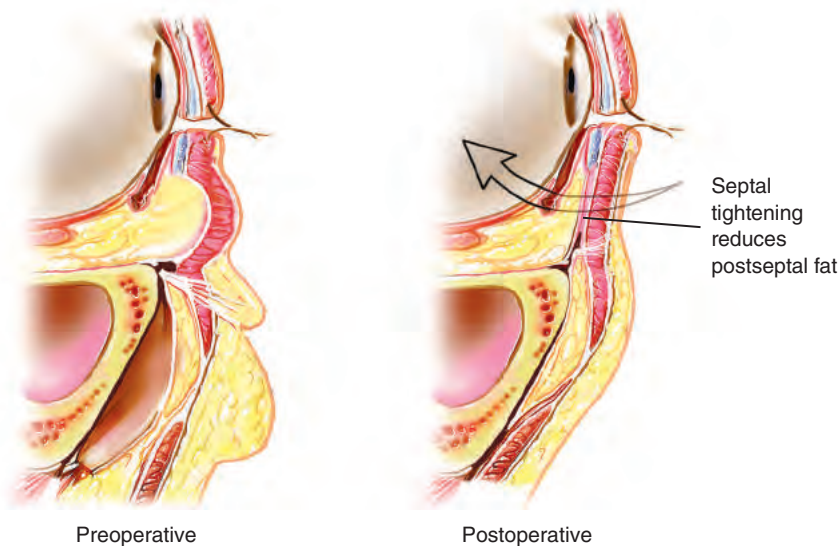


Through the lateral myotomy on the orbicularis oculi, subperiosteal dissection and release of midfacial soft tissue are accomplished with a periosteal elevator under direct vision with endoscopic assistance. This dissection totally spares the pretarsal and preseptal portions of the orbicularis oculi muscle as well as the entire orbital septum, significantly reducing surgical trauma within the middle lamella of the lower lid. Dissection continues medially along the orbital rim, above the infraorbital nerve to the nasomaxillary suture line, and below the infraorbital nerve; the dissection also extends to the nasolabial fold medially, the lower edge of the malar bone inferiorly, and to the junction of the anterior and medial third of the zygomatic arch posteriorly. The extent of this dissection results in release of the soft tissues of the cheek, allowing subsequent elevation and fixation. The dissection includes a release of the tendinous origins of the levator labii superioris and zygomaticus major and minor, the suborbicularis fat pad, the lower third of the orbicularis oculi muscle, the cheek fat pad, and finally, overlying skin, which can be vertically elevated as a unit. Because the dissection is subperiosteal, branches of the seventh nerve to the involved muscles are not at significant risk.

Elevation and Fixation



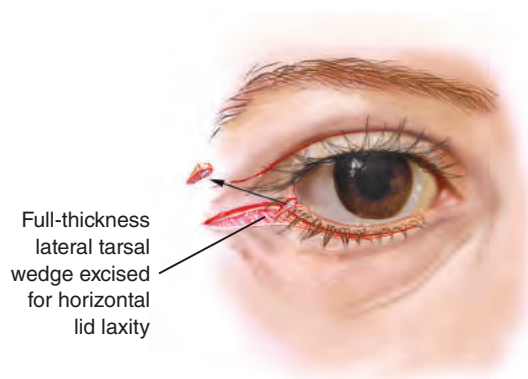
A skin flap is elevated along the lateral third of the subciliary incision, exposing the underlying full-thickness cheek flap to allow fixation. A suture is placed through the already elevated cheek flap and then passed under the skin bridge between the upper and lower lid incisions. Initial fixation is performed to the temporal fascia above the arch and just behind the lateral orbital rim. A very important second suture brings together the medial edge of the elevated flap to the periosteum on the inner surface of the lateral orbital rim. This step provides additional fixation for strength and pulls the lid against the globe.



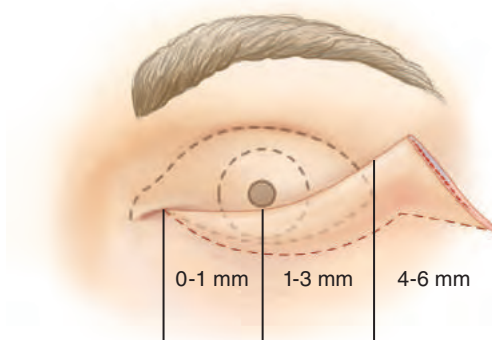
As the orbicularis muscle flap is redraped and tightened, the septum is also tightened, resulting in reduction of herniated postseptal fat, eliminating the need for fat excision in most cases. Retention of this lateral segment allows anatomic repair of the lower lid and provides a “passive tightening” of the lateral canthal tendon and

eliminates the necessity canthopexy. In an occasional patient, the nasal fat pad may be particularly prominent and may not be adequately reduced with septal tightening alone. In this rare situation, reduction of the offending pad is performed several months postoperatively using a simple transconjunctival approach.

Excision of Lower Lid Skin



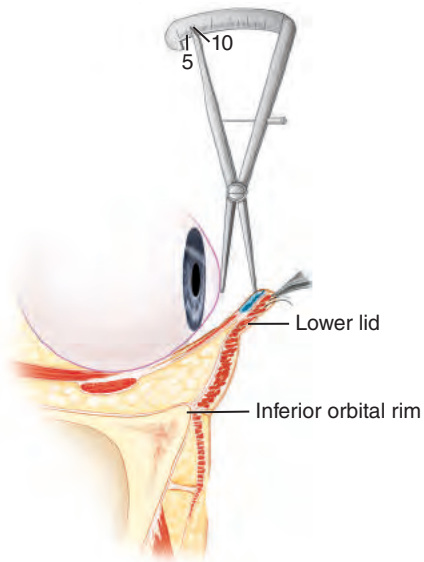
Lower lid skin is excised conservatively. Uncorrected lower lid laxity can lead to postoperative malposition and lid retraction. In both primary and secondary patients, no matter how secure the midface fixation and canthal support, a deficiency of skin in the lower lid will invariably result in postoperative lower lid malposition.



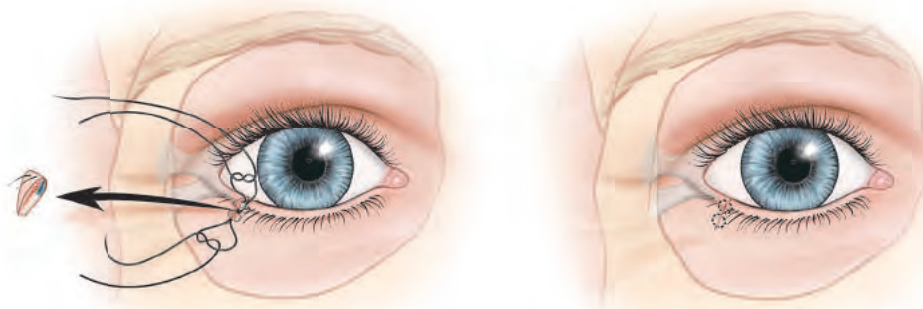
A guide for skin excision is as follows:

- From the medial canthus to the pupil, 0 to 1 mm
- From the pupil to the lateral canthus, 1 to 3 mm
- Lateral to the lateral canthus, 4 to 6 mm

Overresection of lower lid skin will cause lower lid malposition, and overresection on the nasal side of the pupil is the most problematic.

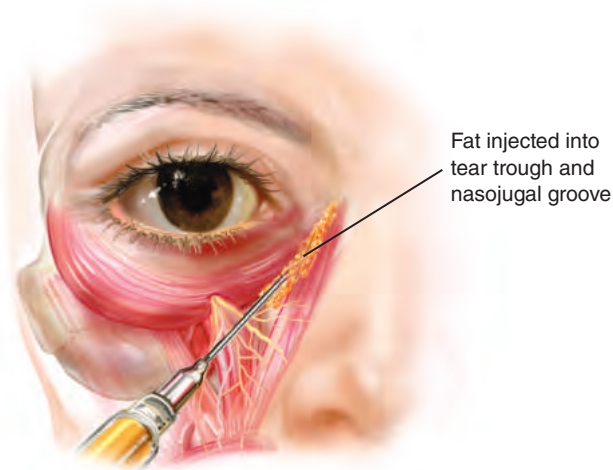


In all patients, orbital morphology is evaluated preoperatively; lower lid laxity is assessed intraoperatively and corrected if indicated. Lower lid laxity can be assessed using the snap-back test or the more accurate distraction test. The upper border of the lower lid is grasped as it crosses the base of the limbus. If the lower lid can be pulled 6 mm or more away from the globe, significant laxity is present and a horizontal lid shortening should be performed.

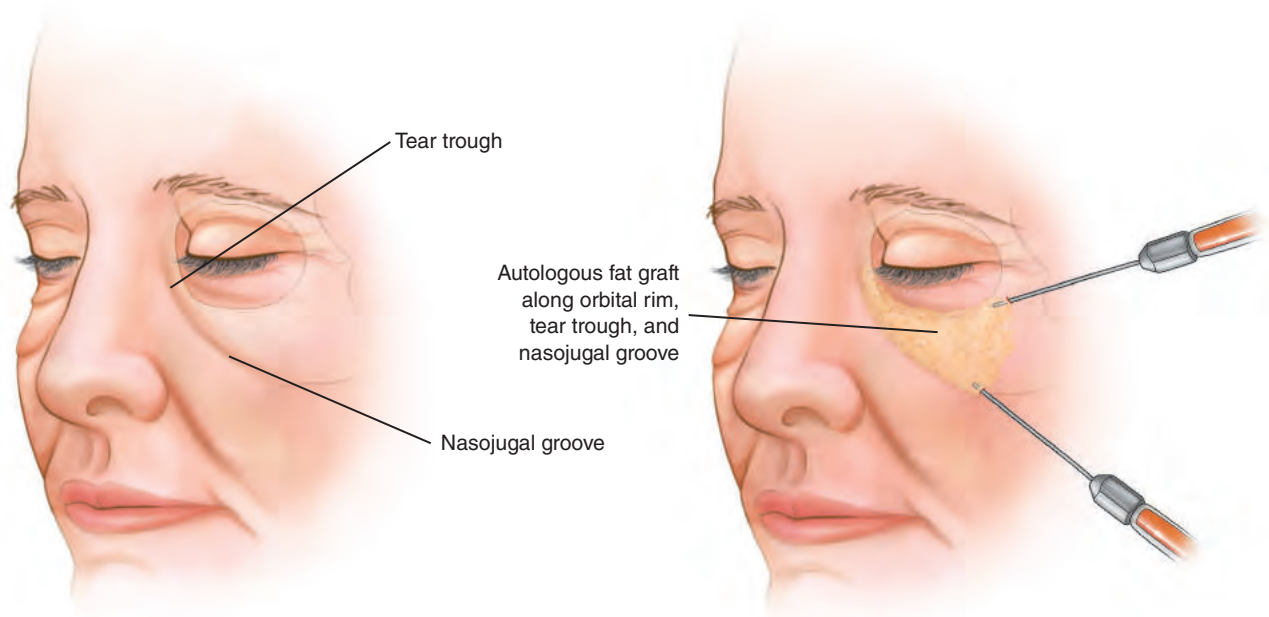


When indicated, a 2 to 4 mm full-thickness wedge of the ciliary margin and the tarsal plate is excised.

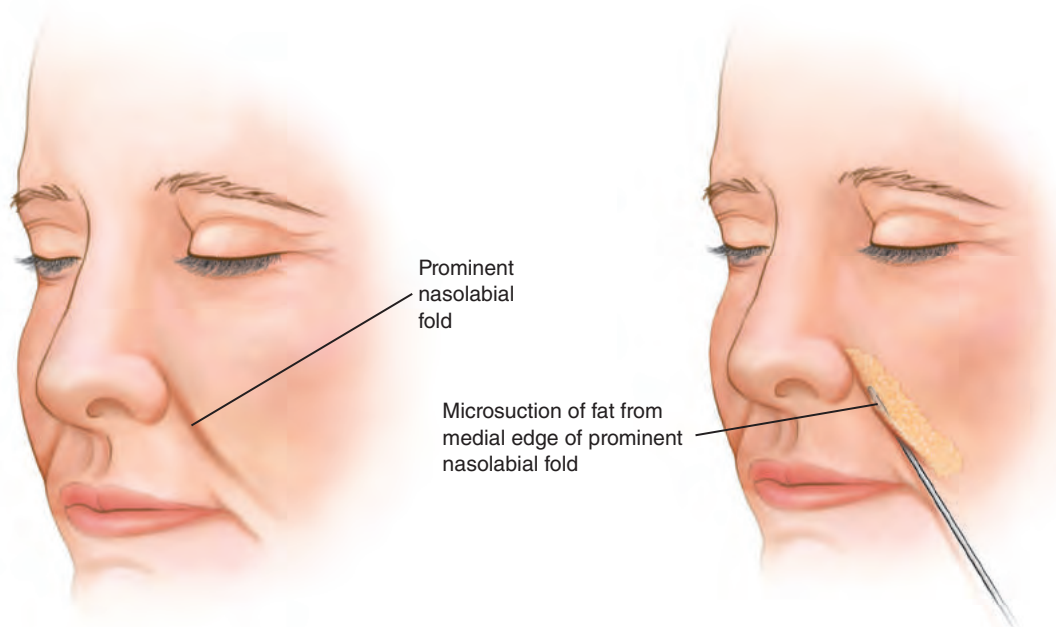
Volume Replacement



Freshly aspirated fat is harvested and 1 to 2 cc is injected into the medial tear trough through a 21-gauge blunt needle. If indicated, additional amounts of fat (5 to 8 cc) are injected into deficient zones of the cheek and lower face.



Early on we began using autologous fat injection to better cover the inferior orbital rim and add indicated volume to the tear trough and nasojugal groove.



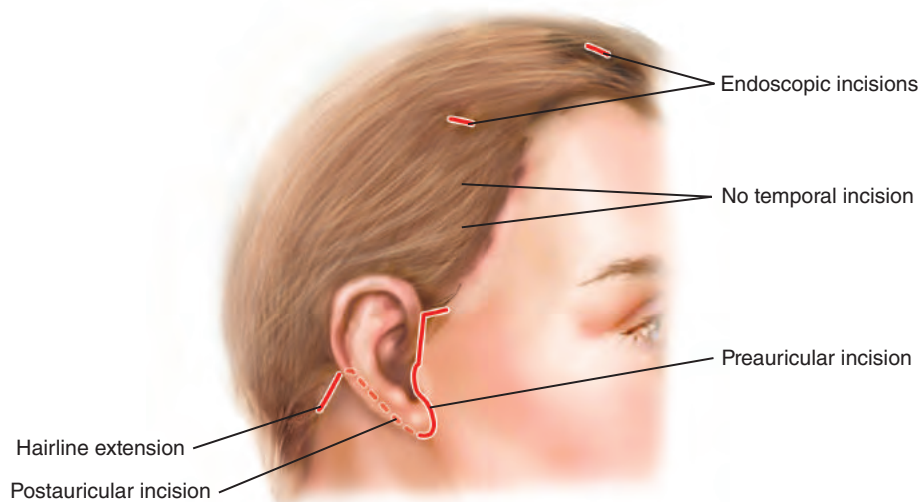
Conversely, we found it helpful in patients with deep nasolabial folds to reduce volume in the medial edge of the fold by suctioning with a small 1 or 2 mm cannula.

Brow Repositioning and Neck Lifting as a Component of Midface Rejuvenation

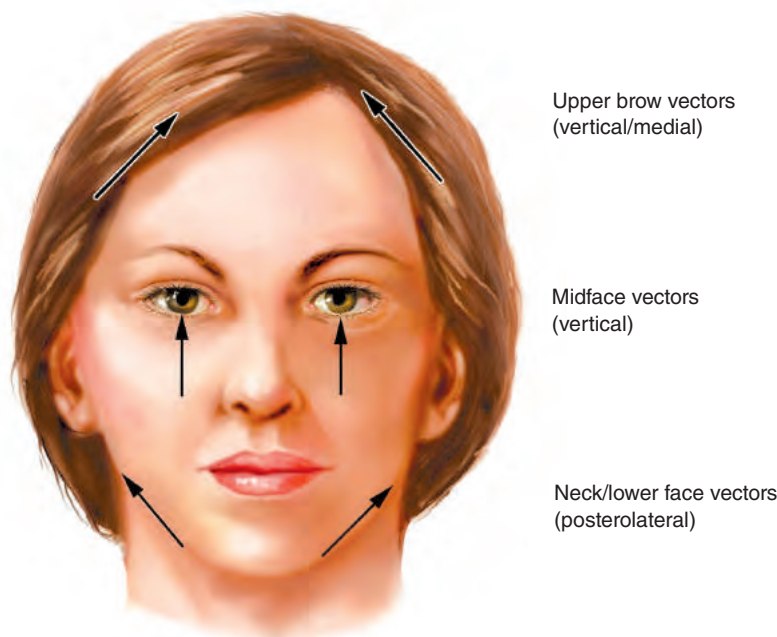
Lower lid and midface rejuvenation is usually done as an important component of comprehensive facial rejuvenation. In essentially all cases, some degree of brow repositioning is necessary. Our preferred technique is an endoscopically assisted subperiosteal approach that includes resection of the corrugator and procerus muscles. If the central brow is not an issue, a limited lateral approach is used. The purpose of the brow manipulation is to correct brow ptosis when present, and, just as important, to smooth and redrape lateral orbital soft tissue excess that occurs with the powerful vertical vector cheek lift. (See Chapter 24 for detailed information on endoscopic brow lift.)

A lower face and neck lift is also performed in patients with significant aging at and below the oral commissure and in the neck. Preauricular and postauricular incisions are used. Sufficient subcutaneous dissection is done to allow lateral plication of the lower SMAS and platysma. As indicated, treatment of the midline of the neck is performed through a submental incision.

Rejuvenation of the midface as we have described eliminates the need for extensive lateral to medial sub-SMAS dissection in the cheek and lower face.



Because the lateral brow is elevated with endoscopic assistance, it is not necessary to extend the preauricular incision into the temporal scalp. Thus elevation of the sideburns or a potentially visible scar in the hair line is avoided.



The vectors used for comprehensive facial rejuvenation are depicted.

Skin Resurfacing

When indicated, skin rejuvenation with an erbium laser or a peel is performed at this stage. If concomitant aesthetic facial procedures are planned, the peel or laser should be the final step after completion of those procedures. Concomitant skin rejuvenation with this procedure is safe, because the dissection of the midface is done in the subperiosteal plane, and the blood supply to the skin is not significantly affected. When the procedure is combined with a face and neck lift, there is limited subcutaneous dissection of preauricular skin, and resurfacing should be superficial to the affected zones.

Postoperative Care

The postoperative course for patients undergoing this technique is comparable to other comprehensive rejuvenation operations. Periorbital swelling can be troubling early, and care must be exercised to protect the globe with drops and ointment. By 2 weeks postoperatively, all sutures and fixation devices are removed. By the third to fourth week, most patients can manage with appropriate cosmetic coverage techniques; 2 to 3 months is required for more complete healing, and in general, revisions are not done for 6 months.

Problems and Complications

The senior author has more than 20 years of experience with the transorbital approach to lower lid and midface rejuvenation in more than 1500 patients. As indicated earlier, the original technique was through an “open” lower lid, incorporating a subciliary incision with a traditional skin-muscle flap dissected to the orbital rim. An overview of this experience was published in 2000. Although overall results were excellent, a small but troubling number of patients had postoperative lower lid malposition, possibly related to the extensive lower lid dissection required. Some patients developed minor degrees of webbing or blunting of the lateral canthal angle secondary to canthoplasty. To minimize these problems, two important modifications of the technique were incorporated in 1999. Open dissection of a skin-muscle flap in the lower lid was abandoned in favor of a “closed” endoscopically assisted approach that avoids dissection in the body of the lower lid. This modification of technique significantly decreased the rate of postoperative lower lid malposition. In addition, canthoplasty involving a transcanthal incision has been eliminated. In 2005 new steps were added to further improve the results, virtually eliminating the incidence of severe lower lid malposition. These new steps included the intraoperative correction of significant horizontal lower lid laxity and decreasing operative septal trauma.

The importance of “deflation” as a significant component of facial aging, in many cases, has stimulated us to be more aggressive with volume replacement when indicated. The use of autologous fat grafting is certainly an attractive option in these cases. However, not all plastic surgeons are enthused about the success rates for fat grafting. In our experience, fat grafting has been useful, but success appears to be very technique dependent. It is important that aspiration be as atraumatic as possible and that injections be done with small-gauge, blunt needles, with small amounts injected in multiple passes. We have also used solid silicone cheek and orbital rim implants, especially in patients with severe degrees of maxillary retrusion.

Outcomes

The very low incidence of this troublesome morbidity is probably related to the decreased trauma to the lid and lateral canthus inherent in the technique. We found that in most cases the tightening of the pretarsal orbicularis muscle that occurs with these modifications provided excellent lower lid support and eliminated the need for a formal canthoplasty. Because the muscle was not dissected off the septum, orbicularis redraping passively tightened the septum, thus reducing postseptal fat herniation without the necessity of direct septal manipulation.

A 2009 article by the senior author highlighted very important steps to decrease complications in lower lid and midface rejuvenation, with the finding that patients with horizontal lid laxity of 6 mm or greater with an exophthalmometer measurement of 18 mm or less were at increased risk of lower lid malposition. When significant horizontal lower lid laxity is present, a lateral lower lid wedge excision is used as described earlier. This maneuver spares the angle and markedly decreases the incidence of healing deformity of the lateral canthal angle. Our experience suggested that patients with enophthalmic orbits combined with horizontal lower lid laxity are also at increased risk.

It should be emphasized that the passive septal tightening that occurs is very effective in correcting postseptal fat prolapse without the trauma inherent in open lower lid procedures.

Results



This 54-year-old woman is shown before and 1 year after closed endoscopically assisted midface lift and brow lift with appropriate skin excision in the upper and lower lids. She also had fat injection along the orbital rim and erbium laser skin resurfacing for acne scarring. The split-view clearly confirms the elevation of the lid-cheek junction, softening of the nasolabial fold, and decreased corrugator and transverse forehead wrinkles without overskeletonization of the upper and lower lids.



Desiring midface rejuvenation and a more uplifted appearance, this 57-year-old woman underwent an endoscopically assisted midface and brow lift, neck lift, and a TCA peel. She was very pleased with the results, which provided elevation of the lid-cheek junction and oral commissure and rejuvenation of her jowls and neck. She is shown 18 months after treatment. The oblique views and split-view dramatically demonstrate the midface elevation that has been achieved.



This woman is shown before and 1 year after a closed endoscopically assisted mid-face lift and brow lift with appropriate skin excision in the upper and lower lids.

Clinical Caveats

Trauma can be limited by eliminating preseptal dissection in the body of the lower lid and endoscopically assisted subperiosteal dissection of midfacial soft tissue.

Elevation and fixation of the midface should be vertical rather than lateral.

The technique involves vigorous vertical elevation and redraping of the orbicularis oculi.

Patients with horizontal lid laxity of 6 mm or greater with an exophthalmometer measurement of 18 mm or less are at increased risk of lower lid malposition.

Horizontal lower lid laxity is corrected intraoperatively when present.

Volume should be replaced when indicated.

Skin rejuvenation should be performed when indicated.

Annotated Bibliography

Finger ER. A 5-year study of the transmalar subperiosteal midface lift with minimal skin and superficial musculoaponeurotic system dissection: a durable, natural-appearing lift with less surgery and recovery time. *Plast Reconstr Surg* 107:1273-1283; discussion 1284, 2001.

The author describes the transmalar subperiosteal midface lift technique as well as its advantages. The results in 272 patients over a 5-year period are presented.

Hester TR. Evolution of lower lid support following lower/midface rejuvenation: the pretarsal orbicularis lateral canthopexy. *Clin Plast Surg* 28:639-652, 2001.

An 18-month experience with an endoscopically assisted closed technique of modified transblepharoplasty lower lid and midface rejuvenation is presented.

Hester TR, Codner MA, McCord CD, et al. Evolution of technique of the direct transblepharoplasty approach for the correction of lower lid and midfacial aging: maximizing results and minimizing complications in a 5-year experience. *Plast Reconstr Surg* 105:393-406; discussion 407-408, 2000.

The purpose of this article is twofold: to provide a comprehensive retrospective evaluation of the value and promise of the technique, and to present a comprehensive discussion of the pitfalls and complications that have been associated with use of this technique. In addition, technical modifications that may lower the rate of morbidity associated with the use of the procedure are described. The authors' experience with transblepharoplasty midface and lower lid rejuvenation confirms that the key to preventing complications lies in the surgeon's ability to manage the lower lid skin/muscle excess that is returned to the orbit after vertical elevation of the midface.

McCord CD, Codner MA, Hester TR. Redraping the inferior orbicularis arc. *Plast Reconstr Surg* 102:2471-2479, 1998.

The authors discuss the surgical technique of redraping of the inferior arc of the orbicularis oculi muscle, used primarily to produce lower lid and midfacial smoothing in patients undergoing aesthetic surgery. They also describe the technique modifications necessary for treating patients with prominent eyes and distensible lower lids as well as adjunctive procedures.

Psillakis JM, Rumley TO, Carmagos A. Subperiosteal approach as an improved concept for correction of the aging face. *Plast Reconstr Surg* 82:383-394, 1988.

A harmonious facial appearance is determined by a balanced relationship among all tissues of the face. With advancing age, balance is lost among the bone, muscle, fat, and skin as progressive changes occur in their volume, shape, position, and consistency. The authors present the subperiosteal rhytidectomy technique to achieve natural results of the upper and central face, eyebrows, periorbital, external canthus, cheeks, and nasolabial folds. They also include patient results and discuss complications.

Sullivan SA, Dailey RA. Endoscopic subperiosteal midface lift: surgical technique with indications and outcomes. *Ophthal Plast Reconstr Surg* 18:319-330; discussion 329-330, 2002.

The authors review the indications for and the surgical technique of the endoscopic subperiosteal midface lift. They also present clinical outcomes in 22 consecutive patients. They found this technique to be an effective method for elevating the midface and achieving a more youthful appearance.

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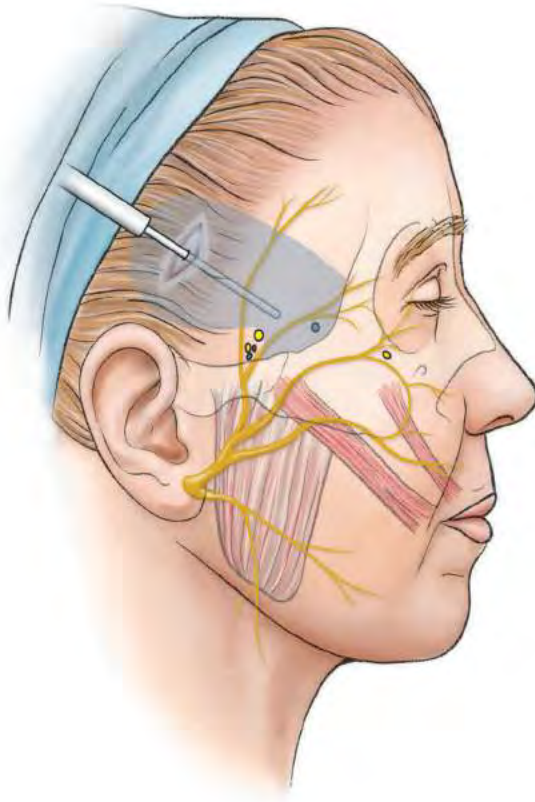
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CHAPTER 38



Endoscopic Rejuvenation of the Midface

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ANDERSON SACILOTO,
GABRIELE CÁCERES MIOTTO

A better understanding of the pathophysiology of midface aging and the intrinsic anatomic structures involved in this process has allowed plastic surgeons to develop safe techniques for midface rejuvenation, and significant progress has been made in recent years. Many different approaches have been introduced for the treatment of the aging midface, including these areas:

- Lower eyelid
- Face lift
- Open temporal incision
- Use of barbed sutures
- Endoscopic temporal and oral incisions

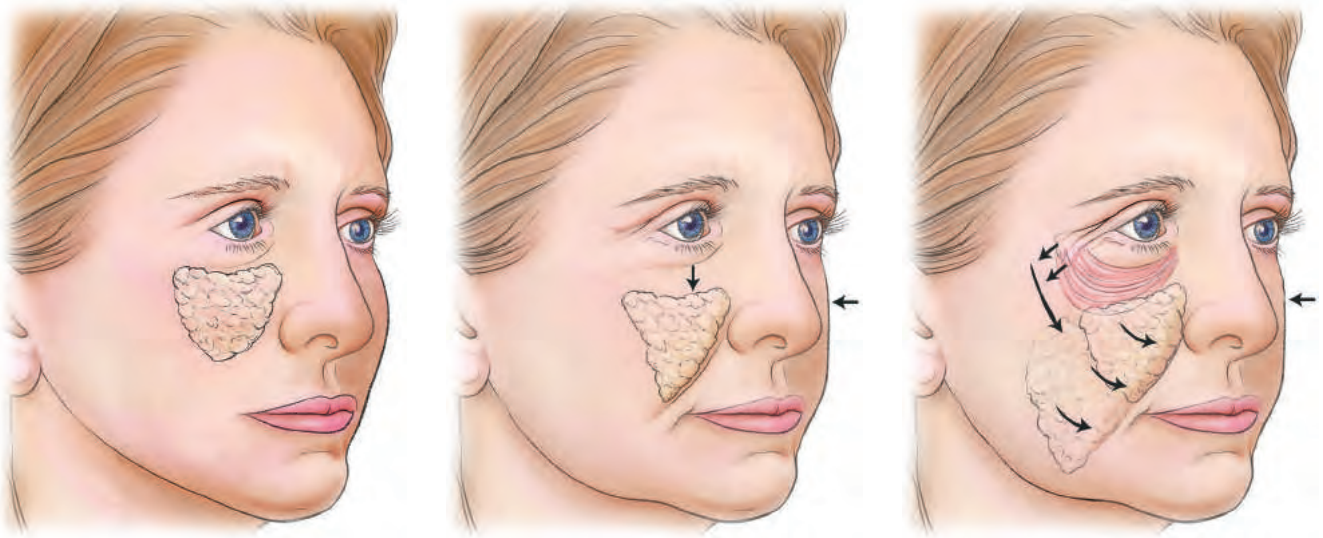
The endoscopic temporal approach for the treatment of the midface has obvious advantages. It provides a safe plane of dissection along the deep temporal fascia and along the subperiosteal plane of the midface or the forehead. It can easily be combined with an endoscopic brow lift when necessary. It provides excellent visualization of the midface anatomy and permits easy fixation, regardless of the method chosen. Because of the extensive dissection and creation of an excellent optical cavity in the midface pocket, one can often eliminate the need for an intraoral incision, thus decreasing the possible risk of infection. Furthermore, endoscopic midface suspension has, in our hands, been shown to be a safe, reproducible technique with good long-term results. Patients appear to be more satisfied because the scars are smaller, there is less bruising, and recovery is faster. Endoscopic magnification provides better visualization of the complex midface anatomy, resulting in reduced morbidity.

Pertinent Anatomy

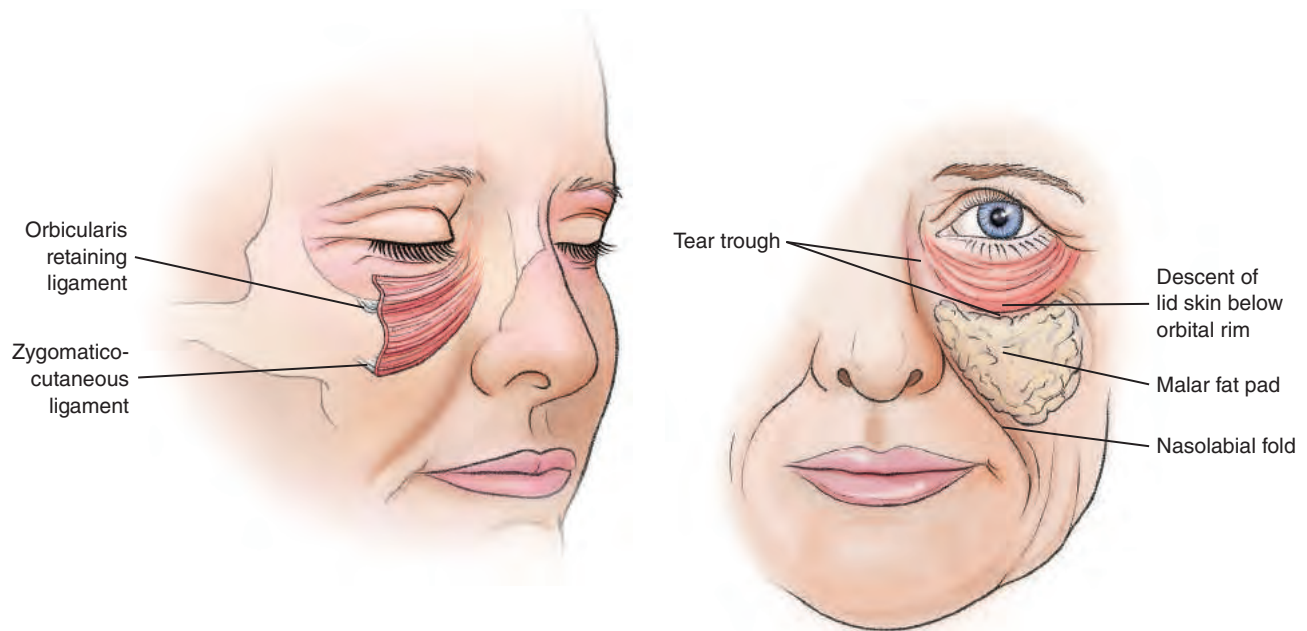
Success with any operation for facial rejuvenation requires a basic understanding of the aesthetic subunits and anatomic structures of the face and how they are affected by the aging process; these should be studied and respected to obtain a harmonious result. It is important to know which structures need to be altered and then to match the correct treatment with the most appropriate technique.

Midface aging is characterized by four anatomic changes:

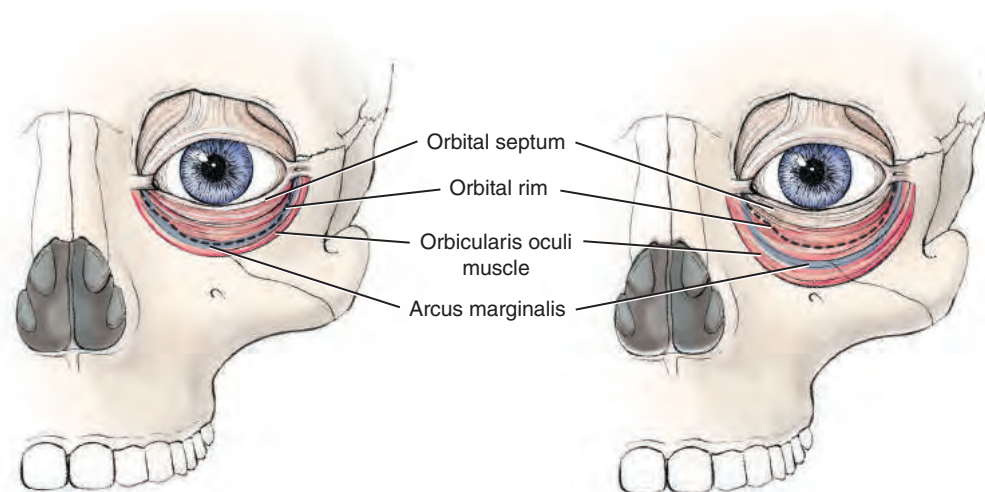
1. Descent of the malar fat pad
2. Descent of the lid-cheek junction
3. Increase in prominence of the nasolabial folds
4. Loss of cheek projection



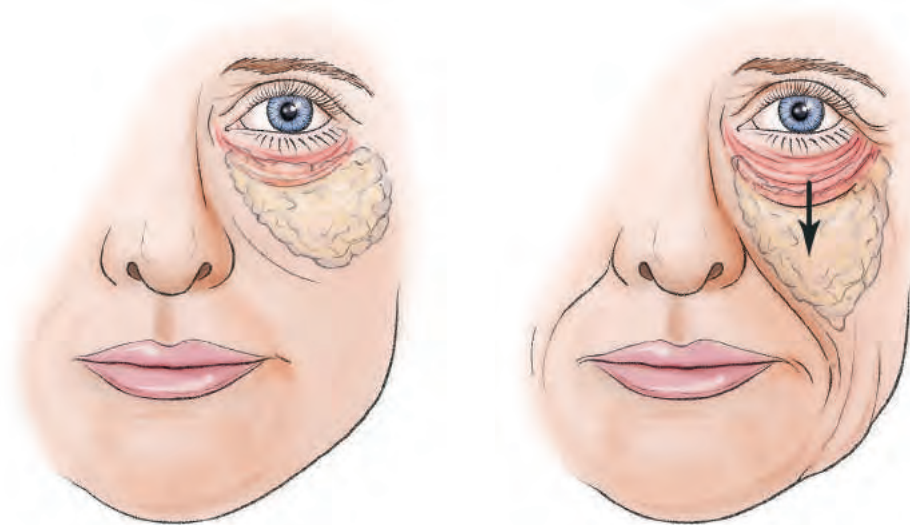
The changes associated with midface aging occur as a result of ptosis of the malar fat pads, with an inferior medial sliding of this tissue. Concomitantly, cutaneous and ligamentous laxity results in the descent of the facial muscles: the zygomaticus minor and major and the levator of the upper lip. Together these changes accentuate the nasolabial groove and contribute to flattening of the malar area.



An excess of tissue known as the *malar bag* or *festoon* may also develop. This is a thick fat layer located between the skin and the superficial musculoaponeurotic system (SMAS). Other changes include maxillary reabsorption and ptosis of the corners of the mouth, resulting in what patients refer to as a “sadistic smile.” This aging process also creates an artificial increase in the vertical length of the lower eyelid.



The musculature of the face is also subject to the aging process. The arcus marginalis of the lower eyelid divides the orbital region and the midface. It is formed by the orbital septum and a thin fascia of the deep portion of the orbicularis oculi inserted at the inferior orbital rim.



With aging, this structure becomes loose and weak and slides downward, further emphasizing the changes of the aging face.

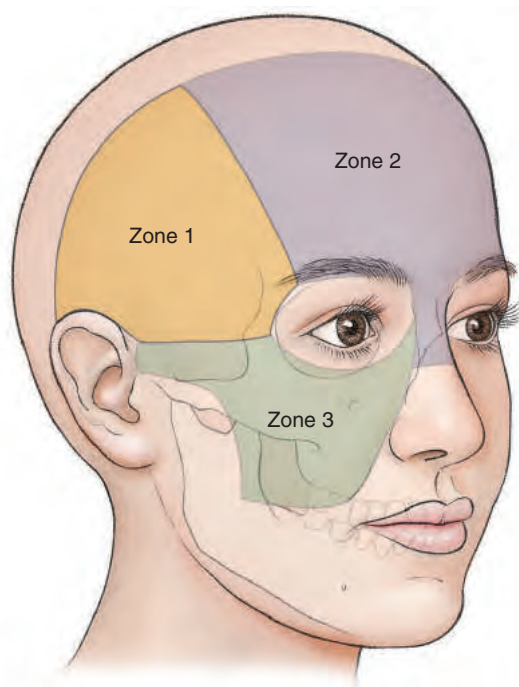
The muscles of the orbitofrontal area have a fundamental importance in determining brow position. The frontal muscle terminates abruptly along the superior temporal line (the crest of the temporal bone); it is an extension of the galea aponeurotica, beginning at the level of hairline implantation and extending through the supraorbital skin. Its function is to elevate the brows. The brow is suspended by the frontal muscle only in its medial two thirds. Because of that anatomic aspect, the descent of the tail of the brow is usually more evident than in the head and body. Clinically, the descent of the brow tissues in the temporal region contributes to the tired or sad facial appearance often associated with aging. The temporal area and lateral periorbital

area can also be considered to be a continuation of the middle third of the face and equally responsible for the anatomic manifestations of the aging face.

FACIAL ANALYSIS

Zones of the Brow and Midface

Careful patient evaluation is fundamental to achieving a good surgical result. Facial aging is nothing more than the clinical manifestation of the physiologic alterations of facial anatomy. The midface has a direct anatomic relationship with the temporal and periorbital areas. Our facial analysis consists of a detailed evaluation of the different facial zones and their structural changes from aging.



To facilitate understanding of the endoscopic anatomy of the brow and midface, we have divided the upper face and midface into surgical zones. Success with any operation for facial rejuvenation requires a basic understanding of these aesthetic zones and the anatomic structures that are affected by the aging process.

Zone One

Zone 1 comprises the temporal region, extending medially to the temporal crest, inferiorly to the supraorbital rim, and downward along the lateral orbital rim and the superior border of the zygomatic arch. The floor of zone 1 is the temporalis muscle and the deep temporal fascia, and the roof is the superficial temporal fascia and all of the other structures superficial to it. Dissection at this level is suprafascial—on top of the deep temporal fascia and below the temporal parietal fascia.

Zone Two

Zone 2 is limited laterally by the two temporal crests, inferiorly by the supraorbital rims and nose, and superiorly to the level of the incisions. Dissection in zone 2 is subperiosteal, keeping the galea and the skin above intact. During midface surgery, the surgeon must connect zones 1 and 2 by releasing the areolar tissue at the level of the temporal crest.

Zone Three

Zone 3 comprises the lateral and inferior orbital rim, malar bone, and the premaxilla. Dissection is subperiosteal, under the malar fat pad. The infraorbital rim is often visualized in the medialmost aspect of the dissected pocket.

Zone 3 also incorporates the inferior eyelid, which we do not consider to be part of the midface.

Transitions

Understanding the transition between zones 1 and 3 and their anatomic structures is critical for safe and precise dissection in the midface. The transition between zones 1 and 3 is outlined by the sentinel veins, the medial temporal zygomatic nerve, the lateral temporal zygomatic nerve, and the lateral temporal zygomatic veins and artery. It is essential to preserve these cutaneous nerves and avoid numbness over this area of dissection.

Indications and Contraindications

Clinical indications for midfacial lifting include the following:

- Accentuation of the nasolabial grooves
- Ptosis of the corners of the mouth
- Ptosis of the lateral corner of the eyelids
- Sliding of the malar bags
- Deepening of the orbital rims
- Loss of the projection (flattening) of the malar area
- Accentuated nasojugal grooves
- Ptosis of the tail of the brows
- Dynamic periorbital wrinkles

Contraindications for endoscopic treatment of the midface include the following:

- Prominent malar bone that compensates for midface ptosis
- Lack of adequate soft tissue volume to restore midface contour
- Need for full facial rejuvenation; this category of patients can undergo midface rejuvenation without the need for a separate endoscopic procedure
- Other medical contraindications

Preoperative Assessment

Preoperative evaluation includes questions about anamnesis, current pathologies, and medications—specifically ones that change platelet adhesion, such as aspirin, ginkgo biloba, and antiinflammatory drugs. The requested preoperative exams include the following:

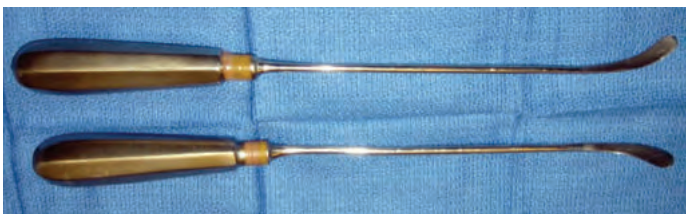
- Complete blood cell count
- Coagulation function assay
- Glycemia testing
- Creatinine levels and clearance
- Electrocardiogram
- Chest radiographs

Planning

Pertinent Instruments

The following instruments are of particular importance for endoscopic midfacial rejuvenation:

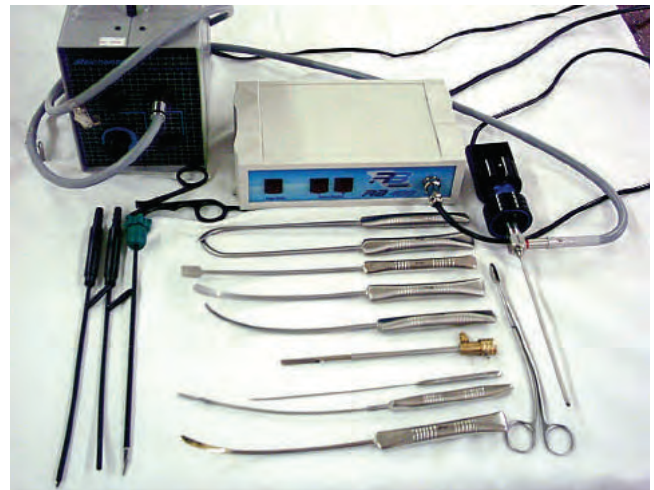
- Subperiosteal hockey-stick elevators
- Fixation devices
 - Casagrande needle
 - Endotine device



Hockey-stick elevators



Casagrande needle



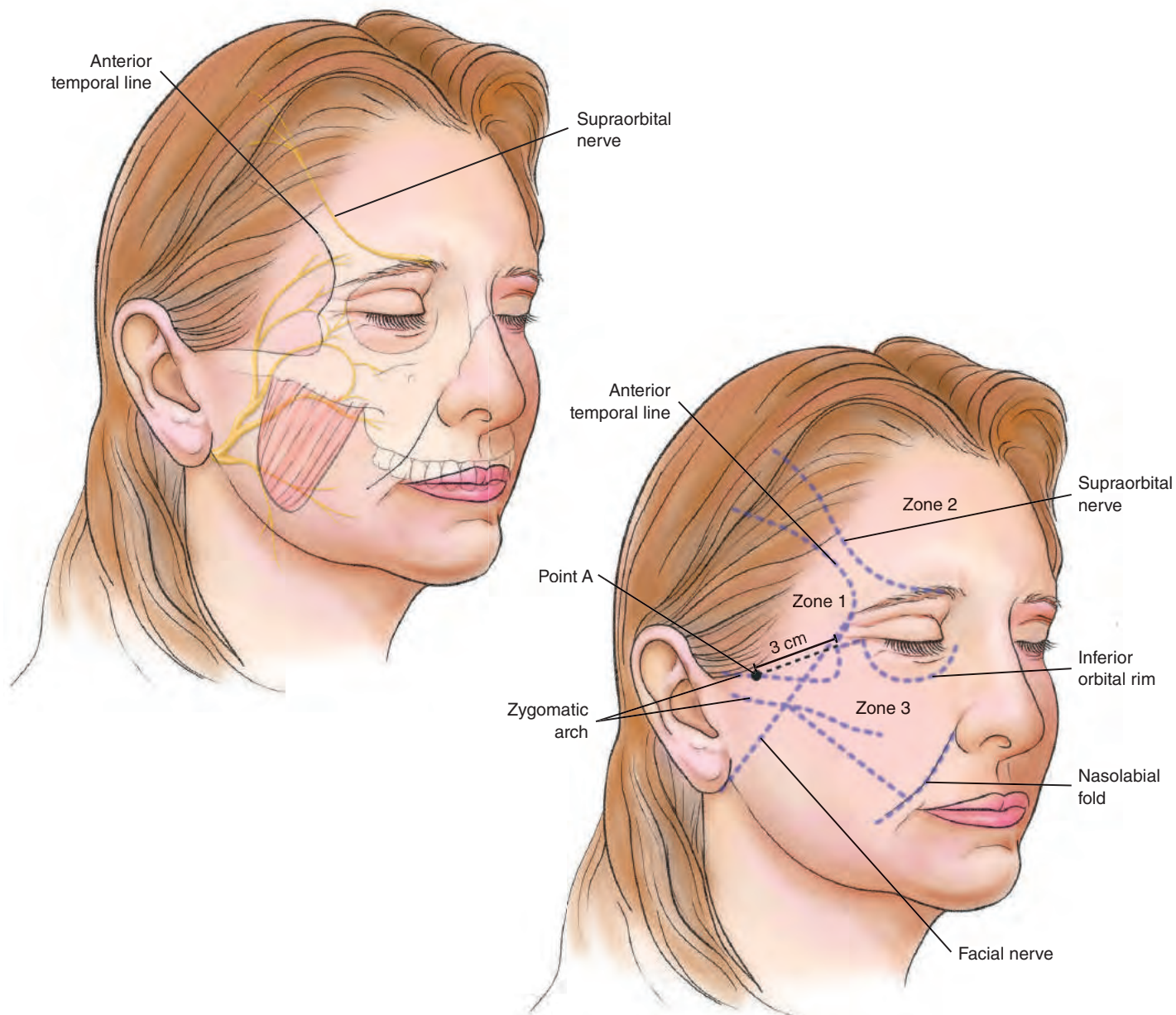
Basic surgical instrumentation for facial endoscopic surgery



Endotine device

Operative Technique

Markings



The midface is a small area of the face, but it represents a very important aesthetic unit. Anatomically, it is delimited superiorly by the inferior eyelid, medially by the nasofacial angle, laterally by the pretragal area and sideburn, and inferiorly by the nasolabial groove. The three zones of dissection should be outlined at this point. Endoscopic midface rejuvenation can be combined with an endoscopic brow lift (zones 1, 2, and 3) or performed as an isolated procedure (zones 1 and 3). The scalp and temporal areas are prepared and marked.

The deep branch of the supraorbital nerve is an important landmark. Its trajectory should be outlined during marking to avoid incisions in this area, which can cause paresthesia in the anterior scalp.

The following landmarks are marked for endoscopic treatment of the midface:

The inferior orbital rim and zygomatic arch

The nasolabial folds

Point A at 3 cm lateral to the lateral orbital rim at the level of the superior zygomatic arch

A line communicating the distal third of the nasolabial fold to define the area of subperiosteal dissection of the midface, which is anatomically defined superiorly by the lower eyelid, medially by the nasofacial angle, laterally by the pretragal area and sideburn, and inferiorly by the nasolabial fold

The anterior temporal line (a periosteal fold that separates the frontal from the temporal area)

A line from the inferior earlobe to the lateral corner of the lateral brow to outline the trajectory of the temporal branch of the facial nerve

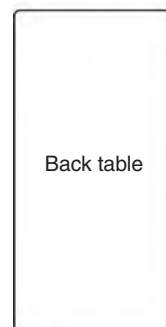
A line from the superior zygomatic arch at the lateral corner of the eye to outline the transition from the temporal area to the midface (zones 1 to 3)

A line that crosses the frontal area until 2 cm above the superior orbital edge divides the frontal area in two areas

Operating Room Setup and Patient Positioning

The surgical suite must be well organized to perform an endoscopic procedure. A complete surgical plan is essential to define the patient's positioning. The imaging equipment should be at the foot of the surgical table to permit better visualization. The surgeon and the assistant should be at the head of the table.

The endotracheal tube should be tied to a tooth using dental floss and wrapped with sterile plastic so that it is visible through the entire surgical case. The microcamera cable should be long enough to permit adequate movement and should be covered with a sterilized plastic sleeve. The fiber of the cold light and the optical should be disinfected in 2% glutaraldehyde solution.



Videoendoscopic equipment (including monitor)

The patient's head should be placed on a soft head support that facilitates the bilateral mobilization. The endotracheal tube, when used, should be fastened appropriately to avoid accidents during some mobilization. The positioning of the team and the patient is very important to facilitate the procedure.

Patient Preparation



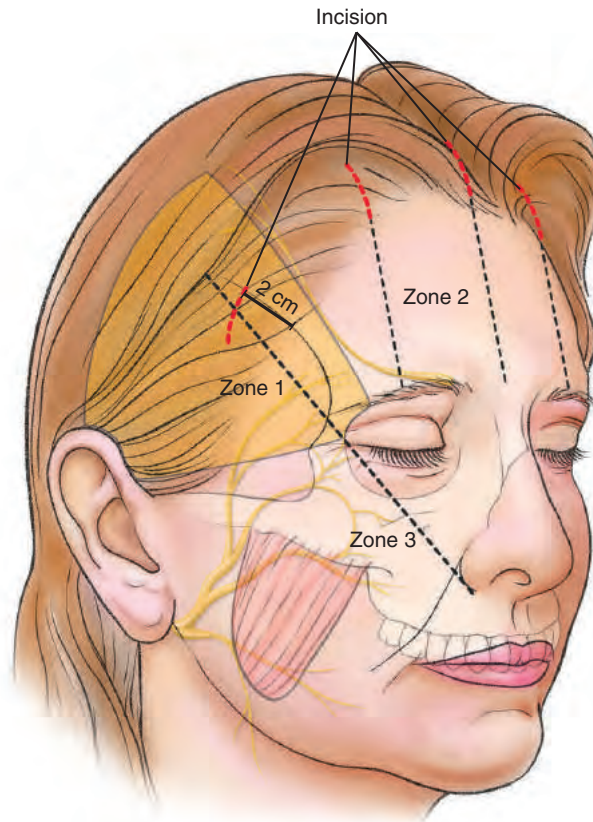
The patient's hair is tied back without shaving to allow spaces for marking the incisions in the temporal and paramedian scalp sites.

Infiltration

This procedure is done with the patient under local anesthesia and sedation. Tumescence infiltration with a local anesthetic to the temporal, forehead, and midface areas allows creation of an excellent optical cavity by providing vasoconstriction and easy dissection. General anesthesia can be used with the endotracheal tube secured to the upper teeth with dental floss. The tube is wrapped with a sterile plastic sleeve and is incorporated into the sterile field. It should be visible and readily accessible at all times and if necessary adjusted without breaking sterile technique. The eyes should be protected with ointment and shields.

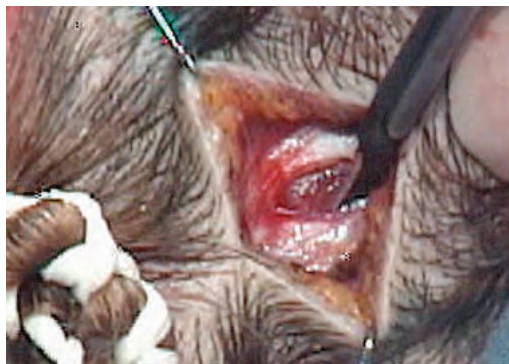
We infiltrate lidocaine 2% without epinephrine for nerve blockade (supraorbital, supratrochlear, and infraorbital). An anesthetic solution contains 20 ml of 2% lidocaine without epinephrine, 20 ml of 0.5% bupivacaine without epinephrine, 1 ml epinephrine, and 160 ml of cold isotonic saline solution for a total volume of 200 ml.

Incisions

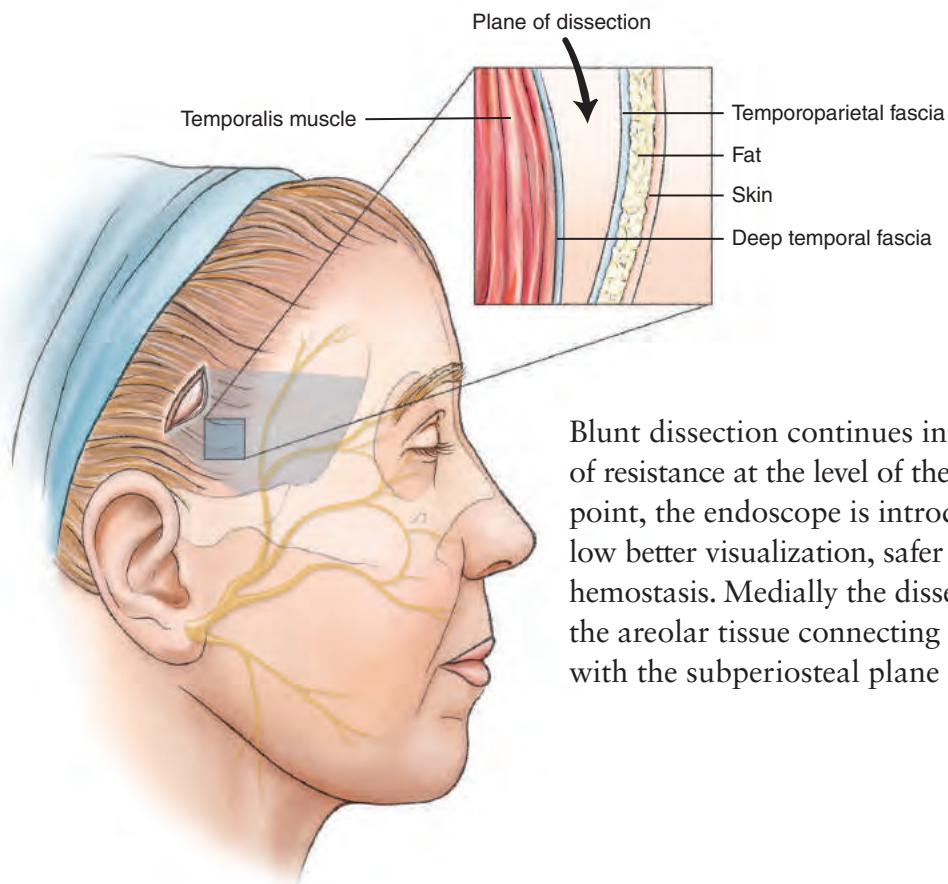


A temporal incision (*red dashed lines*) gives access to the temporal area and the mid-face. It is positioned 2 cm posterior to the hairline in a coronal direction, corresponding to a line from the lateral wing of the nose, passing through the lateral tail of the brow, and reaching the scalp.

Dissection

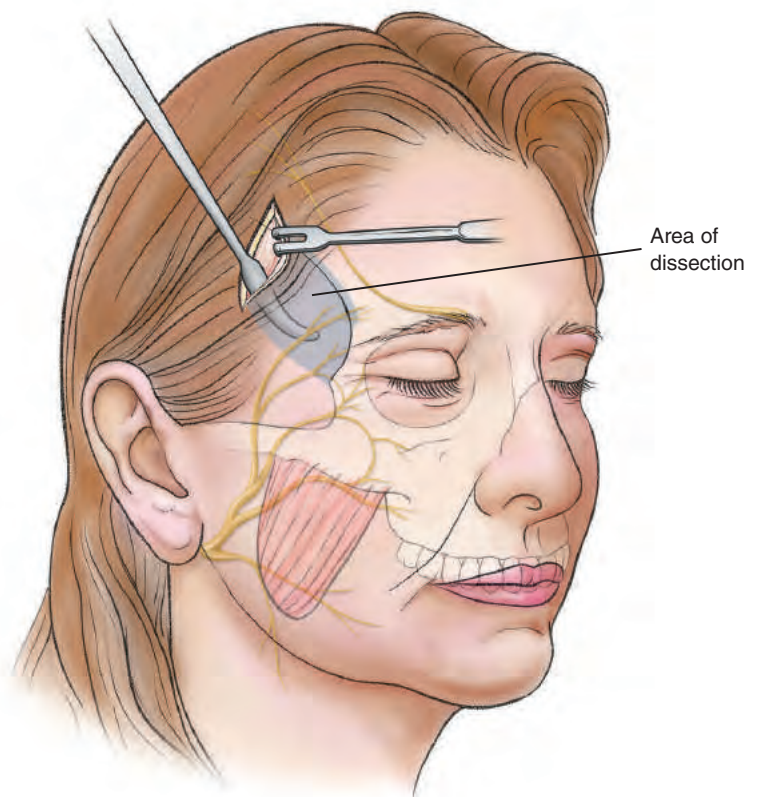


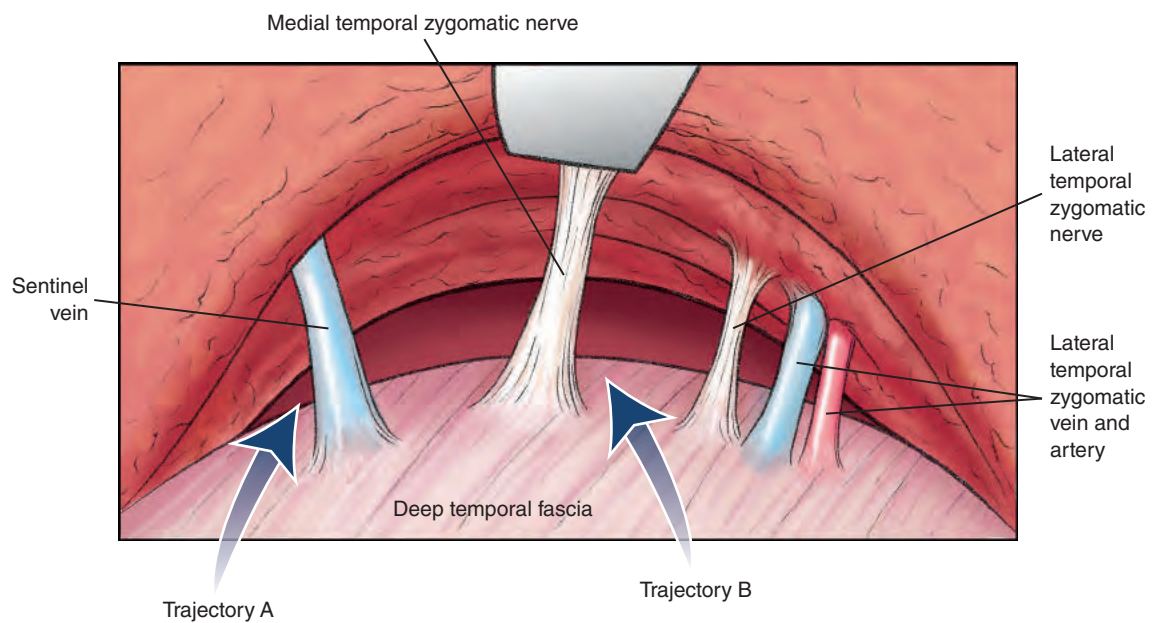
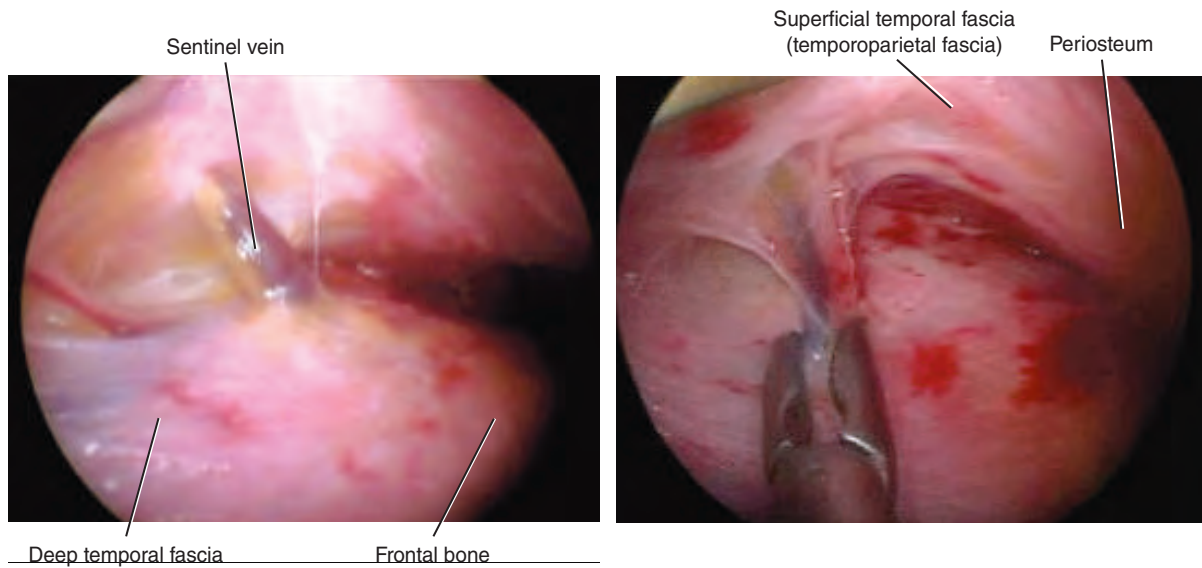
Dissection through the temporal incisions is carried down to the deep temporal fascia. Identifying the temporal muscle under the deep temporal fascia is useful to secure the right plane of dissection, which should be above the deep temporal fascia.



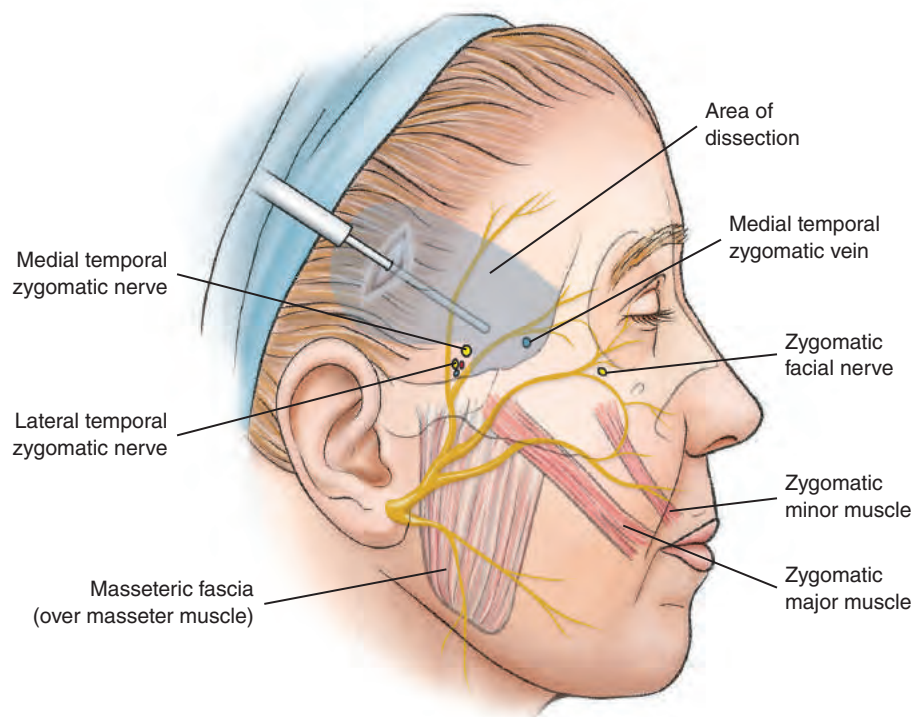
Blunt dissection continues inferiorly down to a point of resistance at the level of the supraorbital rim. At this point, the endoscope is introduced in the cavity to allow better visualization, safer dissection, and adequate hemostasis. Medially the dissection continues through the areolar tissue connecting the deep temporal fascia with the subperiosteal plane (zones 1 and 2).

The plane of dissection in this anatomic zone is under skin, fat, and the temporoparietal fascia. The temporal branch of the facial nerve is superficial to this plane of dissection. It is protected by the intermediate fascia (loose areolar tissue), the superficial temporal fat pad, and the temporoparietal fascia. The nerve is in the “roof” of the dissection. Dissection continues along the areolar plane until it reaches the supraorbital rim and superior border of the zygomatic arch.

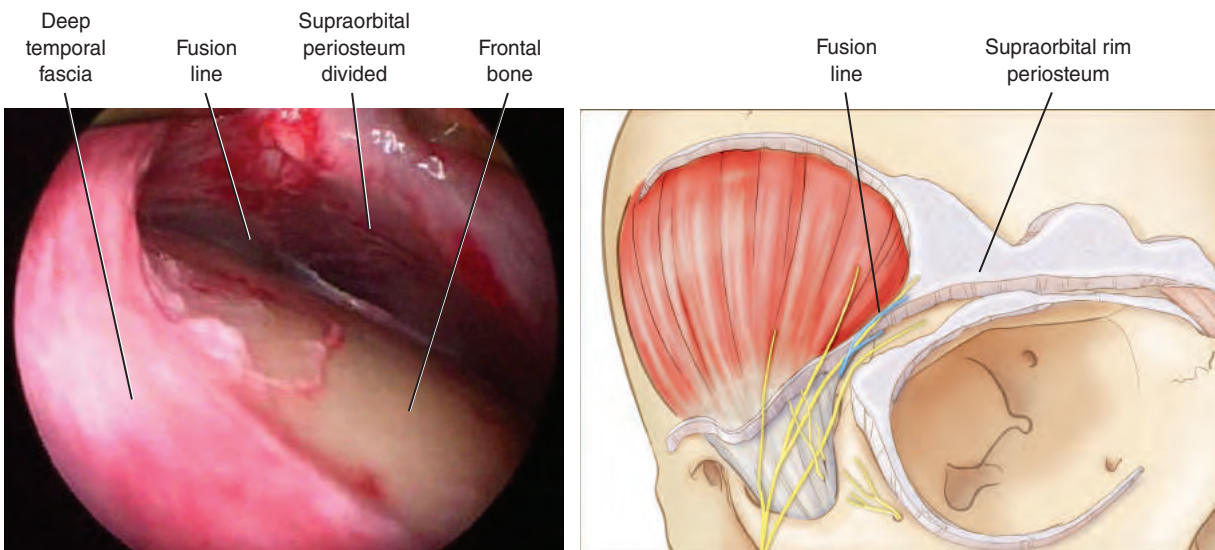




Dissection continues below the superficial temporal fascia (temporoparietal fascia) and above the deep temporal fascia. The sentinel veins are identified and preserved among the two planes. If they are in the way of the dissection, they can be cauterized; the overlying skin should be protected. The assistant should irrigate the site when necessary to optimize the quality of the optical field.

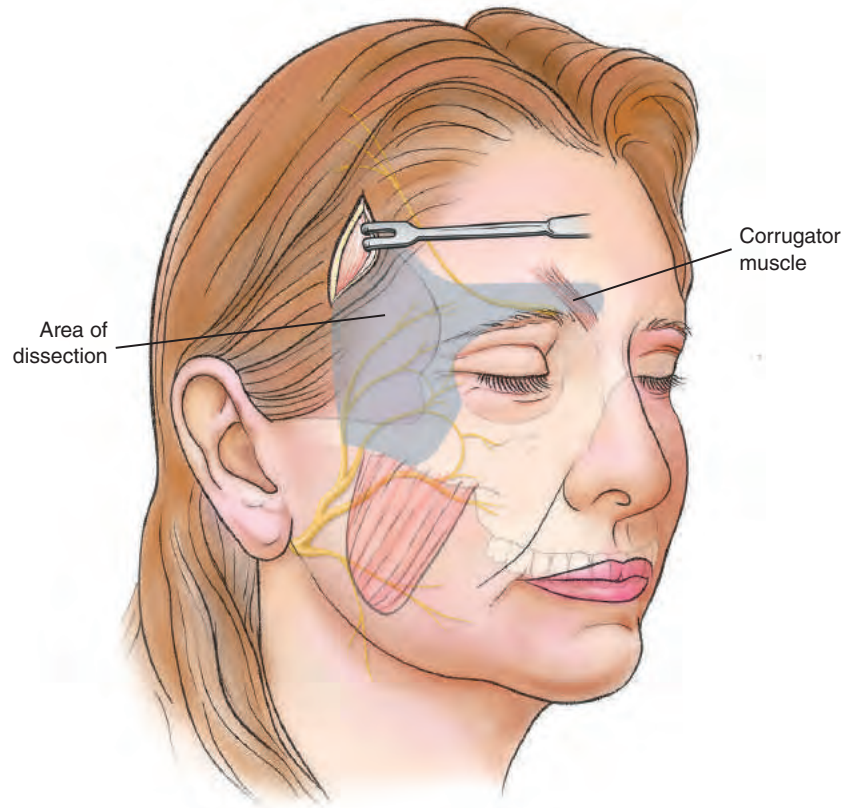


Careful tissue elevation with the endoscope will minimize trauma to the infraorbital nerve and avoid paresthesias in the midface. Creation of a limited medial area of dissection in the transition between zones 1 and 3 will prevent harm to the temporal branch of the facial nerve by avoiding the two lateral thirds of the zygomatic arch. These branches extend from the superior pole of the parotid gland, cross the zygomatic arch under the SMAS, and then become more superficial. They perforate the superficial temporal fascia and follow an anterosuperior direction, approximately 1 cm lateral to the tail of the brow, until they reach the frontal area.



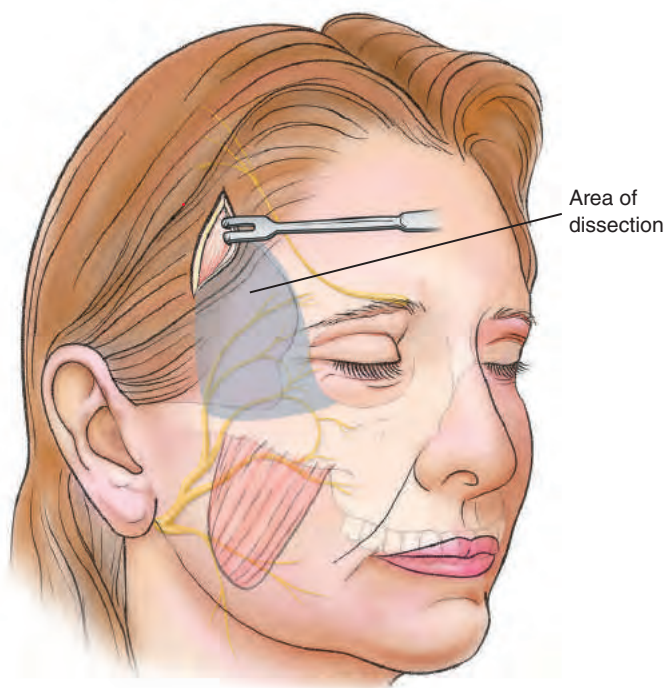
The caudal dissection along the anterior temporal line (temporal crest) encounters the temporal ligament, better known as the *fusion line*; this is where the periosteum meets the deep temporal fascia.

The next step is the dissection and release of the fusion line that continues with the release of the supraorbital rim periosteum to allow release of the brow and permit entry to zone 3 in the midface. The supraorbital nerve is identified and preserved.

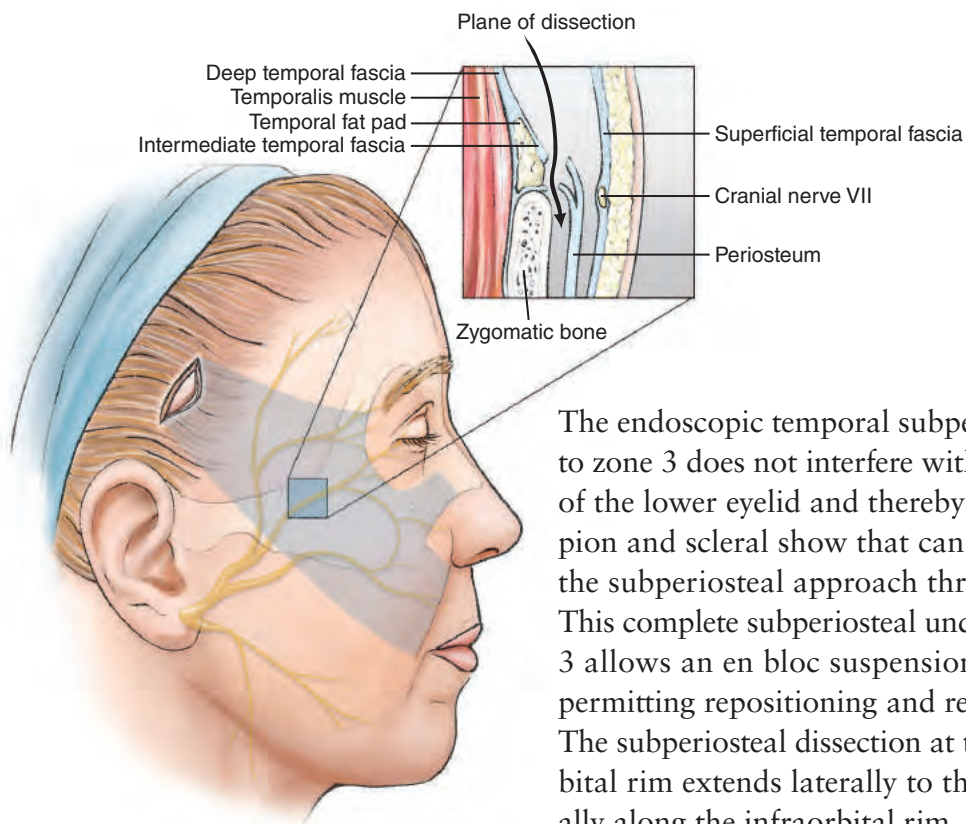


If the brow is also being treated (zone 2), the supraorbital dissection continues medially until the corrugator muscle is seen. The corrugators are completely avulsed with an endoscopic grasper; the branches of the supratrochlear nerve are preserved. The assistant keeps finger pressure over the glabella to assist in the removal of the corrugator fibers and to minimize trauma to the underlying skin and the development of possible future indentations in this area.

Limited undermining into zone 2 reaches the suborbicularis ocular fat (SOOF). The SOOF is a fatty sheath located below the suborbicularis oculi muscle in the lower eyelid and is firmly attached to muscle fascia.

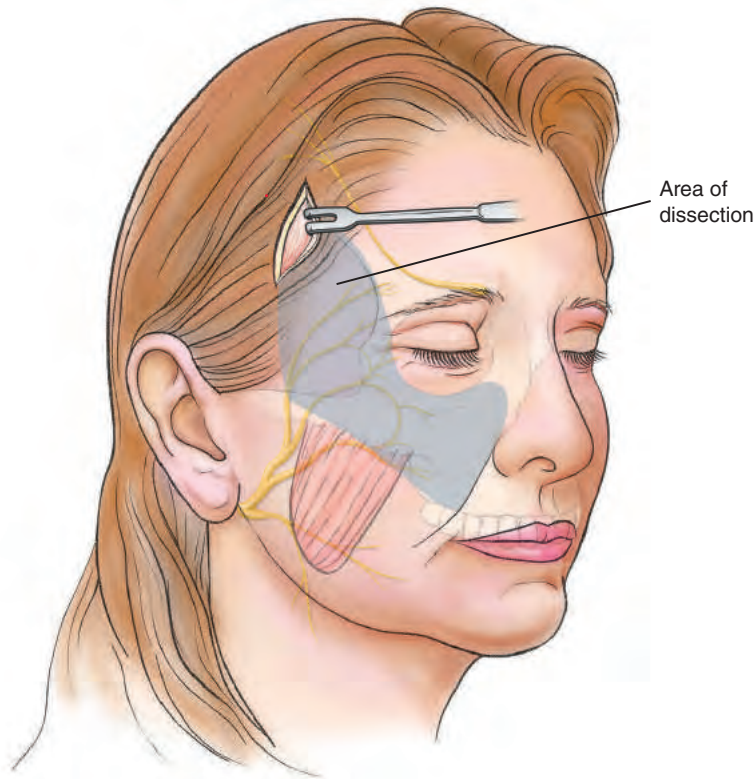


If the brow is not being treated and only zones 1 and 3 are to be dissected, the next step is to extend the subperiosteal dissection down into the lateral orbital rim. Careful attention to this narrow and often delicate area is needed to maximize endoscopic vision and minimize trauma to the neurovascular structures present in this transition zone.



The endoscopic temporal subperiosteal approach down to zone 3 does not interfere with the muscle innervation of the lower eyelid and thereby avoids the risk of ectropion and scleral show that can sometimes be seen with the subperiosteal approach through the inferior eyelid. This complete subperiosteal undermining of zones 1 and 3 allows an en bloc suspension of the midface tissues, permitting repositioning and restoring midface volume. The subperiosteal dissection at the level of the lateral orbital rim extends laterally to the malar bone and medially along the infraorbital rim.

The *Bichat ball* or buccal fat pad is located inferiorly and deeper to the malar bag and medial to the masseter muscle and superficial to the buccinator muscle. The branches of the facial nerve pass superficial to the Bichat ball.



Dissection continues down to the gingival groove after complete release of the orbital retaining ligament. At the gingival groove, the periosteum is thin and easily disrupted during dissection. In this region the nasolabial fold can be treated, if it is too deep, by undermining of the subcutaneous tissue around it.

The masseter muscle inserts into the zygomatic bone. It is often necessary to release some of its fibers to allow an easier dissection to facilitate insertion of the scope through the lateral orbital rim down into the midface. These fibers should be carefully avulsed or transected with the endoscopic scissors. A wider dissection in this very narrow tunnel allows better visualization of the midface cavity, more secure fixations, and decreased incidence of relapse after midface lifting with the potential for better long-term results. However, a wide midface dissection can also cause more pronounced and prolonged edema.

Once the lateral orbit rim periosteum is elevated, the endoscope can be advanced with a downward movement. Subperiosteal undermining with a hockey-stick elevator allows dissection of the inferior orbital region in a safe plane. The objective is to elevate the whole periosteum and lower eyelid and its structures to allow correction

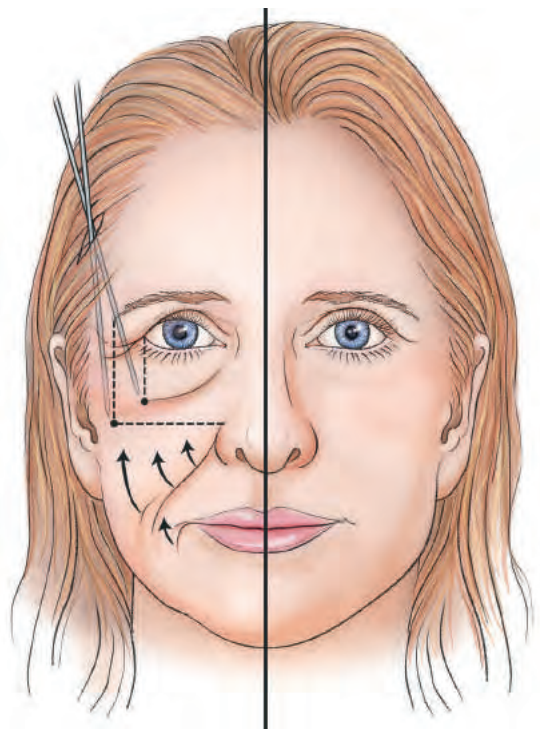
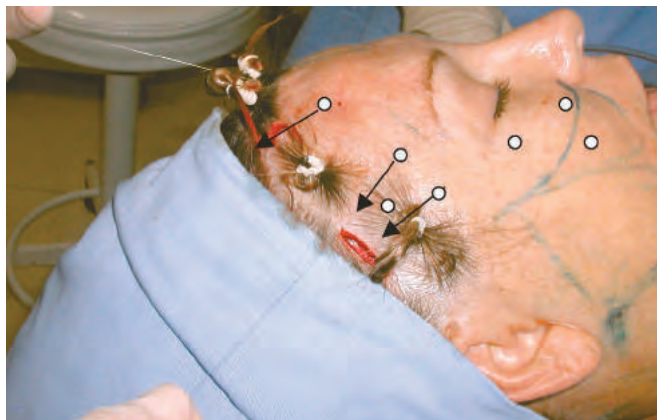
of depressions in this area. The dissection lifts and redrapes the skin and underlying tissues. The inferior eyelid can be treated separately through a transconjunctival approach to ameliorate the herniated fat pockets. If there is skin excess, it can be treated by very conservative skin removal or laser therapy. This safe approach protects the integrity of the lower eyelid innervation. The dissection extends medially to the nasal bones. At this point the premaxilla is completely released and ready for fixation.

Fixation

Long-lasting results often depend on adequate dissection, extensive periosteal release, and appropriate fixation. Two different techniques of fixation will be presented: the direct needle fixation technique and the device fixation technique.

Direct Needle Fixation

Fixation begins after undermining is complete. With this technique, a straight, thin needle (Casagrande needle) is used, based on the principles of the Reverdin needle.



The needle is introduced through the skin at points that are marked for skin elevation. After the needle is inserted, endoscopic visualization allows direct observation of the needle penetrating the optical cavity. The needle is carefully drawn out through the temporal incision, and a nonabsorbable suture is introduced through the eye of the

needle. The needle is then passed back under the skin, and after a small trajectory through the soft tissues, is brought out again externally through the temporal incision and secured to the deep temporal fascia. At this point the suture material is removed from the needle's eye and kept attached to the soft tissues, promoting elevation and fixation. Outlining of the nerves in this region helps the surgeon to avoid any damage during this maneuver. The soft tissues are secured first. In extended endoscopic frontal lifting, there is only one point of fixation at the level of the SOOF. In endoscopic midface lifting, two, three, or more points of fixation are used: the first at the level of the malar fat pad, the second to the SOOF, and another one at the infra-orbital area. In the frontal region the fixation points are applied through the paramedian incisions. Usually the first fixation point is applied in the direction of the lateral canthus, the second at the level of the lateral brow, and the third at the hairline. Proximally, the fixation is as close as possible to the hairline and deep temporal fascia.

This fixation technique permits precise repositioning and fixation of soft tissues, with predictable outcomes. The subperiosteal dissection provides an adequate blood supply to the skin flaps and allows the simultaneous use of skin resurfacing modalities, such as lasers and chemical peels. The limitations of this technique are that it relies on suture suspension only, may result in minor asymmetry because of different vectors for fixation, and involves a long learning curve.

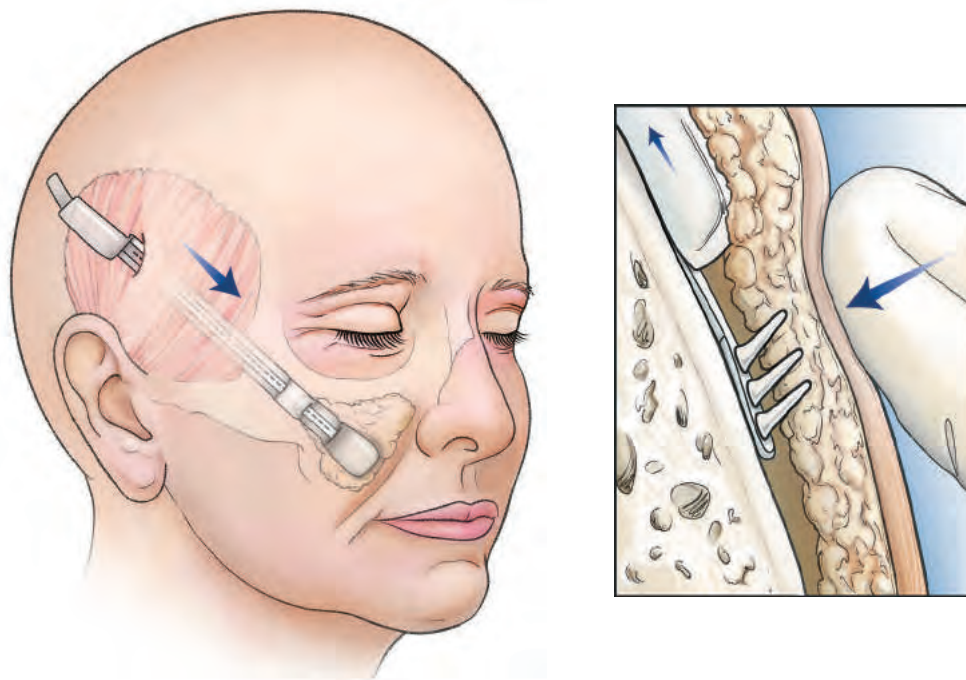


This 50-year-old patient requested full facial rejuvenation. She underwent endoscopic suspension of the frontal region and midface with a Casagrande needle and suture technique, with fixation to the temporal fascia. She also had a cervical lift, treatment of zones 1 and 3, and a SMASectomy, as described by Baker.

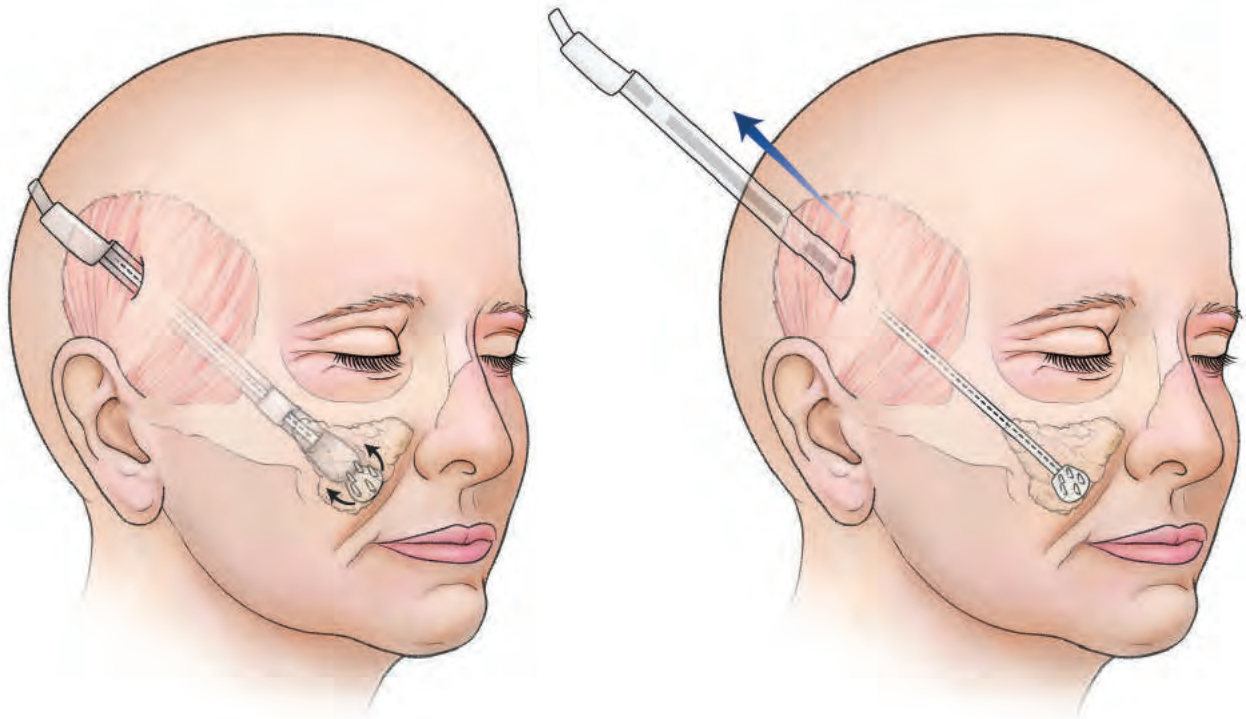
Device Fixation Technique

Since 2003 I have been using the Endotine midface device (Coapt Systems, Palo Alto, CA). It is now my preferred method of suspension and fixation for malar fat pad elevation. The surgical technique for dissection is the same as previously described.

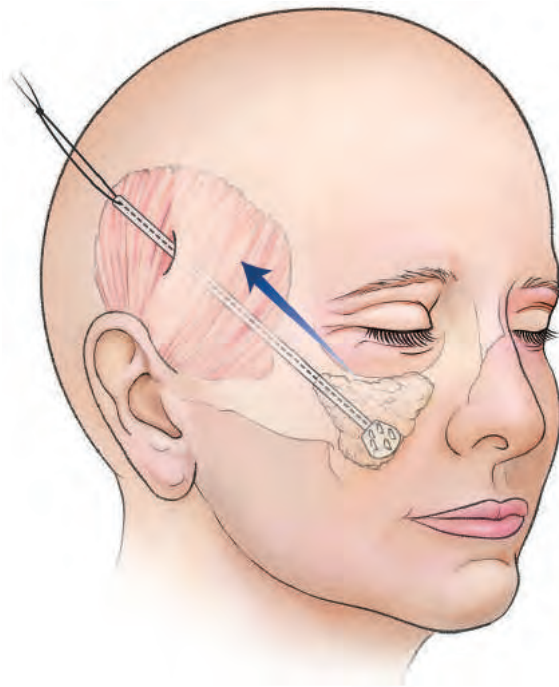
The Endotine midface device has five prongs or tines that will engage the soft tissues and suspend and secure them in position.



A deployment system protects the implant during insertion, and deployment is achieved with a simple trigger release to engage tines to soft tissue. Digital pressure engages the tines.



Once the soft tissue is engaged, the insertion tool is removed through the temporal incision.



Tension is applied to the anchoring leash to achieve the desired elevation. The leash is then sutured to the temporal fascia and the excess leash is trimmed.

This easy, step-by-step midface suspension-fixation device enhances soft tissue fixation, provides simple adjustability for optimal elevation and projection, and maintains mechanical fixation until biologic fixation is adequate. The five tines provide multiple points of contact for secure soft tissue fixation. The elevation forces are evenly distributed over a wide area, eliminating skin irregularities. Insertion and deployment are readily accomplished through the temporal incision. Implant palpability is minimal, and reabsorption starts at 6 months. The Endotine midface fixation technique offers several advantages:

- It avoids an intraoral incision.

- It eliminates sutures.

- The deployment is simple, secure, and offers multipoint fixation.

- The device is bioabsorbable.

- The leash fixation mechanism provides fast and simple adjustability for optimal control of the elevation and volume of the midface.

Tissue glue is sprayed in the dissected pocket to decrease swelling and bruising by acting as a sealant on the lymphatic drainage system.

Closure

The scalp is closed in the temporal area in two planes: one reattaching the scalp to the temporal fascia and the other closing the dermis and the skin, both using absorbable sutures. The hair and scalp are shampooed, then the patient is extubated and taken to the recovery room.

Postoperative Care

During the immediate postoperative period, the position of the patient's head should be watched carefully to maintain the airway. In the anesthetic recovery room, the headboard should remain elevated to 30 degrees to avoid excessive facial edema. The patient's blood pressure must be carefully monitored to avoid bleeding and hematomas. Ice bags can be used on the surgical areas. We also supply a splint on the undermined areas for 5 days. The patient is allowed to shower from the first postoperative day. Analgesia is accomplished with the use of an oral analgesic. Antibiotics are used for only 24 hours. Lymphatic drainage massage (48 to 72 hours postoperatively) promotes opening of the lymphatic channels with decreased swelling, less discomfort, and improved appearance in the early postoperative period.

Results



This 49-year-old patient underwent endoscopic lifting of the frontal region and mid-face with fixation, using the Casagrande technique. She also had a cervicoplasty combined with a SMASectomy, superficial and deep chemical peels, and a combined rhinoplasty. She is shown 1 year postoperatively.



This 45-year-old woman was seen in consultation for midface rejuvenation. She was treated with an endoscopic brow and midface lift using the temporal incision only and Endotine devices for fixation. Fibrin glue was sprayed in the midface pocket to minimize swelling and bruising. Lateral and oblique views at 1 year after surgery show rejuvenation of the midface area with elevation of the malar fat pad, improvement of the tear trough, and softening of the nasolabial folds.



This 39-year-old woman requested forehead and midface rejuvenation. She underwent a brow and midface lift in which the endoscopic technique was used, with a temporal incision only. The fixation of the brow lift was completed using permanent sutures from dermis to deep temporal fascia under the temporal incisions and Endotine fixation devices for the paramedian incisions. The midface elevation was obtained by using Endotines. Fibrin glue was sprayed in both dissected pockets to seal the tissues, minimize bleeding, and decrease early postoperative swelling.



This 52-year-old woman requested facial rejuvenation. She was a candidate for full-face and forehead rejuvenation with a brow and face lift. However, she did not want to have a face lift at this time to avoid the preauricular scars. She underwent a forehead and midface rejuvenation with an endoscopic technique through a temporal incision, avoiding any visible scars. The 1-year postoperative views demonstrate improvement in the forehead wrinkles, brow position and symmetry, and periocular and midface rejuvenation. Midface suspension also softened the nasolabial folds and decreased obvious jowling. Although a face lift would have provided a better solution for the lower face, this procedure employed a combination of minimally invasive procedures to meet the patient's expectations.



This 49-year-old patient wished to improve her facial appearance, especially her midface and neck. She underwent surgical rejuvenation of the entire face, with endoscopic frontal and midface suspension with fixation to the deep temporal fascia with the use of 3-0 and 4-0 nylon sutures. She also had treatment of the cervical region and a SMASectomy.

Complications

The most common complications are temporary supraorbital and supratrochlear nerve paresthesia caused by pocket dissection and stretching of the tissues. They usually last 2 to 3 weeks, are manifested frequently as numbness or local itching, and recover spontaneously.



This 45-year-old woman was seen in consultation for forehead rejuvenation. She underwent endoscopic forehead rejuvenation and experienced temporary paralysis of the right temporal branch of the facial nerve. She recovered completely after 120 days. Paresthesias resulting from a lesion of the temporal branch of the facial nerve are extremely rare. The treatment is observation and reassurance for 3 to 6 months, time required for spontaneous resolution.

Persistent edema and ecchymosis can also occur, and patients should be instructed to avoid sun exposure during this period. Hematomas can be avoided with good surgical technique, careful hemostasis, control of blood pressure during surgery, and a smooth recovery. Treatment for expansive hematomas consists of immediate surgical evacuation and drainage.

Brow and midface asymmetries can occur. They can be related to dissecting pockets differently, asymmetrical or inadequate lifting in one or both sides, and/or excess of facial muscular action immediately after surgery. Sometimes surgical revision is necessary to correct the resulting asymmetry.

Clinical Caveats

In an endoscopic midface lift, during the dissection from the temporal region to the lateral orbital rim and midface (the zone of transition), it is critically important to preserve the nerve structures to avoid numbness in the cheek area.

If necessary, the sentinel veins can be cauterized for better dissection and easier instrument manipulation in the transition zone between the temporal region and the midface.

Subperiosteal elevation at the level of the lateral orbital rim is the key to facilitating safe undermining of the midface.

Release of masseter attachments to the malar bone facilitates dissection and improves the surgeon's ability to slide the scope along the narrow tunnel in the lateral orbital rim to visualize the midface structures.

Fixation with an Endotine device is quick, safe, and reliable and does not produce the asymmetry seen with some suture fixation.

Fibrin glue can decrease the amount of swelling, discomfort, and bruising when sprayed in the midface pocket before fixation.

Intraoral incisions can be used to reinforce the fixation if necessary.

It is important to preserve the integrity of and avoid trauma to the inferior orbital nerve to prevent paresthesias.

Patients should be informed that swelling may be present for 3 to 4 weeks and numbness for 6 to 8 weeks.

Endoscopic midface lifting does not treat jowling and aging of the neck—it does not replace a face lift.

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The Endotine midface technique, through an endoscopic temporal incision only approach, is the author's preferred method of malar fat pad suspension and fixation. The bioabsorbable Endotine device avoids an intraoral incision, eliminates sutures, offers multipoint fixation, and the leash fixation mechanism provides fast and simple adjustability for optimal control of midface elevation and volume.

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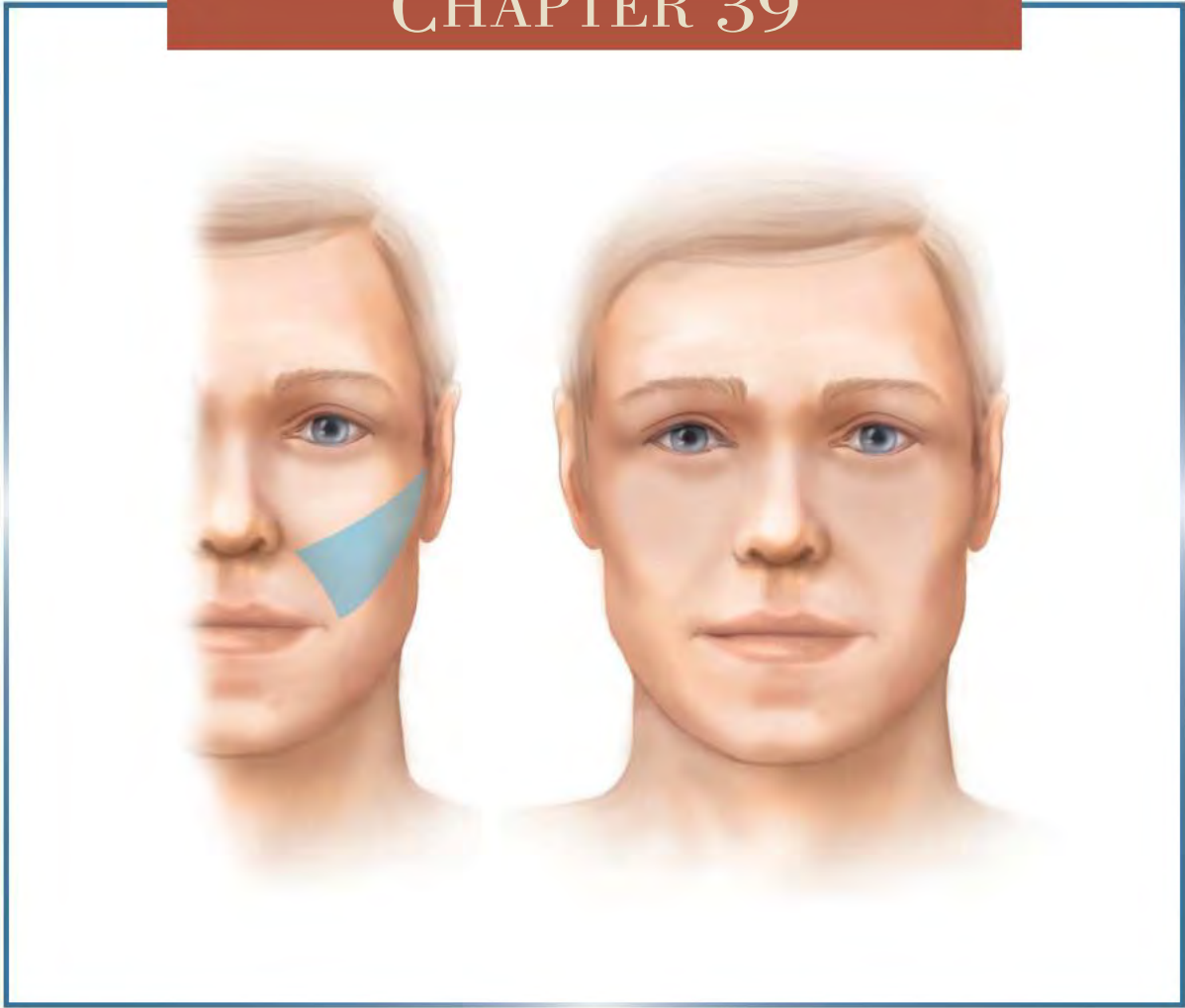
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CHAPTER 39



Alloplastic Facial Contouring

EDWARD O. TERINO

Through the ages, mankind has acknowledged that perceived beauty bestows admiration and power to its possessor. Although standards of beauty change from century to century and generation to generation, the effects that beauty has on those who both perceive it as well as on those who possess it are profound. Facial beauty represents an even more desirable goal, because all communication with others is directed from the eyes and face. The rest of the body, while it may be eloquent in its movements, is camouflaged with clothing most of the time.

Standards of facial beauty have always been associated with the face's anatomic contours. These contours exist as a result of the location, volume, and size of the facial soft tissues and their relationship to the three-dimensional architecture of the underlying facial skeleton. During some eras, roundness and fullness of facial soft tissues were the aesthetic ideal of artists, whereas in other periods more defined and dramatic skeletal contours in the malar and jawline regions were considered most attractive.

During the Renaissance, many artists depicted the ideal female face as heart shaped, with a weak lower face, chin, and mandibular contours. In contrast, contemporary standards of female beauty embody stronger structural contours. Today's women seeking aesthetic plastic surgery request jawlines with more anterior projection, a wider midlateral region, and stronger definition of the posterolateral angle. Malar-midface cheek contours cited as ideal are also strong and defined.

Facial aesthetics is important to today's patients, for whom the idea of surgical alterations to improve attractiveness has become almost a commonplace. The sculptural shape of faces has been known by artists from time immemorial; when plastic surgeons describe a face as *sculptural*, we are referring to its three-dimensional form, including its many integral parts, whose volumes and masses interrelate through juxtaposition. The location of these elements and their relative size and shape constitute what plastic surgeons call *facial contours*. Therefore facial contouring surgery refers to the art of manipulating specific anatomic features in specific locations by working with the skeletal foundation and soft tissues to alter facial topography to either create or enhance facial attractiveness. The skeletal foundation lends definition and structure to the face. Our culture considers such definition attractive or beautiful in youth and even more so during the aging process. The shape of the facial skeleton determines the contours of the overlying soft tissues. Thus skeletal augmentation with alloplastic materials allows plastic surgeons to sculpture faces three-dimensionally.

Autologous soft tissue manipulations and injectable fillers add versatility to the arsenal of aesthetic plastic surgeons; however, I think the results with these materials are less predictable and less precise than with alloplastic contouring. Structural fat grafting techniques are discussed in Chapter 13.

The Future Interrelationship Between Alloplastic Facial Implant Volumization and Injectable Fillers

To the knowledgeable surgeon who is experienced in enhancing facial volume and who has become comfortable with creating attractive facial contours by using implants, the mention of temporary injectable fillers may engender a response equivalent to the negative attitude of trained craniofacial and oromaxillary surgeons toward using alloplastic facial implants. The time-honored tradition in plastic reconstructive surgery has been to use autologous materials for reconstructing facial skeletal injuries, deformities, deficiencies, and disfigurements.

My development of alloplastic skeletal alterations for both aesthetic and reconstructive purposes, which began 35 years ago, has taken many years to gain acceptance by traditional orthognathic, craniofacial, and oromaxillary surgeons, who prefer bone, bone substitutes, and rigidly fixed materials such as Medpor and hydroxyapatite in the face. However, such materials have had a persistent history of causing infection, palpable and visible deformities, and difficulties with removal and exchangeability. Silicone rubber implants have enjoyed the true test of time and have persisted for more than 40 years because of their significant advantages.

Alloplastic facial contouring surgeons fully appreciate the inherent necessity of creating skeletal structural integrity that provides the foundation for either minor or quite dramatic and significant improvements in facial balance to create aesthetic attractiveness or beauty. They also appreciate the value of the permanent, precise dimensional qualities of these implants, which can be easily removed, modified, exchanged, or eliminated according to the patient's and the doctor's desires.

The technical simplicity with which facial implants can be routinely inserted can be thought of as equivalent to surgical interns learning their first hernia, hemorrhoid, or varicose vein operations. The only difference is that the surgeon requires an artistic perception and precise understanding of patients' anatomic needs and must know how to provide them alloplastically.

These procedures are far simpler than a rhytidectomy, SMAS dissection, deep plane dissection, or midface suspension. They require only the willingness and interest of the surgeon to learn this advanced unique, to master this valuable technology and to pay great attention to detail regarding patients' descriptions of their needs and endeavor to translate them into reality. The anatomic and technical concepts presented in this chapter are intended to provide a basis for learning these techniques.

In my experience, alloplastic facial structuring and volumization of faces are the most creative forms of facial aesthetic surgery. The role of today's injectable fillers can also be very valuable. Along with autologous fat transplantation to the face, injectable fillers have enjoyed much interest and extensive use. The role of fat grafting and injectable fillers in facial rejuvenation is more valuable than originally thought, because their results have become more predictable and longer lasting. The beneficial effects of a hyaluronic acid filler used in nonanimated areas of the face, such as the suborbital, malar, or midface region or the nasolabial sulcus area, can last 1 to 2 years. Moreover, there may even be some permanence to these fillers, because there have been some reports that their results persist for an extended period.

However, this remains an underresearched enigma. Although there are experts in fat contouring who show excellent permanent results, the process is very technique dependent: a number of plastic surgeons have found that the fat may partially or totally resorb, depending on circumstances. When transplanted fat persists, it sometimes results in unnatural-looking contours, bumps, and swellings that may be difficult to correct. When one also considers that an increase in weight produces an expansion of the transplanted fat in the face, it seems that the indications for fat transplantation should be carefully defined, and it should be used sparingly when surgeons are trying to provide long-term or permanent volume changes for their patients.

However, injectable fillers provide an exciting adjunct when combined with alloplastic facial structuring and volumization. They can be used to modify and improve the areas over, around, and near the basic foundation structure of the implants, enabling the surgeon to refine the desired aesthetic contours.



This 62-year-old woman had marked midfacial atrophy 20 years after inappropriately shaped implants were inserted by another surgeon (*left*). We replaced the implants with implants of the correct size and shape (*right*) and used injectable HA fillers to soften the contours around the implants and to fill the lower submalar mid-face region. The patient is seen 3 years postoperatively.



This 54-year-old woman had acne that had caused midfacial subcutaneous atrophy, and incorrectly shaped malar implants had been placed by another surgeon 12 years earlier (*left*). She is seen (*right*) 1 year after soft tissue volumization in the submalar midface to soften contours, and the malar implants were replaced to improve her cheek shape.

When HA fillers are used, the surgeon is able to reverse, alter, or modify unsatisfactory contours with hyaluronidase, adding another beneficial dimension to the use of semipermanent fillers. When permanent alloplastic implant facial foundations have already been built by the alloplastic surgeon, these fillers are used to augment and refine contours with greater precision.

Advantages and Disadvantages

The advantages of alloplastic augmentation of the facial skeleton are many:

Such procedures provide volume, mass, and shape to the various natural promontories of the face. The most important of these are the malar-midface and jawline-premandibular regions. The nose is a third major promontory. Great aesthetic advantage derives from augmenting or diminishing its volume. However, alloplastic augmentation of the nose is still very controversial.

Alloplastic materials do not require harvesting operations on other areas of the body.

The operations tend to be relatively rapid.

Placement under the periosteum and directly on bone produces rapid immobilization by surrounding fibrotic capsule formation.

Depending on the material used, the biologic compatibility of the host to resist rejection and infection is very high.

I favor silicone rubber, because any surrounding infections can be resolved in nearly all cases without the need to remove the implant. Administering antibiotics and placing drains will abolish infection around such implants as long as they are nonporous. If infection occurs, porous materials such as Gore-Tex, hydroxyapatite, and Medpor (Porex Surgical Group, Atlanta, GA) may have to be removed, because infectious processes can lodge within the interstices of these nonsmooth materials and challenge the body's defenses.

Another major advantage of alloplastic facial augmentation, especially when using a smooth, flexible material such as silicone rubber, is that it is easily removable, reversible, and changeable. Silicone rubber implants are very flexible and can be introduced and removed through small incisions.

Although it is true that removal of large implants from the central chin region may produce soft tissue ptosis of the central chin mound, this problem is much less likely to happen when introduction of the implant does not transect the mentalis muscle in a horizontal fashion and the dissection is performed vertically through the midline pillars of the muscle. In a rare case, a patient may request removal of a mandibular angle implant or malar-midface implant. In my series, no cosmetic or functional problem has ever resulted from removal.

The major disadvantages of the use of alloplastic materials are several:

Severe infection is possible, especially with porous materials, which become infiltrated with fibrotic ingrowth that complicates ready removal.

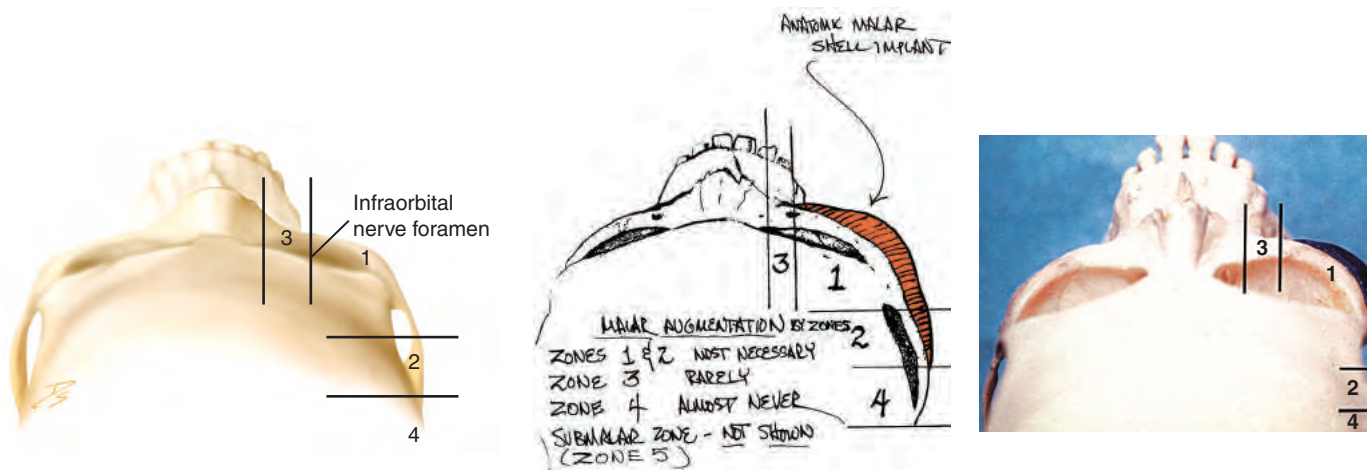
Contour abnormalities of an unattractive or even disfiguring nature can occur when implants do not have the proper shape, size, and positioning.

Damage to facial nerves and musculature is possible from excessive and inappropriate trauma during dissections to introduce or remove the implant.

Indications and Contraindications

Good indications for alloplastic facial augmentation are determined by relative or absolute deficiencies of contour volumes in various anatomic regions resulting from heredity, aging, or trauma from accidents, surgeries, or ablation. Contraindications exist when the overlying soft tissue coverage is severely deficient (as in severe HIV subcutaneous atrophy) or in volume deficiencies in areas of the face that do not have a stable skeletal base, such as the orbital and oral apertures.

I think that any area of the facial skeleton can be successfully contoured with alloplastic implants if they have an anatomically correct design and are placed appropriately.



Optimal implant designs must include a posterior surface that contours to the facial skeleton to provide secure contact and fibrotic immobilization. The margins of the implants must be finely tapered to eliminate palpability. There should be no fenestrations in the implant to allow penetration or fixation with fibrotic scar tissue during the healing process; this makes implants difficult and dangerous to remove. In the vast majority of cases, skeletal fixation using hardware is not necessary and may make removal complicated and risky for a novice surgeon. When desired or indicated in a specific patient situation, customized implants can be manufactured rapidly by extracting data from CT scans and skeletal radiographs (Accuscan, Implants Corporation, Ventura, CA).

Basic Concepts of Facial Aesthetic Contouring

Indications for alloplastic facial contouring arise from considerations of facial aesthetics. An artist is one who perceives natural beauty and develops techniques to imitate it. Artistic perception varies from artist to artist, patient to patient, and surgeon to surgeon. However, there are common denominators in facial form and structure that are perceived by the majority and dictate what is ultimately highly desirable today.

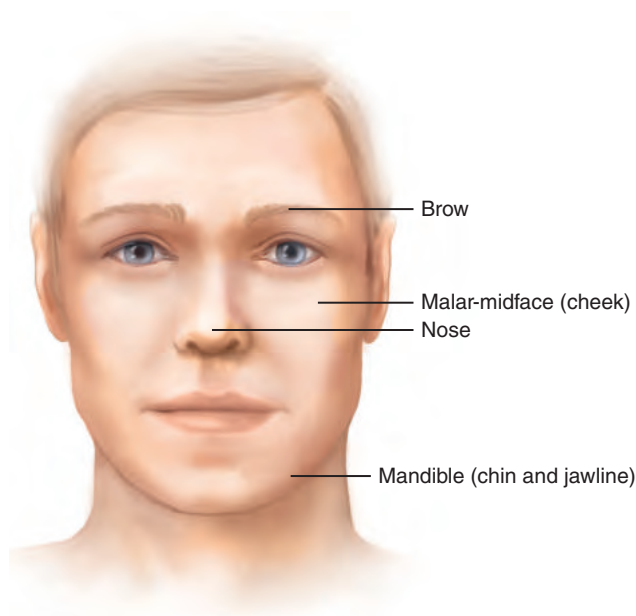
Even the casual observer easily notices the progressive, shrinking, atrophic quality of soft tissue substance in the faces of both men and women. This quality has often been described as the older, tired look of aging rather than the beauty of youthful maturity. This deterioration of the more ample and youthful quality of a face may be observed as early as a person's mid to late twenties and may rapidly proceed into the thirties and early forties.

It is also commonly acknowledged that in individuals with an excellent underlying skeletal foundation, as aging progresses the soft tissues shrink, and the bony prominences show more definition in the face. For some individuals, this definition actually enhances their beauty, whereas in others it unattractively emphasizes the atrophy of the overlying soft tissue. This frequently produces a negative effect that emphasizes the loss of youthful beauty.

Facial beauty relates fundamentally to a harmony and balance of various parts of facial anatomy. Therefore soft tissue substance as well as skeletal structure constitute the common denominators that determine the three-dimensional aesthetic form and shape of faces culturally recognized as attractive or beautiful.



This 58-year-old patient's face lacked balance. To correct this problem, she underwent an upper midface suspension (suborbital mimetic muscle elevation, or SOMME lift), malar augmentation in zone 1 and submalar zone 5 (SM5) with medium 3 mm malar shells. She also had palpebral shape contouring with a lateral canthal sling and revision rhinoplasty. Her lips were augmented with AlloDerm and her chin was augmented with a Terino extended anatomic large implant (Implantech). She is shown 12 months postoperatively.



The major elements of facial volume and mass are four promontories: the chin and jawline, the nose, the malar-zygomatic cheek prominence, and the forehead and supraorbital volumes. Secondary considerations are the temple contours, the premaxilla, and the suborbital region. These areas contribute more subtly but are important nuances to overall aesthetic facial balance. Tertiary contour considerations involve small increases or decreases in soft tissue volumes of the face. These exist:

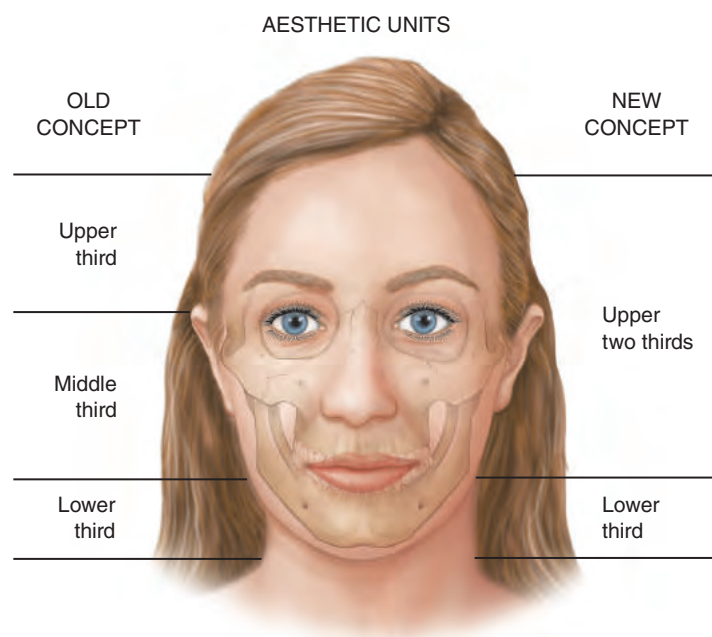
- Along the jawline as jowls

- Within the perioral nasolabial region as creases and folds

- In the suborbital tear trough valley as hollowness

- Around the central perinasal premaxilla as a retrusion or protrusion

Contours in these areas also have major relevance to facial form and balance. It is the interplay between the topographic soft tissue collections and the underlying skeletal promontories that architecturally determine the contours that are perceived as facial harmony, balance, and beauty.



There are three major architectural aesthetic facial segments: upper, midface, and lower. The fundamental principle of facial balance is that a diminution or enhancement of volume (size) in one facial segment directly and inversely affects the aesthetic impact on the others. This principle applies equally to all of the primary, secondary, and tertiary volume/mass contour subunits.

Although large volume/mass changes are the most significant in matters of facial balance, even minor alterations of the subunits are equally important to observe and understand. Augmenting the nasolabial sulcus, the suborbital regions, the glabella, and other more minor subcutaneous contours has a major visual impact on facial aesthetic balance and attractiveness.

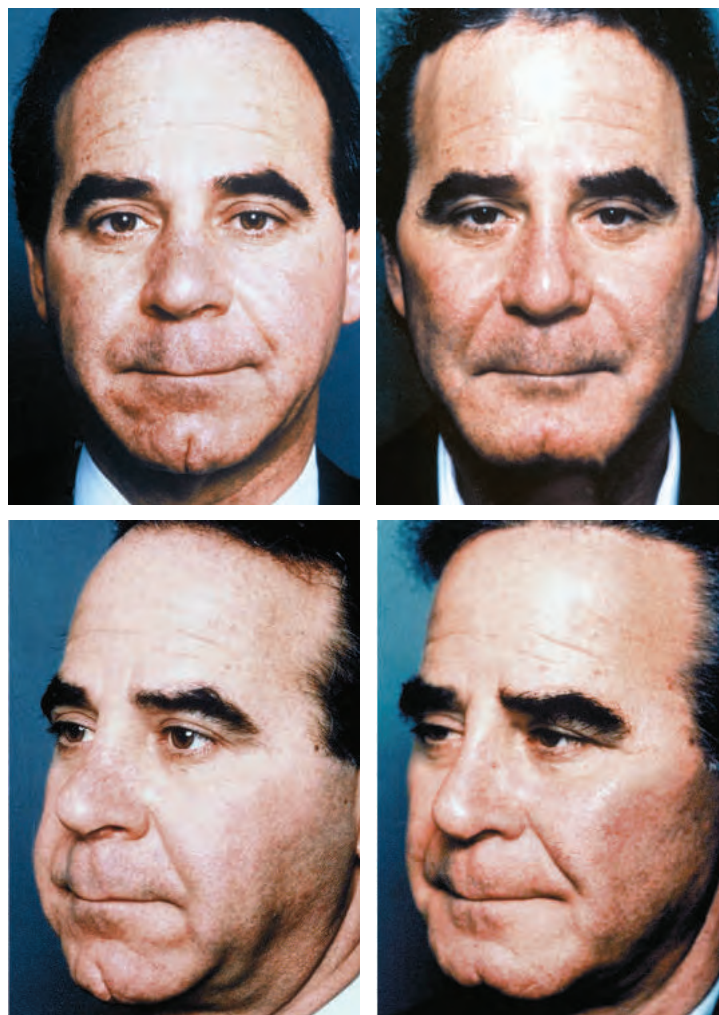
Significant aesthetic improvement is possible only when all three facial segments are evaluated precisely and comprehensively for possible simultaneous alteration. Alloplastic augmentation permits the surgeon to adjust both the major and minor promontories with equal ease and predictability, subtly or dramatically. Modifying facial contours involves three-dimensional change, whereas traditional face-lifting procedures are severely limited because of their more two-dimensional nature.

Recent suspension techniques of the upper facial segment (brow and forehead) as well as the malar-midface segment significantly complement the three-dimensional changes that provide alloplastic regional volume enhancement when performed alone. Nonetheless, only with alloplastic techniques can permanent, precise, and aesthetically pleasing changes in facial contour be produced.



Twenty years earlier, this 46-year-old woman underwent orthognathic surgery for prognathism. Fifteen years ago, she underwent malar augmentation in zone 1 and SM5 with large malar shells; she also had rhinoplasty. She is shown 1 year after undergoing upper midface suspension, a lateral canthal sling, palpebral contouring, lip augmentation with AlloDerm, and chin augmentation with extended anatomic medium and mandibular angle implants, 8 mm on the left and 10 mm on the right.

Patients with round, full, fleshy facial contours, an abundance of subcutaneous fat, and substantial muscle bulk are limited in their options when they desire a lean face that is well defined in the malar and chin-jawline regions. However, with alloplastic augmentation, full-faced patients can enjoy modest but often significant improvements to help them achieve their goal of a more sculpted face.



This 44-year-old man underwent revision rhinoplasty with conchal cartilage dorsal augmentation, as well as malar augmentation with extra-large malar shells and a large square I chin implant (8 mm projection). He is shown 2 years postoperatively with more definition to his chin-jawline and malar regions.

At equal disadvantage are extremely lean-faced individuals with a vertically long and horizontally narrow skeletal architecture and who may have extreme volume-shape weakness of the malar-maxillary or chin-mandible skeleton. These patients frequently have extremely prominent nasal contours. Although miracles cannot be accomplished, modest and often significant improvements can be achieved by rearranging adjacent proportions within their facial aesthetic segments by employing alloplastic onlay techniques in the midface or mandibular regions, with or without rhinoplasty.

Pertinent Anatomy

Understanding the fundamentals of aesthetic facial form and balance is critical for applying technical alterations to the facial skeleton successfully and predictably, without complications. Thus it is essential that surgeons adopt a specific method for analyzing faces that defines anatomic zones as well as any aesthetic segmental deficiencies of volume and mass. Relating this data about a patient's anatomy to specific goals in facial form permits surgeons to execute alloplastic contouring with excellence and precision.

Conceptualizing the anatomy of facial form into aesthetic units and anatomic zones enables surgeons to determine which areas of the premandibular, malar, and mid-face region will respond well to augmentation and produce contour changes that have visual impact, as well as emotional impact for the patient. These anatomic zones are few, but when augmented properly, each produces a different appearance.

Although the three major aesthetic segmental units of the face—upper, middle, and lower—have been described as equal thirds, the lower third jawline aesthetic unit is often smaller, both horizontally and vertically. This deficiency of the entire lower third of the face can make the nose appear too strong and overbearing. True aesthetic deficiencies in the malar-midface region often go undetected when there is a weak lower jawline segment.



This 37-year-old man with a weak lower jawline underwent rhinoplasty, chin augmentation with a square I extended extra-large anatomic implant (9 mm projection), submental-submandibular liposuction, and platysma plication to correct the deficiency and improve his profile. He is shown 13 months postoperatively.

When the lower facial segment is equal to the other two aesthetic units of the face, a malar-midface deficiency is more obvious, and many noses do not seem prominent but instead appear to be in balance with the rest of the face.

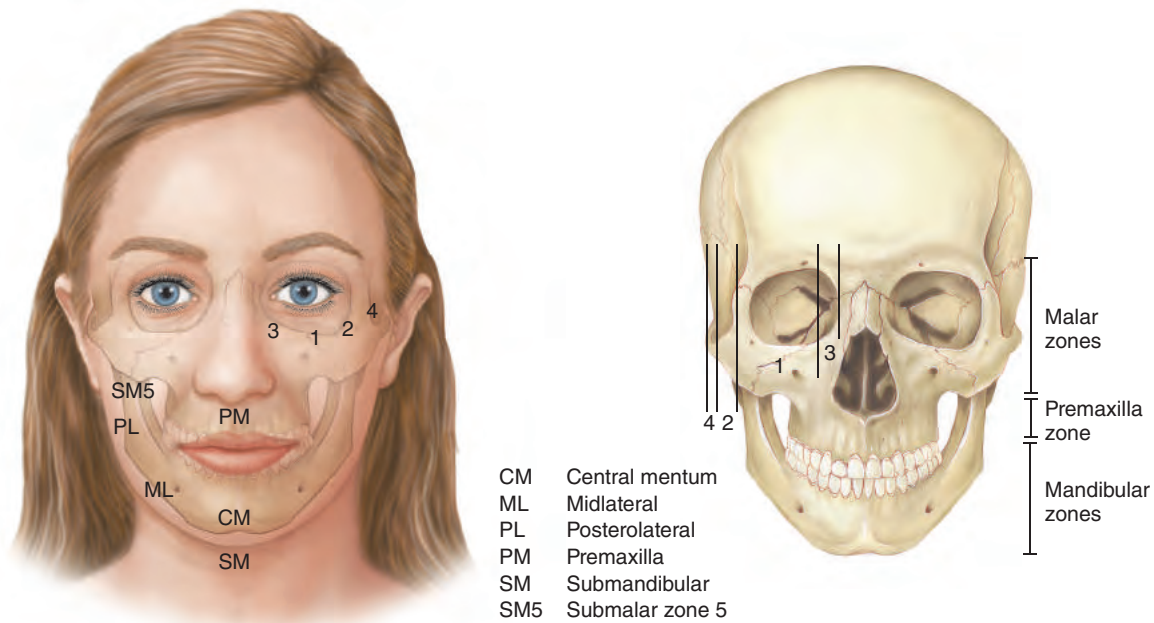


Examples of aesthetic balancing: increasing a weak lower jawline segment reduces the prominent appearance of the nose. This 39-year-old man had a malar-midface deficiency. He did not wish to have nasal contouring surgery. He underwent chin augmentation with insertion of a large square I implant (6 mm projection) to correct his deficit. He is shown 11 months postoperatively.



This 65-year-old woman underwent a standard rhytidectomy, SMAS plication, platysma plication, and insertion of an extended anatomic implant with a 6 mm projection. Seen 9 months postoperatively, she has a more balanced face.

Anatomic Zonal Analysis of the Malar-Midface Region



The midface aesthetic segment comprises the entire zygomatic-maxillary complex. The *malar space* is therefore the region on the facial skeleton that when augmented appropriately produces a beneficial aesthetic change in the contour of the midface-cheek segment.

The malar space can be seen as containing five distinct anatomic zones. Zone 1 is the largest subspace and includes the major portion of the malar bone. It extends from the infraorbital foramen to include the first third of the zygomatic arch and continues inferiorly to the lower border of the malar bone. A volume expansion of 4 to 5 mm in this zone increases the contour only in the upper portion of the cheek; this effect is often not suited to creating the desired softness of feminine facial form. An implant in zone 1 may appear too strong and skeletal. A 3 mm volume expansion is considerably more subtle, especially when combined with midface suspension techniques. However, augmentation of zone 1 by 4 to 5 mm is frequently useful in men to create a strong, masculine, sculptured appearance.



This 33-year-old woman presented with previously placed malar augmentation that she felt was too prominent. To correct this problem, she had secondary malar augmentation with large malar shells in a submalar SMS location. She is shown 10 months postoperatively.



Zone 2 has less aesthetic significance. It comprises the middle third of the zygomatic arch. Volume enhancement in this zone, especially in combination with zone 1, accents the cheekbone laterally, creating a broader dimension to the upper third of the face. It is therefore useful in improving the appearance of patients with a narrow upper face or a *long-face syndrome*. This 36-year-old woman demonstrates how a malar implant extending into zone 2 of the zygomatic arch will broaden the upper midface.

Zone 3, the paranasal region, is medial to the infraorbital foramen and nerve. A deficiency in this suborbital region can create a hollow “valley” appearance called a *jugal-malar sulcus* or *tear trough*. Alloplastic implants have been specifically designed for this anatomic zone. Releasing the origins of the orbicularis oculi muscle from the medial orbit is necessary to specifically improve this suborbital hollow appearance. Because of the thin nature of the skin and subcutaneous tissues over zone 3, any alloplastic implant or transplanted tissue must be perfectly shaped and tapered to ensure invisibility.



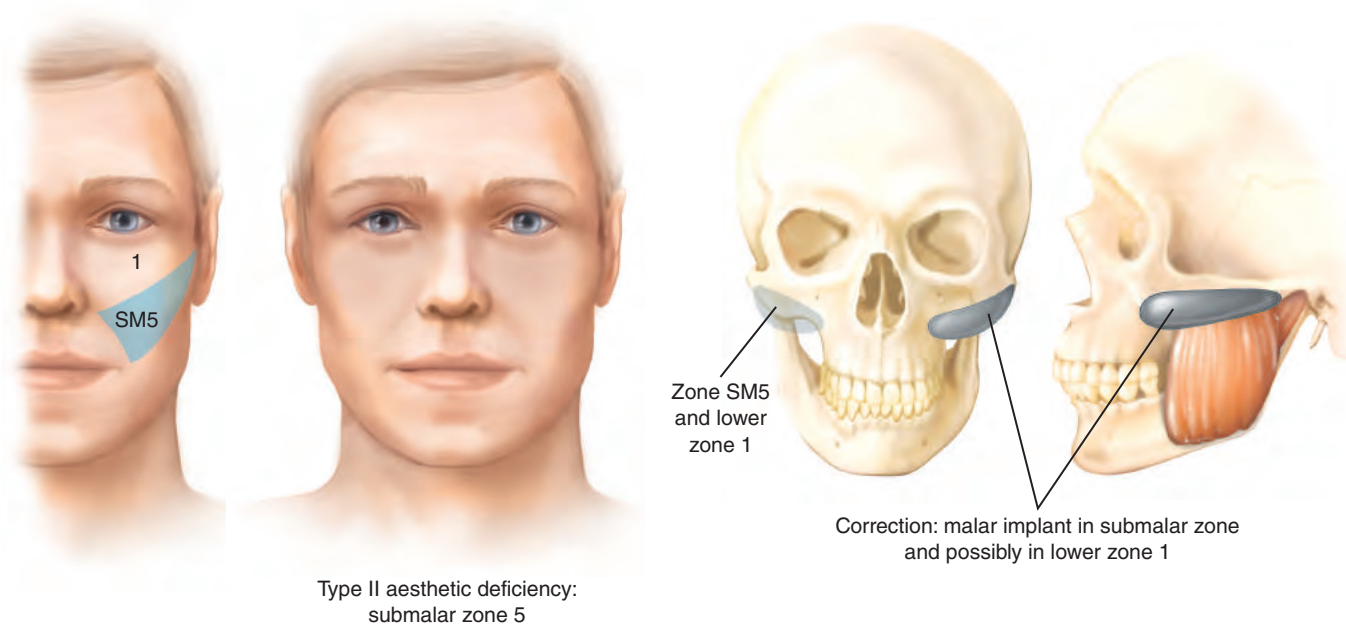
This 37-year-old man presented with maxillary suborbital deficiency and brow ptosis. He underwent an upper midface suspension (SOMME lift), a lateral canthal sling, and palpebral shape contouring. He also had large extended malar mandibular implants (12 mm) inserted bilaterally and a medium square I chin implant (6 mm projection) placed. He is shown 1 year postoperatively.

The infraorbital nerve is more sensitive to trauma than the mental nerve is; dissection around it must be gentle to prevent prolonged, disabling symptoms. Extended malar suborbital implants that comprehensively augment zones 1, 2, and 3 are useful for treating people with a hereditary infraorbital maxillary bone deficiency called *negative-vector polar bear syndrome*.

Zone 4 overlies the posterior third of the zygomatic arch. Volume enhancement in this area is never necessary and would produce an unnatural appearance. Inappropriate dissection in this zone as well as in zone 2 could injure either the capsule of the temporomandibular joint or the zygomaticotemporal branches of the facial nerve. Such injuries can produce edema, pain, temporary dysfunction of the temporomandibular joint, and/or weakness of eyebrow elevation. These conditions are rare and usually temporary.

Zone 5 consists of the submalar zonal triangle. This region of the midface is the most significant for augmentation, requiring the most frequent use of midface implants in both older and younger patients. Augmentation in this area extends midfacial fullness down from the malar bone itself, creating a rounder, fuller, “apple cheek” contour. Submalar zone 5 (SM5) is defined anatomically as follows. The masseter muscle and its overlying tendinous fascia are posterior; more medially, the border of the masseter muscle is adjacent to the canine fossa of the maxilla. These structures serve as the floor on which implants are placed. Its anterior soft tissue roof consists of the overlying zygomaticus muscle groups, their origins and innervations, and the submuscular aponeurotic system (SMAS). The medial limit of the submalar triangle is adjacent to the nasolabial mound.

Effective alterations in this zone may often need to be extended up and into zone 1 to create the illusion of a larger malar bone and to imitate soft tissue volume. Sometimes an implant is indicated to augment only the submalar space. The superior boundary of submalar zone 5 is also the lower border of zone 1 and constitutes the inferior bony margin of the malar eminence.



The inferior limit of SM5 is a sulcus created below the malar zone that can be extended downward through a natural dissection plane that exists between the masseter muscle and the overlying zygomatic muscle complex. As the submalar midface dissection and augmentation are extended lower, the fullness of the midface contour created by an implant in this location is also extended downward. However, no implant can extend below the mucosa of the gingival buccal sulcus adjacent to the lateral commissure of the mouth.



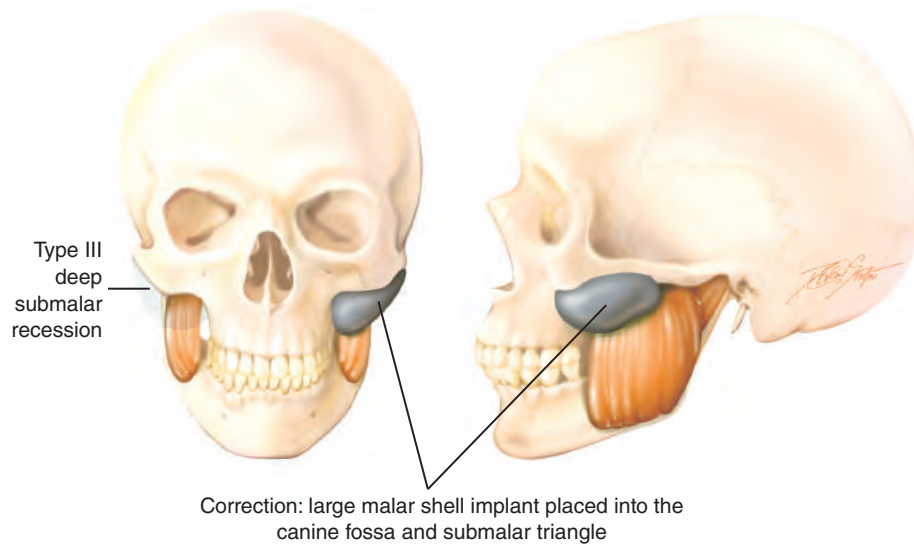
This 28-year-old woman presented with facial type II submalar aesthetic volume deficiency. She had submalar augmentation with insertion of 4 mm large malar shells. She is shown 2 years postoperatively with a softened, more youthful cheek.



This 49-year-old patient had a similar aesthetic submalar deficiency. To correct her deficit she underwent rhytidectomy, nasal contouring, and had 4 mm extra-large malar shells placed in SM5. She is shown 6 months postoperatively with a rounder, fuller cheek contour.



Type III aesthetic deficiency:
prominent malar eminences plus deep submalar
recession in submalar zone 5



Soft tissue volume deficiencies in the submalar-midface region are very common. These can be inherited, or, more frequently, are the result of the natural aging process. Atrophy of submalar facial fat removes the soft, full contour of youth.



Preoperatively this 61-year-old man displayed prominent malar eminences with deep submalar recessions, a type III submalar volume deficiency; 4 mm extra-large malar shells were inserted to augment SM5. He is shown 6 months postoperatively.

In many people, midface atrophy creates a tired, drawn, haggard appearance early in the third and fourth decades of life. Restoration of soft tissue fullness in the submalar region is the most significant function of midface alloplastic augmentation to restore youthful contour.



This 47-year-old woman complained of submalar atrophy and facial laxity; she underwent a rhytidectomy and upper and lower blepharoplasties. Her chin was augmented with a large 4 mm malar shell. She is shown 10 months postoperatively with more youthful contours.

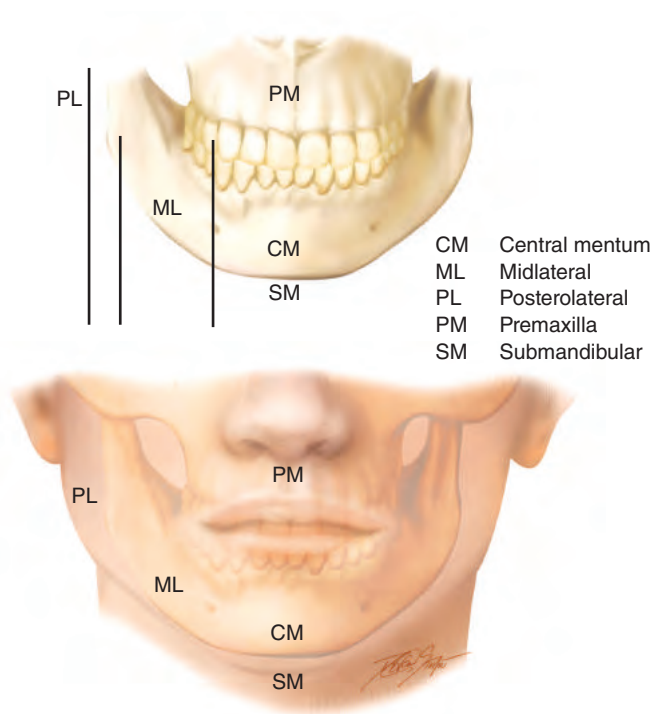
The second most frequent need for midface contouring is comprehensive augmentation of the malar-midface region, which involves both zone 1 and SM5. A large shell that augments both zonal regions mimics both midfacial soft tissue volume in the lower aspect and bony augmentation in the more superior zone 1 area. The design concept of a large midface shell is to augment a generous midface area with an implant that is thinly tapered at the margins to produce volume changes without being visible or palpable and without the unnatural appearance of a localized protuberance that can be produced by smaller, traditional oval implants.



This 54-year-old woman had a relative midface volume deficiency resulting from the natural aging process. An upper midface suspension (SOMME lift) with palpebral aperture shaping, lateral temple brow contouring, submandibular liposuction, and platysma plication were performed. She also had submalar augmentation with large 4 mm malar shells and an AlloDerm lip augmentation. The result, seen 10 months postoperatively, shows natural contours and a more youthful appearance.

Zonal Anatomy of the Premandibular Jawline Aesthetic Facial Segment

Assessment of the lower third facial aesthetic segment is also necessary to comprehensively evaluate facial aesthetic balance that improves appearance. The premandibular space, when variously augmented, produces attractive changes to the shape and volume characteristics of the lower third of the face and jawline.



Within the premandibular space, four anatomic zones can be defined. These zones enable the surgeon to assess the relative volume correction needed for deficiencies in the premandibular region. Correction of such deficiencies by alloplastic implants can create specific contours for the lower face, depending on patients' individual needs and preferences.



The central mentum is the area between the mental foramina where traditional chin implants have been placed for more than 45 years. As seen in these four patients, implants placed under this central segment alone without lateral extension will produce an unattractive contour with an abnormal rounded central protuberance that accentuates the appearance of a prejowl sulcus or a valley in the area of the anterior mandibular ligament just below the mental foramen.



Traditional central implant



Contemporary anatomic implant

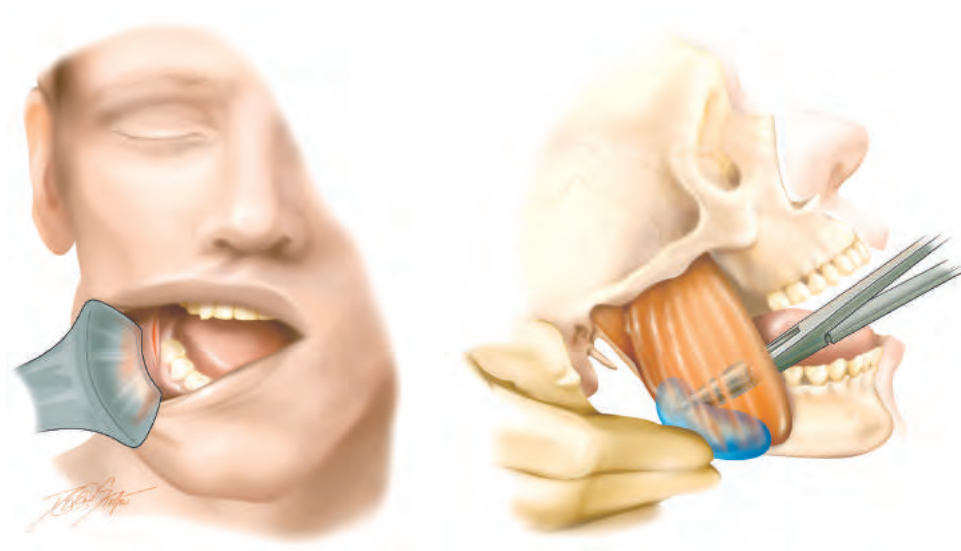
The floor of the central mentum zone is the surface of the central mandible, which includes the midline mental tubercle. Recent anatomic implants are contoured posteriorly to securely fit this bony contour like a glove. They provide an entirely natural-looking augmented jawline.

The midlateral zone of the mandible extends from the mental foramen posterior to the oblique line of the horizontal ramus. The anterior limit of this zone is at the mental nerve and foramen; the posterior limit is the oblique ridge of the mandible. Its superior boundary is the upper border of the horizontal mandible. The lower extent is the inferior border of the mandible. The mandibular branch of the facial nerve exits through the mental foramen 8 to 10 mm above the inferior border of the mandible. The roof of overlying soft tissues in the mid-jawline contains the platysma, SMAS, anterior facial vein and artery, and the marginal branch of the facial nerve as it crosses the mandible to enter the depressor muscles of the lower lip. Implants can augment the midlateral zone, widening the appearance of the lower jawline segment while increasing the anterior-posterior dimension of the central mentum.



I have designed a variety of implants that have differing shapes and volumes to alter the central projection and vertical length of the mandible as well as the midlateral region (midlateral zone) of the horizontal ramus.

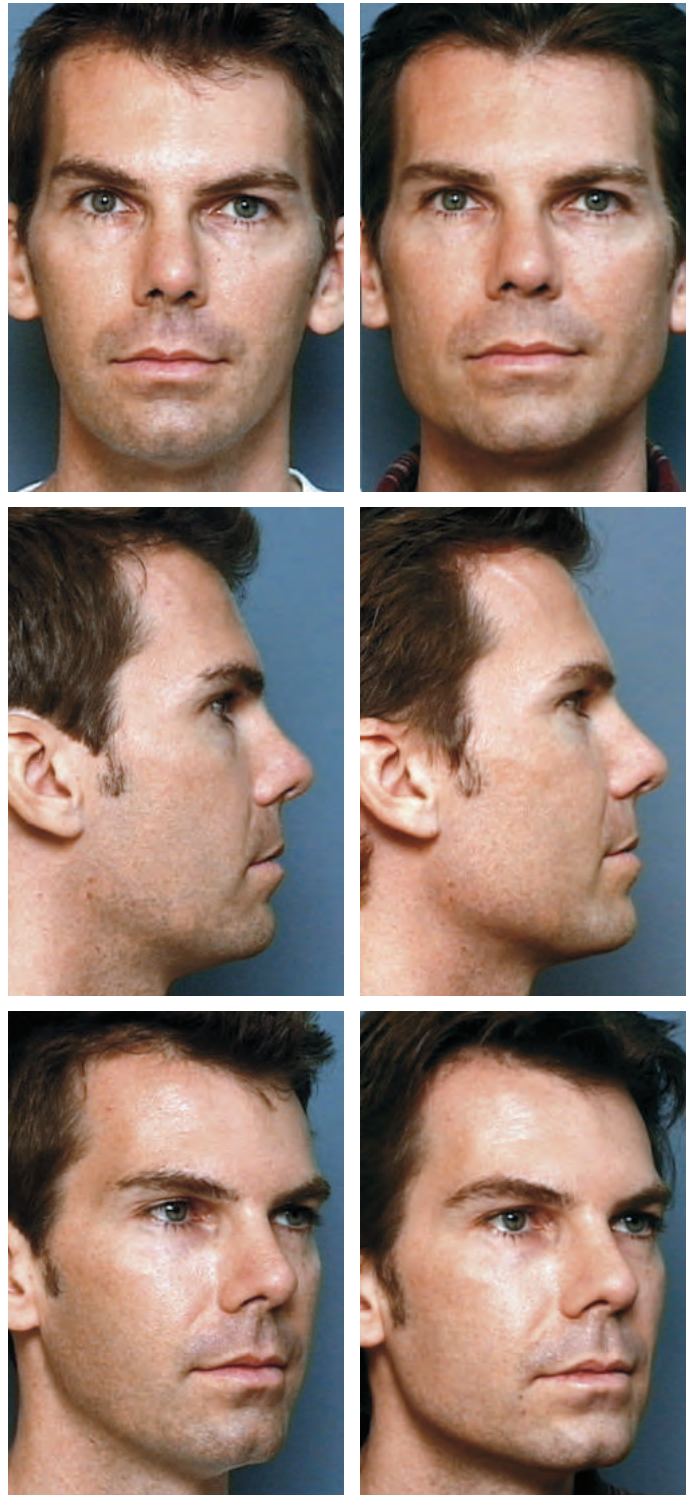
Men are requesting jawline changes with increasing frequency. Their main area of concern is the posterolateral zone of the mandible, which includes the posterior third of the horizontal ramus extending back from the oblique line and includes the gonion of the mandible and the lower 4 cm of the ascending ramus. Its boundaries are as follows: the floor is the mandible itself; the roof is the overlying masseter muscle; the superior border is limited by the sigmoid notch of the mandible; and the posterior and inferior borders are limited by strong, fibrofascial insertions of the masseter muscle. These must be completely released to expand the space around the bony borders of the mandible. This release is necessary to allow the curved borders of the angle implants to extend around the inferior and ascending posterior mandible margins to secure these implants into position.



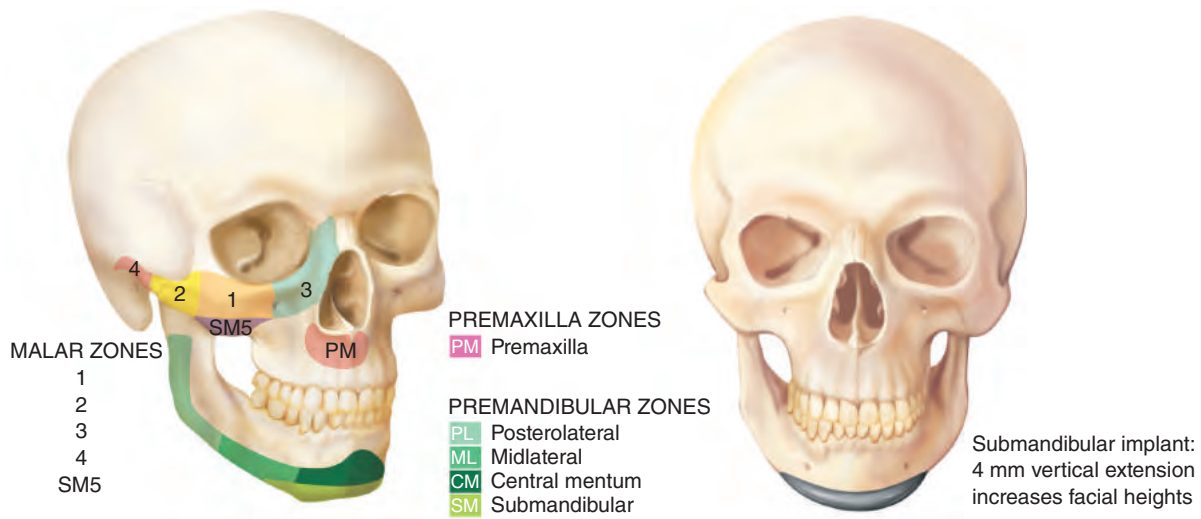
A mandibular angle augmentation is shown on the left, with a 3 cm intraoral incision. The illustration on the right shows degloving of the ascending ramus and inferior border of mandible.

The surgeon must avoid a traumatic dissection when releasing the masseter muscle from the bone so that neither the mandibular branch of the facial nerve (VII) nor the fragile posterior jugular veins or anterior facial vein and artery are harmed. When damaged, these vessels can bleed profusely.

The angle can be augmented to produce a strong posterior jawline contour with excellent angle definition. Implants are available that either widen this posterolateral segment in a lateral direction or extend it downward in an inferior direction. Extending it down creates a less obtuse, more acute posterior mandibular angle that gives the lower mandibular border more horizontal definition.

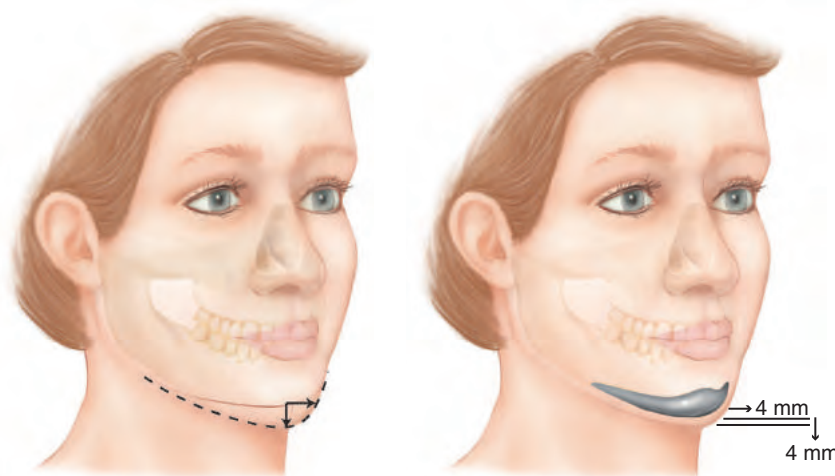


Exhibiting posterolateral zone deficiency of the premandibular region, this 38-year-old man requested mandibular augmentation. A 12 mm implant was inserted on the right side and a 10 mm implant on the left to correct his facial asymmetry. He is shown 1 year postoperatively with a strong posterior jawline and excellent angle definition.



The fourth and very important jawline region is the submandibular zone, which is defined as the region in the lower facial jawline-mandible aesthetic segment where volume/mass alloplastic alterations will produce variable lengthening of the vertical dimension of the face.

Traditional alloplastic chin implants do not and cannot increase the vertical height to lengthen the lower third aesthetic segment. Osteotomies with interpositional bone grafting or autologous fat transplant techniques are currently the methods chosen by most plastic surgeons to accomplish this important contour change. For the novice surgeon, orthognathic genioplasties are technically complicated, imprecise, and have significant complications (5% to 10%) such as nerve damage, asymmetries, and stepoff irregularities.



In 1986 I developed a unique extension implant to wrap around the inferior or bony region of the mandible and increase the vertical distance from the lower lip to the inferior chin. It extends 4 mm down and laterally augments the submental zone. This implant adds volume to the anterior mandibular segment and to the prejowl sulcus or marionette groove at the origin of the anterior mandibular ligament.



Implants in the submalar zone improve or correct a witch's-chin deformity and the anterior mandibular prejowl sulcus, as is seen in this 62-year-old woman. She had facial laxity resulting from aging, suborbital hollowing, and prejowl sulcus and platysmal laxity. To correct these problems, she underwent an upper midface suspension with fat transposition and palpebral aperture shaping. In addition, medium malar shell implants were inserted in lower zone 1, and extended anatomic implants with 4 mm projection were inserted in the upper SM5. A rhytidectomy with SMAS plication and platysma plication were performed during the same operation. She is shown 7 months postoperatively.

Augmentation of the submalar zone involves complete disinsertion of muscle origins along the lower mandibular border. At present submandibular implants afford only 4 mm of projection. There are times when additional projection necessitates placement of a second implant on the anterior surface of the central mentum.

Just as volume augmentation changes are specific for each zonal area of the malar-midface middle third facial segment, contour changes can be differentially produced in the lower third of the premandibular jawline.

Nasal size alterations are also frequently requested. These procedures also contribute greatly to overall aesthetic facial balance.

The correct choice of implant size and shape as well as positioning it properly are the key steps to achieving specific, predictable results.



This 27-year-old man presented with nasal deformity, lower third facial aesthetic segment deficiency, submental and submandibular lipodystrophy, and a defuse neck. He is shown 1 year after cosmetic rhinoplasty, submental-submandibular liposuction, and platysma sculpture. Submandibular augmentation with a medium vertical extension implant was also performed.



This 22-year-old patient demonstrates dramatic improvement in facial balance from malar, chin, and mandibular angle implant augmentation combined with rhinoplasty. He is shown 2 years postoperatively.

Anatomic Danger Zones

Midface

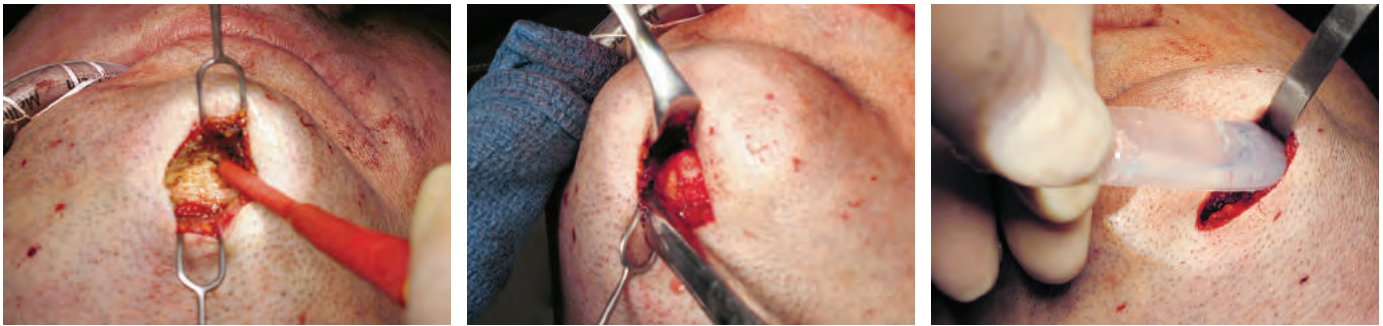
Midface problems and complications arise from too vigorous a dissection over the middle third of the zygomatic arch when the surgeon places a malar implant into zone 2 to create a broader face. The overlying facial nerve branch to the frontalis muscle may be damaged temporarily or permanently. Branches of the zygomaticus muscle groups, as well as those that extend up into the inferior lateral orbicularis muscle can be traumatized during dissection into malar zone 1 and SM5. This may result in transient or permanent lagophthalmos and an impaired ability to elevate the nasolabial area during smiling and facial animation.

Dissection in the zone 3 medial suborbital maxilla area exposes the infraorbital nerve to damage when alloplastic tear trough implants are introduced or during midface suspension techniques.

When a subperiosteal malar space is created over the lateral aspect of the orbital rim, but the dissection space is not opened inferior enough on the maxilla to permit a malar shell to be placed approximately 4 mm below the orbital rim, the implant can ride high enough to overlap the lateral rim, encroach on the orbit, and produce vertical descent of the lower eyelid or ectropion. This is particularly common when implants are introduced through the subciliary lower eyelid approach.

Premandible

During premandibular dissections, trauma to the mental nerve is common, but symptoms are usually transient. Dissecting gently along the inferior border of the mandible and sweeping upward lightly to observe and protect the mental nerve helps to avoid these symptoms.



The surgeon is able to visualize the mental nerve using a retractor and insert an implant submentally.

Dissecting and degloving the muscles along the inferior mandibular border are an absolute necessity for midlateral zone augmentation. However, during this dissection the marginal mandibular branch of the facial nerve can be injured, producing lower lateral lip dysfunction.

Unless great care is exercised during dissection in the posterolateral mandibular zone by degloving the entire posterior region of the inferior border and ascending ramus of the mandible, the jugular vessels posterior to the ascending ramus can be injured. This could create profuse, dangerous bleeding.

A forceful upward dissection into the sigmoid notch and coronoid process of the mandible can produce troublesome temporomandibular joint symptoms. These are usually transitory—less than a week in duration. Trismus is an uncommon sequela of posterior angle augmentation. In my experience, this has always been extremely short lived.

Regional Midfacial Volume Deficiencies

To determine which elements are necessary to achieve facial balance in a specific patient, the surgeon must recognize malar-midface zonal deficiencies. Although there are infinite variations in facial size, shape, and contour, there are several common midfacial types that can easily be identified for determining specific implant sizes and positioning. Several of these will be described.

Surgical Treatment Plan for Premandibular Augmentation of Regional (Zonal) Volume/Mass Deficiencies

Zone	Implant* (depends on face size)
Central mentum	Anatomic or styles I and II 4-9 mm
Posterolateral	Mandibular angle implants 8-12 mm Lateral projection
Midlateral	Lateral bars 4-6 mm Widens lateral jawline
Submandibular	Vertical extension implant 4 mm Inferior and anterior projection

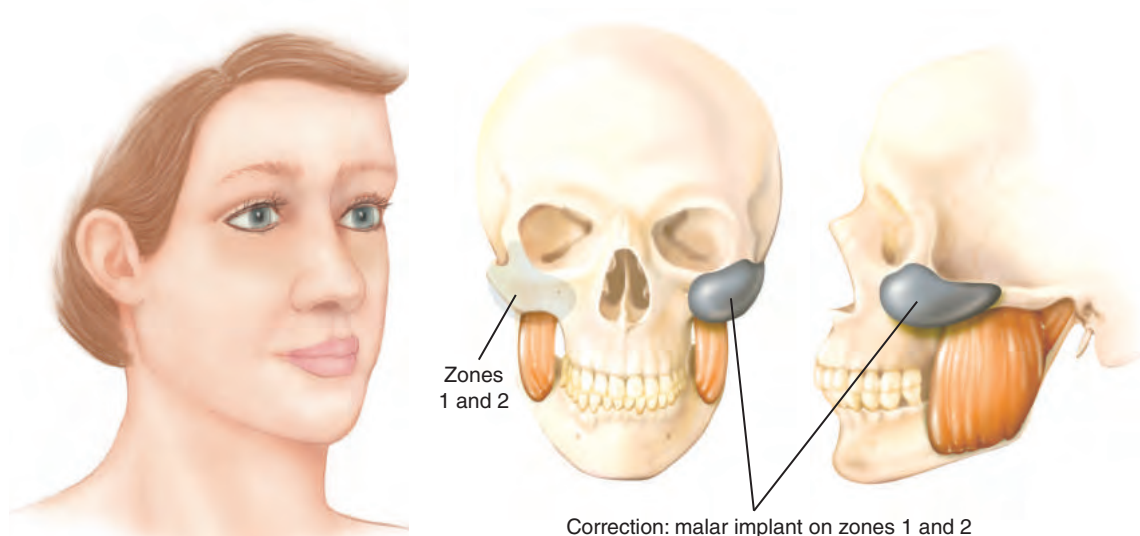
*Manufactured by Implantech Corp., Ventura, CA.

Selection of Implants

Facial Type	Anatomic Augmentation Zone	Size (depends on skull size)
I	1 and 2	3 or 4 mm (occasionally 5 or 6 mm)
II	Submalar 5	4 or 5 mm (possibly a combined shell)
III	Submalar 5	5 or 6 mm (large or extra-large)
IV	1, 2, submalar 5	5 or 6 mm malar shell (large or extra-large)
V	3	Tear trough implant (small, medium, or large)
VI	Premaxilla	Various premaxilla implants Brink implant*

*Manufactured by Implantech Corp., Ventura, CA.

Type I Deficiency



Type I aesthetic deficiency:
malar hypoplasia

A facial type I deficiency consists of a relative contour weakness in the upper segment of the malar-midface region. It encompasses zones 1 and 2 over the malar bone and the medial third of the zygomatic arch. This involves either a bony or soft tissue deficiency, or both. Augmentation in these zones creates upper cheek fullness that simulates both bony and soft tissue contour.



This 39-year-old woman had a type I regional volume deficiency. She is shown 1 year after malar augmentation with 4 mm large malar shell implants in zones 1 and 2.



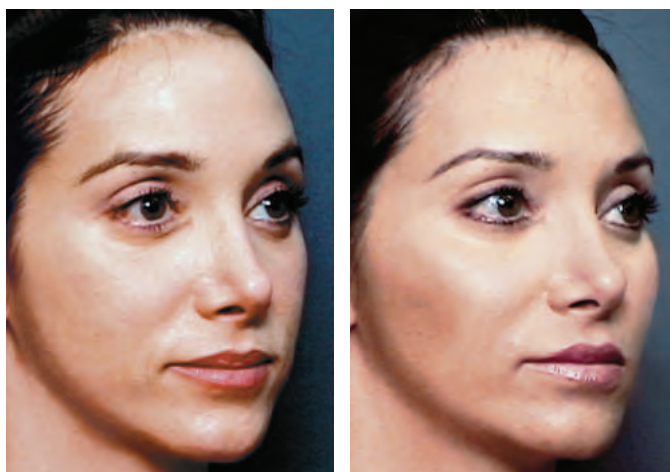
When a large implant is used to augment zone 2 as well as zone 1, the upper midface becomes broader, shortening the appearance of a long, narrow face, as seen in this patient. This 34-year-old woman desired more definition in malar zones 1 and 2 as well as in her mandibular angle. She also wanted aesthetic segment enhancement of the lower third of the central mentum. She had 4 mm medium malar implants inserted to augment zones 1 and 2. Her mandibular angle was augmented with 8 mm per side, and 4 mm small extended anatomic implants were placed to augment the central mentum. She is seen 1 year postoperatively.

Type II Deficiency

A type 2 regional aesthetic deficiency consists of a relative decreased volume in SM5. An implant placed here produces volume filling that imitates bone and soft tissues. Use of a large malar shell over the inferior aspect of the malar bone in zone 1 and extending down into the submalar space creates the illusion of a round, full, apple cheek. The fat atrophy that occurs with aging is corrected by placing implants in SM5.



This 55-year-old woman had facial laxity and submalar atrophy from aging. She underwent a rhytidectomy, upper and lower blepharoplasties, and SM5 augmentation with medium Terino 4 mm malar shells. She is seen 2 years postoperatively.



This 37-year-old woman had malar facial deficiency in zones 1 and 2. She underwent malar augmentation with medium Terino 4 mm malar shells. She is seen 1 year postoperatively.



This patient, 55 years old, had a type II midface volume deficiency and relative prognathism. She had adequate malar bone prominence but was specifically deficient in submalar soft tissue volume. This can create a tired, haggard look. The submalar zone ends just lateral to the nasolabial smile mound. Volume filling of this space deemphasizes the appearance of the nasolabial mound and corrects the sunken appearance in the midface to restore a fuller, more youthful appearance. Her procedures included midfacial implants, upper and lower blepharoplasties, rhytidectomy, rhinoplasty, and SM5 augmentation with medium Terino 4 mm malar shells. She is seen 6 months postoperatively.



Aging changes in this 62-year-old patient included brow ptosis, lateral face and neck laxity, and type II malar deficiency. She underwent an upper midface suspension with palpebral aperture shaping, malar augmentation of zones 1 and SM5 with a large Terino 4 mm malar shell, lower face and neck rhytidectomy, SMAS and platysma plication, and cosmetic rhinoplasty. She is seen 1 year postoperatively.

Type III Deficiency

A type III regional volume deficiency consists of a strong malar-zygomatic superstructure accompanied by an extremely deficient submalar infrastructure. When this condition is accompanied by thin skin and subcutaneum, the patient appears emaciated and sick. Fortunately, unless a person has an actual physical debility, this facial type is uncommon in the general population. Correction requires generous submalar augmentation with a large surface area midface shell with a projection thickness of 5 to 7 mm.

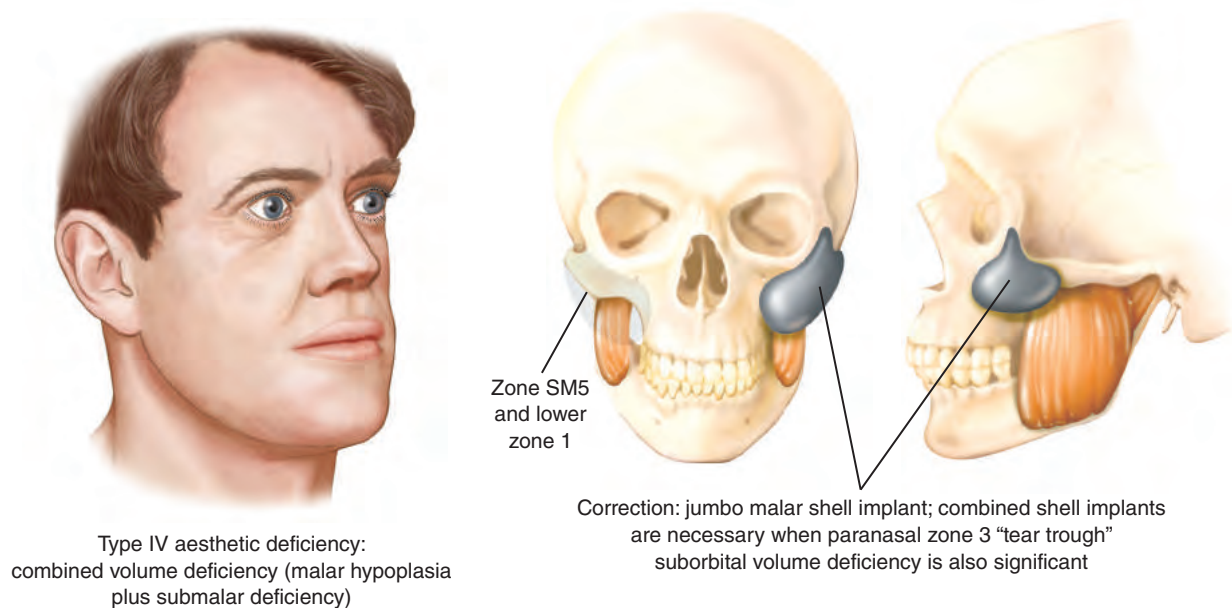


This 67-year-old woman had an emaciated appearance, facial atrophy, and extreme laxity of the facial skin. She desired only augmentation of the malar-midface region. A malar-midface SM5 and zone 1 augmentation was done with an extra-large Terino 5 mm malar shell. She is seen 1 year postoperatively.



Extreme type III submalar atrophy and prominent malar bones were present in this 43-year-old woman. She underwent SM5 augmentation with large Terino 4 mm malar shells. Her cheeks have a more youthful fullness 6 months after surgery.

Type IV Deficiency



A type IV face consists of extreme volume deficiency throughout the anterior maxillary region. This includes malar zones 1 and 2, the SM5 regions, and the entire orbital and paranasal zone 3 area. This deficiency seems to be more common in men than in women. It is identified by a flat-face or dish-face appearance. It has been described as the *polar bear syndrome* because of the deficiency recession of the inferior orbital rim, which contributes to a proptotic bulging appearance of the ocular globe. This is called a *negative-vector bony deficiency* of the inferior orbital rim. It may be associated with a downward or vertical descent of the lower eyelid causing sclera show.

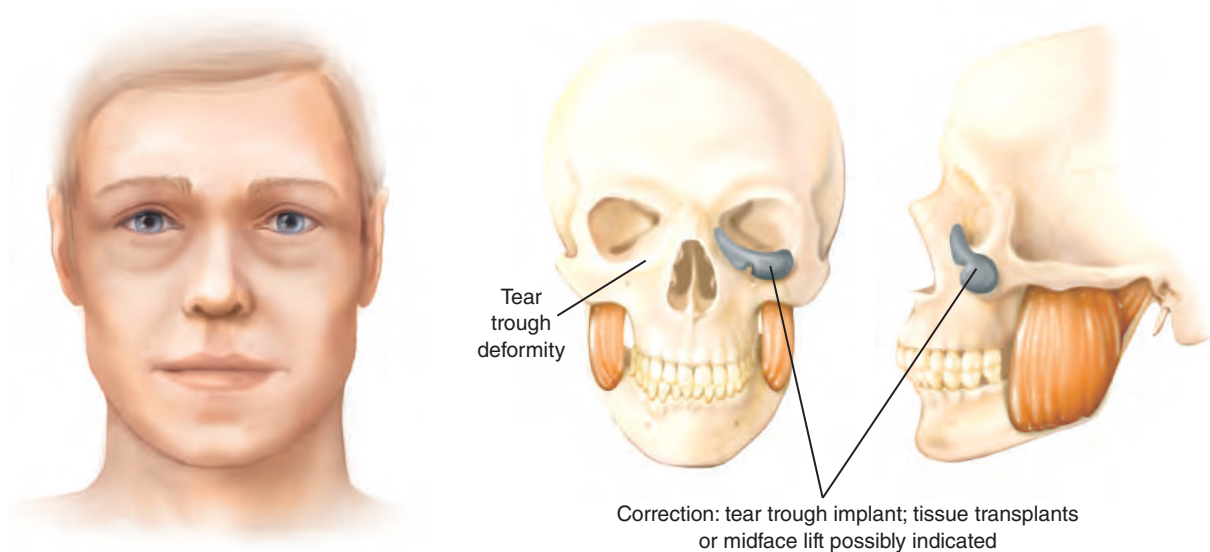
Significant improvement in this type IV aesthetic imbalance can be achieved through placement of a comprehensive shell implant that contributes volume in all of these midface zones, including the infraorbital region. This implant also adds support to the lower eyelid and elevates it to a more attractive horizontal position.



This 35-year-old man had a negative-vector suborbital hollowness deficiency, type IV aesthetic regional volume deficiency, malar hyperplasia, and submalar maxillary deficiency. An extra-large Terino 5 mm malar shell was placed in zone 1 and SM5. He is seen 1 year postoperatively.

Lateral canthopexy techniques are often necessary to correct the descent of the lower eyelid that is common with this facial type and to prevent its worsening after malar surgery. This represents both an aesthetic and a functional correction.

Type V Deficiency



Type V aesthetic deficiency:
suborbital zone 3 and upper zone 1 deficiencies

A type V aesthetic regional deficiency involves a specific weakness of skeletal structure in the inferior orbital and medial tear trough region. This contributes to a tired, hollow appearance around the eyes following the deflation and atrophy of the peri-orbital tissues as the individual ages.

A uniquely designed tear trough implant is placed that extends from the medial canthus to the lateral orbital malar rim; this considerably improves the previously hollow appearance. Autologous tissue transplants of fat, muscle, galea, and temporalis fascia placed into this area have provided good results, but their success and the associated complication rate are still controversial. Fat grafting along the inferior orbital rim is considered by some to be advantageous. My own experience has been that autologous soft tissue grafting results in unpredictable shrinkage and may produce irregularities or yield negligible improvement.



This 42-year-old man presented with an extreme suborbital volume deficiency. This deficiency was corrected with large tear-trough implants of 5 mm projection, placed through a transconjunctival approach. He is seen 1 year postoperatively.

Over the past 5 years there has been strong interest in a subperiosteal elevation of all soft tissue layers from the maxilla followed by a suspension of them in an upward direction to provide greater volume filling in the inferior orbital rim area. This mid-face suspension can be accompanied by inferior orbital fat rearrangement over the inferior orbital rim. This is done after severing the origins of the orbicularis muscle and disrupting the arcus marginalis and underlying SOOF tissues in the medial tear trough area.

Subperiosteal midfacial suspension alone without the addition of alloplastic implants is a technique that is still new enough to require the test of time to evaluate long-term persistence of volume correction and three-dimensional improvement of the suborbital hollow appearance and malar-submalar shape.

SOMME MIDFACE SUSPENSION LIFT

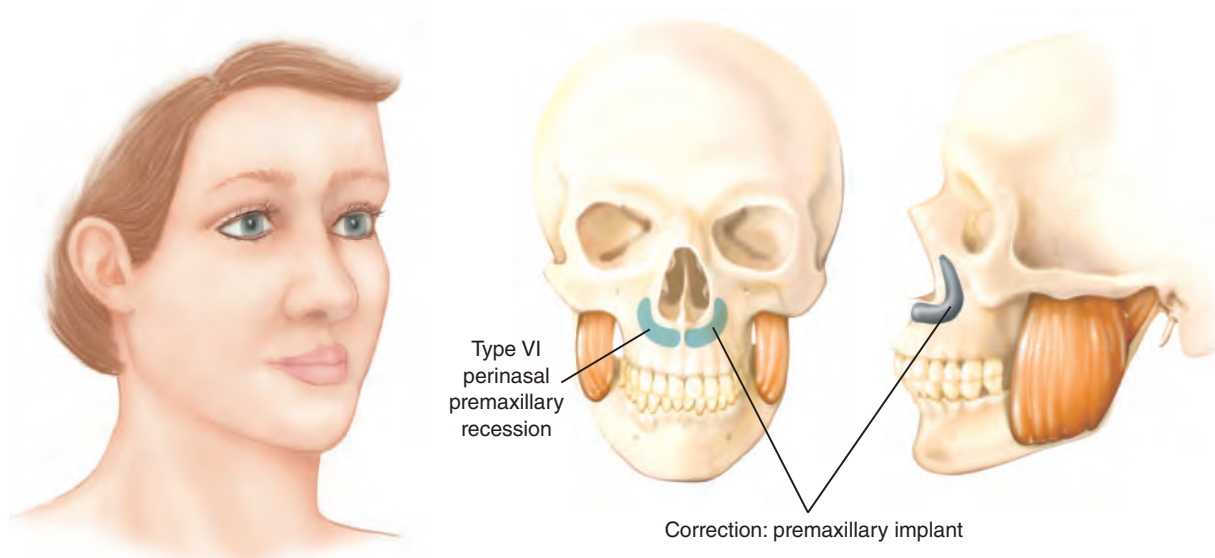


The subperiosteal dissection in the SOMME midface suspension lift extends 3 to 4 cm below the lower border of the malar bone and over the masseter tendon down to the area of the buccal fat pad. This also extends to the buccal sulcus just superior to the canine tooth. The entire soft tissue mass of the cheek, which includes the zygomaticus muscles, is secured to the deep temporal fascia via a subperiosteal tunnel made along the lateral orbital rim. This elevation automatically includes the orbicularis, which adds an additional layer of support over the infraorbital bony rim, obliterating the hollow lid-cheek junction.



A midfacial implant can be chosen to fit (1) on the malar bone, (2) on the submalar zone over the masseter tendon, or (3) to be an extended tear trough implant in the midface when placed during a midface suspension procedure.

Type VI Deficiency



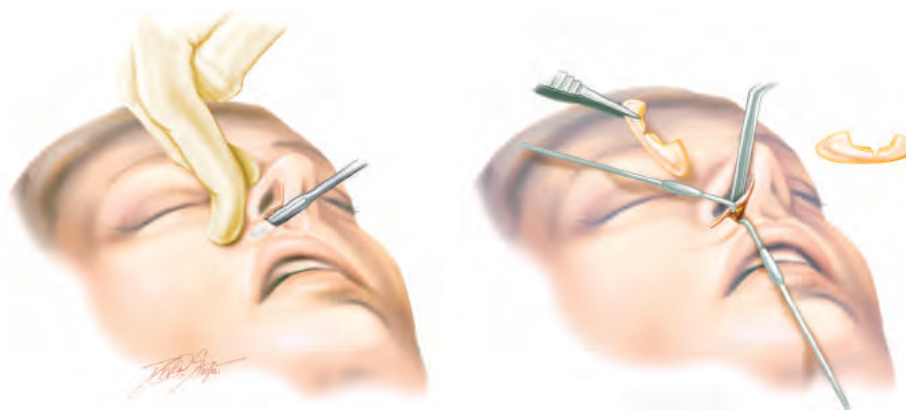
Type VI aesthetic deficiency:
recession in perinasal premaxillary region

A type VI midface deficiency occurs in the perinasal premaxillary region. Volume deficiency or the appearance of retrusiveness in this aspect of the skeleton is common in certain ethnic groups, especially in Asians and Indians in the Americas. It also exists as a congenital hereditary trait, which can be mild or severe and may require complicated orthognathic surgery using maxillary LeForte bony advancement techniques.

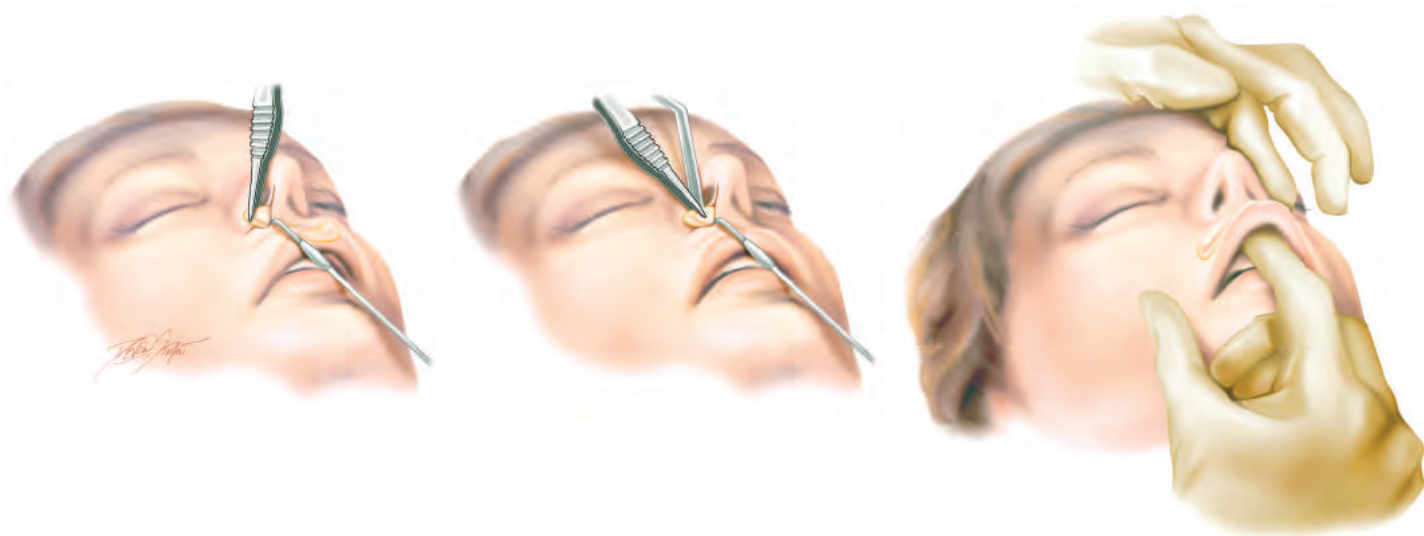
Alloplastic augmentation can improve mild to moderate premaxillary deficiency to produce significant aesthetic changes. There are several designs and sizes of silicone rubber implants that have been used successfully over the years to alter nasolabial and premaxillary relationships. Although other materials such as AlloDerm, autologous fat, Gore-Tex, collagen, and other injectable materials are used in the nasolabial and perialar sulcus, these have only resulted in temporary augmentations. Alloplastic augmentation is permanent. Type VI peripiriform and premaxillary volume deficiencies are common. They are frequently overlooked by aesthetic surgeons. They are usually of lesser magnitude than the greater volume/mass interrelationships of the malar-midface area, jawline, and nose. Therefore they do not warrant as much attention during an initial aesthetic facial contour consultation unless the patient is focused on such a deficiency.



Left: A local anesthetic is injected over the intended bed of the implant and at the preferred incision site, which is at the junction of the columella and floor of the right nostril. *Center:* The orbicularis oris muscle is split and the dissection plane established directly on bone. *Right:* The pocket is easily developed with a periosteal elevator. The edges of the piriform aperture are visualized, and the nasal vestibule is avoided.



Left: External palpation can facilitate dissection in the upper reaches of the pocket. *Right:* With an Aufricht retractor and curved hooks, the implant is inserted with a rotary motion first to the side opposite the incision.



Left: The implant can be gently overinserted on the first side to facilitate introducing its trailing edge into the incision. *Center:* The Aufricht retractor and hooks are repositioned to assist insertion through the incision. The implant is advanced back to midline. *Right:* The symmetrical position of the implant can be confirmed by direct visualization of its central notch at the nasal spine and by external and intra-oral palpation.



This 38-year-old Asian woman had a type VI regional facial deficiency with a retrusive maxilla RY volume deficiency. Correction was accomplished by the addition of a Brink small premaxillary peripiriform implant. She is seen 6 months postoperatively.



This patient, 33 years old, had a type VI severe retrusive peripiriform volume deficiency. A Brink peripiriform medium premaxillary implant was placed. One year postoperatively, the patient shows significant improvement.

Preoperative Assessment

Physical Examination

I use computer imaging as an integral part of the physical examination/consultation to provide more objective analysis of the patient's anatomic contours. The patient holds a mirror during the examination. One of the most important objectives of the consultation is to precisely identify the various asymmetries of bone and soft tissues in the patient's face; it is imperative that the patient understand the significant limitations in correcting these asymmetries.

A fundamental and critical element in a consultation is to accurately define a patient's desires and goals by asking the patient to precisely describe changes he or she hopes to achieve and in which anatomic regions. The surgeon must then be able to relate the patient's remarks to the anatomic zonal analysis data previously described.

I require patients to bring two sets of standard medical facial photos and, just as important, examples from magazines of contour ideals they want to emulate. It cannot be overemphasized that the selection and placement of implants is determined by directly comparing the anatomic zonal contours from their choice of images to the patient's own face. It is important to discuss with the patient in precise terms whether or not it is possible to achieve his or her goals, and to what degree.

Patient Education

The Consultation Process

In my practice, patient education begins with the requirement that patients who desire facial contour alterations must describe verbally, as well as in writing, the specific details of their desired contour changes. This must include their perception of their contour deficiencies. This written statement must be accompanied by standard professional photographs of the patient in five views: one frontal, left and right profile, and left and right oblique views. These facilitate analysis of their perceived contour deficiencies and are used along with photographs they choose from magazines and other sources to demonstrate the ideal they would like surgery to create. Photos of the patient at an earlier age are also requested.



This patient provided photos of herself at age 41 (*left*) and at age 50 (*right*). She was seen for consultation at age 59 with relative midfacial atrophy from aging. She desired a return of youthful fullness as well as contouring of her lower face, neck, and jowls.



An upper midface suspension was performed, with lateral temple–brow contouring. Submalar midface augmentation was also done in lower zone 1 and SM5 using a large Terino 4 mm malar shell. A lower face and neck rhytidectomy with SMAS and platysma plication was also performed. She is seen 1 year postoperatively.

The patient benefits from the use of educational tools before a face-to-face consultation with the surgeon. The Confirm Program CD on facial implants, which I prepared for the American Society of Plastic Surgery, serves as an excellent instructional tool to explain concepts of facial balance as they relate to the basic interrelationship of the three major promontories: the malar-midface, the nose and the chin-jawline. I also use other videos and photos in which I draw the malar zygomatic and pre-mandibular zones of the facial skeleton on the patient's face and demonstrate how specific positioning of various sizes and shapes of implant alters the third dimension of the midface in different ways.

Computer Imaging as a Teaching Tool

Computer imaging is an invaluable tool to assist the surgeon in explaining the possible outcomes of augmentation. It must be emphasized to the patient that while it is useful to view a simulated potential result, there is no guarantee that the result will be identical to the simulation.



In this series, the patient is shown preoperatively on the left, and a computer simulation of possible alterations is shown on the right. The lateral views demonstrate volume augmentation of the chin and diminished volume of the nose. The oblique views show the effect of augmentation of the cheeks, chin, and angle of the mandible without rhinoplasty. The frontal views demonstrate the effect of using rhinoplasty in addition to malar and chin augmentation, and angle of mandible augmentation.



Not only can changes be shown that simulate desired volume and shape alterations, but these can later be compared using side-by-side preoperative, computer-generated, and postoperative images. When this tool is used cautiously and conservatively, the surgeon can demonstrate that the final results of surgery (in the case of these two patients, 1 year postoperatively) are photographically superior to the image simulations made during the consultation.

Markings

Final planning is done on the morning of surgery before the patient is taken to the operating room or given any form of preoperative medication. The surgeon sits with the patient before the image computer and with the selected magazine photographs brought by the patient. Markings are made on the patient's face to outline the borders of the bony architecture and to designate the facial zones of the midface and premandibular regions. Similar markings can be made on the magazine photographs. The patient is then asked to identify which specific zones he or she wants altered by looking at the marked magazine photos and their own facial markings in a mirror.



These are typical markings made before augmentation surgery. The red markings indicate the supraorbital, infraorbital, and mental nerves in the malar, submalar, and chin region. The outline of the chosen implants is circumscribed as well.

Then the implant size, surface area, and projection are discussed with the patient by placing implant sizers on the patient's cheek over the skin markings of the anatomic zone or zones the patient has selected. In this way the patient assists in the decision about the zones and implant sizes most suitable for an ideal result. The implications of various sizes and thicknesses of implants and how they could be used to achieve a subtle, conservative result or a more dramatic appearance are discussed.



For this patient, malar-midface augmentation was planned. Outlining of the malar zygomatic bone and infraorbital nerve is shown, as well as measurement of the submalar zygomatic space. Measurements are used to help select the proper size implant to fit the patient's anatomy. The red marks demonstrate the planned augmentation, which in this patient will extend below the malar bone and into the top of the submalar zone to create fullness in that area.

A similar patient-doctor communication session with the computer and magazine images is used when augmenting the lower third of the face, chin, and jawline.

PREOPERATIVE PLANNING

Implant Considerations

Choice of Implant

Detailed discussions with the patient always reveal the subtleties and nuances of the specific contour results he or she anticipates. It remains for the surgeon to evaluate whether the patient's desires can be fulfilled by means of up-to-date implant augmentation techniques.

The following guidelines are suggested:

1. Implant enhancement of the upper malar/zygomatic bony region (zone 1) produces a sharp, high, angular appearance.
2. Placing the implant or choosing one that extends laterally into zone 2 widens the upper aspect of the midfacial segment.
3. Augmenting the submalar region to correct a hereditary defect or the appearance of aging (type 2 midface deficiency) produces a fuller midface in the lower aspect of the cheek below the bone.
4. Deciding whether to augment the upper malar bone aspect of the middle third aesthetic facial unit or the lower submalar soft tissue segment is the most important factor in creating a specific cheek-midface contour that meets the patient's goals.

Implant Size

The size of an implant relates to surface area and thickness. Standard 4 mm commercial shells of large or jumbo sizes are suitable to produce natural, pleasing augmentations in more than 90% of patients. Occasionally, when the patient wants a more subtle effect, 3 mm medium shells can be used. When a more dramatic effect is desired, 5 or 6 mm shells are most advisable. Large shells of 20 cm² and jumbo shells of 30 cm² are always preferable to small implants of 15 cm² or medium implants of 18 cm². A broader surface area creates subtle, invisible, and nonpalpable contours rather than a prominent, localized lump.

Implant Positioning

A subperiosteal location has proved the most desirable one because of rapid fixation of implants to the bone or underlying structures, such as the masseter muscle. Subcutaneous placement frequently results in implant mobility, because circumferential encapsulation occurs within elastic soft tissues, permitting ready movement when manually manipulated.

Fibrous ingrowth into porous materials or through implant fenestrations is completely unnecessary. When smooth implants are used, correction of a malposition simply requires that a new, accurately located space be created directly on the bone level and beneath all anatomic tissue planes, including scar tissue and previous capsules. Dissection of the space of slightly larger capacity facilitates placement of an implant without buckling, infolding of the edges, or abnormal bulging.

Facial Asymmetry

Natural facial asymmetry is universal. A form of hemifacial microsomia occurs in more than 90% of patients. On careful examination, the left and right sides of the face are usually quite different in size, shape, or volume. One side may be wider and have a greater volume of bone and soft tissue. One orbit, eyebrow, or eye complex is usually lower than the other.

Patients can be very particular and obsessed with asymmetries. Such asymmetries frequently go unnoticed before facial implant contouring. Therefore it is imperative to evaluate facial asymmetry meticulously in the preoperative consultation, noting them in the medical record, and explaining them in detail to the patient. It is also necessary to warn the patient that asymmetries will still be present to some degree following surgery, even when implants of different sizes are chosen and positioned to compensate for the variations in volume and shape that already exist.

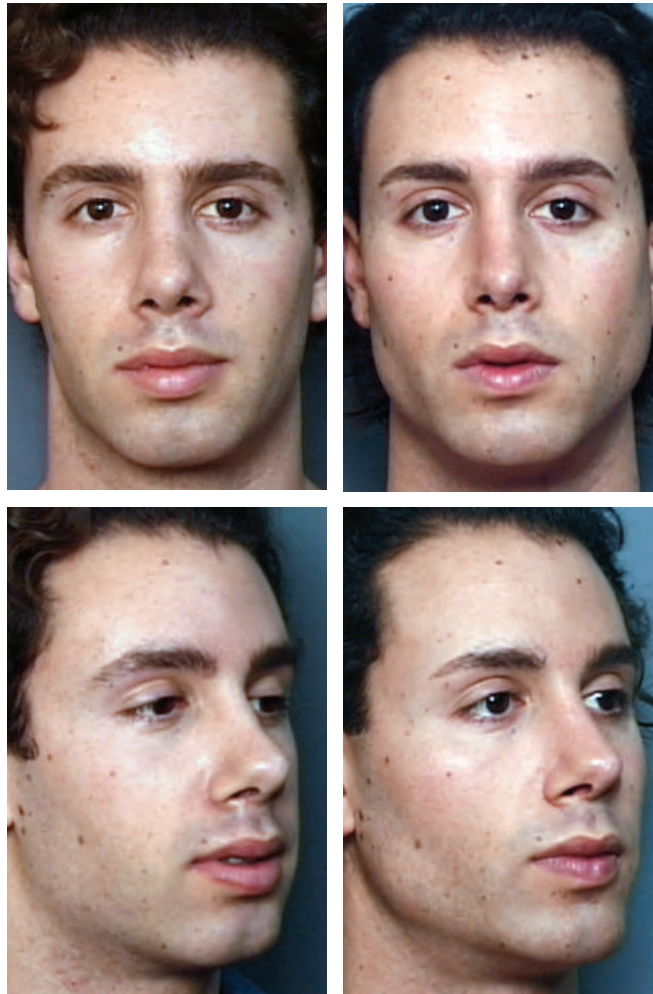


This 42-year-old man had subtle asymmetry of his mandible-jawline for which he requested improvement. Different sizes of mandibular angle implants were used, 12 mm thick on his smaller right side and 10 mm thick on his larger left side. Malar implants were also requested. He is shown 2 years postoperatively.

In my practice, asymmetries are documented in the patient's chart by computer imaging or photographic modalities. Documentation helps to counter any postoperative criticism if the asymmetry is still apparent in the least degree to the patient.



Preoperative

Computer-generated
right-sided mirror imageComputer-generated
left-sided mirror image

This 28-year-old man had significant hereditary facial asymmetry, as demonstrated by computer imaging technology. The computer-generated images dramatically show that the right side of his face was proportionally narrow compared with the left side. The patient is shown 1 year after mandibular augmentation.

Although CT-generated computer-aided design/computer-aided manufacturing (CAD/CAM) technology can be used to create implants from customized models with asymmetrical skull anatomy, at present such an advanced method is used only for correction of the most complicated and sophisticated problems. CAD/CAM customized modeling has been used mostly for correction of posttraumatic and congenital birth defects and deformities. Such customization is time consuming and expensive, and the results are at best only moderately more successful than those obtained with standard, universally designed anatomic implants. In the past 3 years, however, approximately 1 out of 12 of my patients who consulted exclusively for facial implant contouring felt comfortable purchasing implants derived from CT CAD/CAM technology; these are molded on their posterior aspect to custom-fit a personalized skull model.

Advancements in this area of computer technology are rapidly evolving and will soon enable aesthetic plastic surgeons to correlate implant sizes and shapes with desired changes in facial form and contour.

Choosing implants to correct asymmetries is presently a matter of intuitive artistic judgment rather than of technical precision. Obviously, a thicker implant with a larger surface area is indicated for the side of the face that lacks bone and soft tissue volume. Similarly, for jawline asymmetries in the posterior mandibular and mid-lateral zones, implants that provide additional thickness of 1, 2, or 3 mm at the angles and along the horizontal ramus can be used on the deficient side of the mandible.

Perhaps the most important principle for the surgeon to remember is that minor asymmetries tend to become less noticeable within a 6-month postoperative healing period, during which relaxation of the collagenous capsular matrix around the implants allows the contours to appear softer.

Custom Designing Implants Using Three-Dimensional Computer Modeling

Any chapter on facial volumization with implants would be incomplete without a brief discussion of the latest unique and innovative techniques for custom-designed facial implants. I have been responsible for the major advances to date regarding the development of anatomic alloplastic designs for the chin, jaw, malar midface, sub-orbital maxillary area, and other regional volume deficiencies in the face. I first used these designs in 1977. My patented implant designs represent a decade of evolutionary alterations to evaluate the final contours produced by observing the resolution of the final swelling at the end of the first postoperative year.

Through years of experience, I found that the need for certain small modifications was obvious for a number of patients. With the growing popular interest in facial contour modification by means of implant volumization, current patients have become very specific and particular about the details of the contours they believe can be achieved through the modern miraculous work of aesthetic plastic surgeons.

Some patients develop unachievable expectations from having pored over glamorized articles, photographs, comments, and various media reports that indicate that many of the most attractive models and actors have achieved their structural beauty through prosthetic plastic surgery.

Thus present patient demands have stimulated sophisticated alloplastic facial surgeons to accept the challenge to meet such expectations. Custom-designed facial implants are now possible through modern CAD/CAM methods that perfectly duplicate anatomic topographic contours to form-fit implants individually to the skeleton in these more sophisticated and demanding cases.

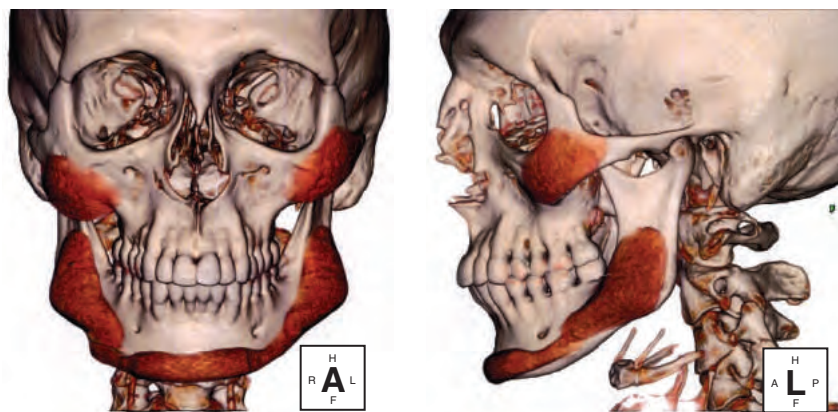


These CAD/CAM models were generated from CT scans that precisely duplicate anatomic topographic facial skeletal contours.

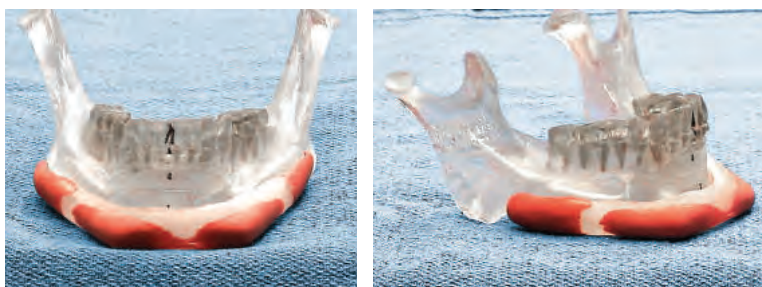
Over the past 20 years, three-dimensional CAD/CAM implants have been used successfully for facial reconstructions by craniofacial and oromaxillary surgeons. Over the past 8 years, I have found good reasons to also apply this technology for regional aesthetic facial volume deficiency problems.

Although asymmetries of the face are present 100% of the time in varying degrees, when they are minor, they may go unnoticed by patients before their cosmetic surgery consultation, and if these are not brought to their attention before surgery and documented, the surgeon will surely be plagued by patient complaints after surgery about perceived malpositions, asymmetries, and postoperative deformities.

When asymmetries are more obvious, many patients come to the consultation with a specific goal to have their asymmetries corrected. Many have somehow come to believe implicitly that the aesthetic facial surgeon, especially one who performs facial implant procedures, can succeed in achieving a near-perfect result. All experienced surgeons know that nothing can be farther from the truth. In trying to accomplish symmetry over a 35-year period, I have discovered that this is rarely possible, although considerable improvements can be made through the use of different sizes and shapes of implants positioned slightly differently on the facial skeleton. Even so, today's patients demand still more precision. Therefore custom-designed fitted implants that are accurately matched to the external surface nuances of the bony facial skeleton can often provide more ideal positioning and attachment of the implants to the underlying bony prominences.



These CT scans show accurate positioning and form-fitting of multiple custom implants for a particular patient's skull (see patient on p. 1254).



This silicone rubber preliminary custom-made implant has been form-fitted based on a patient's CAD/CAM-generated mandible model.

I have also discovered that facial asymmetries are never exclusively skeletal in origin. In cases in which by good fortune surgery has resulted in perfect bony symmetry, soft tissue deficiencies of the muscle, fascia, and fat layers still persist, demonstrating that they also contribute to the asymmetries in every instance. This reality must also be emphasized to patients preoperatively.

It is not within the scope of this chapter to discuss the detailed techniques for using custom-designed facial implants. My purpose is to acquaint readers with this subject and to indicate the marvelous technologic progress in aesthetic facial contouring that exists and will continue to be developed.

All facial aesthetic surgeons are waiting for the historical moment when computer image modification of the patient's photographic image in their office can be successfully combined with a three-dimensional CT scan to provide instant individualized patient information regarding the dimensions of implants and specifics for positioning them, which will provide optimal precision results. Indeed, if equipment were available for office use that could readily manufacture such personalized implants, the ultimate dreams of an alloplastic aesthetic surgeon would be realized. Patients as well as surgeons would be grateful for the emotional security and enhanced confidence in both the surgeon and the procedures.

The details of this customized methodology can be found in the references section. For aesthetic custom design implants to be used for facial skeletal volumization, biocompatible alloplastic implant materials such as Silastic (silicone rubber) are more predictable and durable than autologous grafts. Experience as well as research with bone or cartilage autografts has confirmed that unpredictable and variable amounts of resorption occur, and harvesting the grafts carries a risk of donor site morbidity.



This 41-year-old man required multiple malar-midface and chin-mandibular angle custom-made form-fit implants, as seen on his CT scans on p. 1252.

It has also been established that it is easier to predict soft tissue displacement after direct augmentation with grafts or implants than with orthognathic procedures such as osteotomies and segmental bone repositioning. Therefore custom-designed onlay implants are a more desirable option than more extensive traditional orthognathic reconstructive surgery.



A custom-made hemimandible silicone implant is shown.



This 27-year-old woman had a congenital right hemimandibular deficiency. The markings for the surgery are shown, and she is seen 6 months after a right hemimandibular implant was placed.

Operative Technique

Patient Positioning

In all facial contouring surgery the patient is positioned supine on the operating table. General anesthesia is indicated to control the blood pressure adequately. Clonidine (0.2 mg) is given preoperatively for vagosympathetic stabilization. The systolic blood pressure is maintained by the anesthesiologist at a level of 90 to 100 mm Hg. A local anesthetic is also generously infiltrated into the tissues. The ideal anesthesia for alloplastic facial contouring is shown in the box.

Anesthesia Protocol

General Anesthesia

Maintain systolic blood pressure at 90 to 100 mm Hg
Clonidine 0.2 mg given orally preoperatively

Local Anesthesia

Lidocaine solution 0.2%
Epinephrine 1:800,000
Generous tissue infiltration into malar or premandibular space (20 to 30 ml each)

A volume of 20 ml is injected into each malar and premandibular region. The anesthesia solution should be placed beneath the periosteum. This protocol enables the surgeon to execute facial implant surgery in a nearly bloodless field.

Incision Placement

Incisions to approach the malar-midface and premandibular regions are as follows:

- Intraoral
- Lower blepharoplasty (subciliary)
- Rhytidectomy
- Transcoronal
- Transconjunctival



There are several surgical approaches for augmenting the malar-midface space. The most traditional and commonly used approach for midface augmentation is the intraoral route. A 1.5 cm incision is made only through the mucosa. The excision is extended obliquely upward over the anterior buttress of the maxilla just above the canine tooth. It is connected with another 1.5 cm horizontal incision made 1 cm above the gingival buccal sulcus that is extended posterior to the premolar tooth. The dissection is initiated onto the bone only through the lower border of the incision and always remains on the bone.



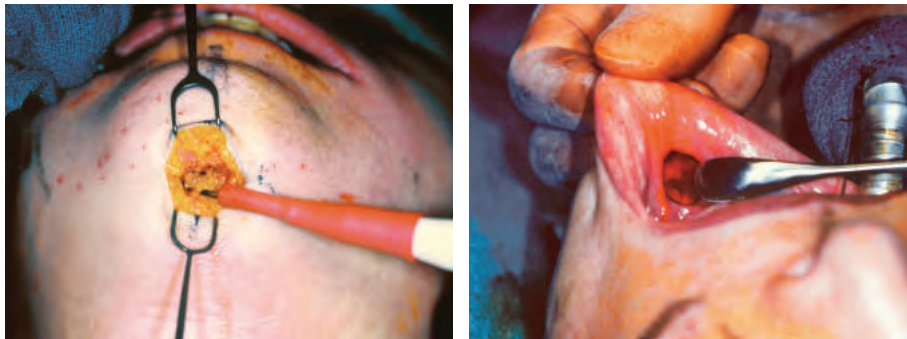
A lower blepharoplasty incision can also be used by dissecting beneath a skin muscle flap onto the lower orbital bony margin and penetrating the suborbicularis oculi fat (SOOF) layer in the lateral aspect of the orbit down to the bone. The midface zone 1 area can be dissected subperiosteally from that location.

If a rhytidectomy insertion is intended, a small penetration is made through the soft tissues over the lateral aspect of the malar bone at the junction with the zygomatic arch. This facilitates entrance into the subperiosteal malar space in an area where no major facial nerve branches are endangered.

Premandibular augmentation involves two types of incisions to:

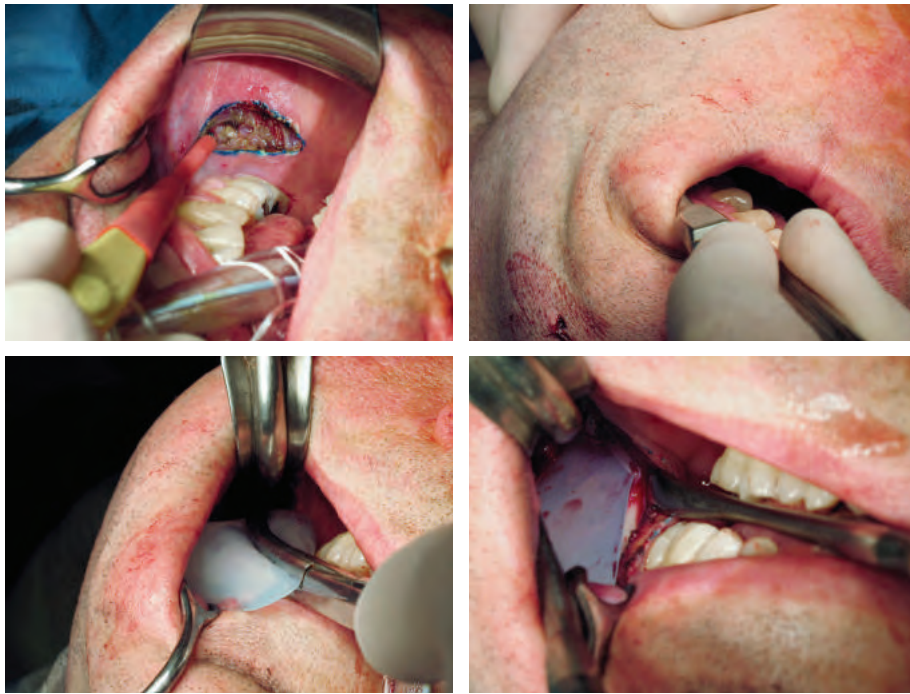
Augment the angle of mandible

Create the central mentum space for insertion of a central implant with lateral anatomic extensions

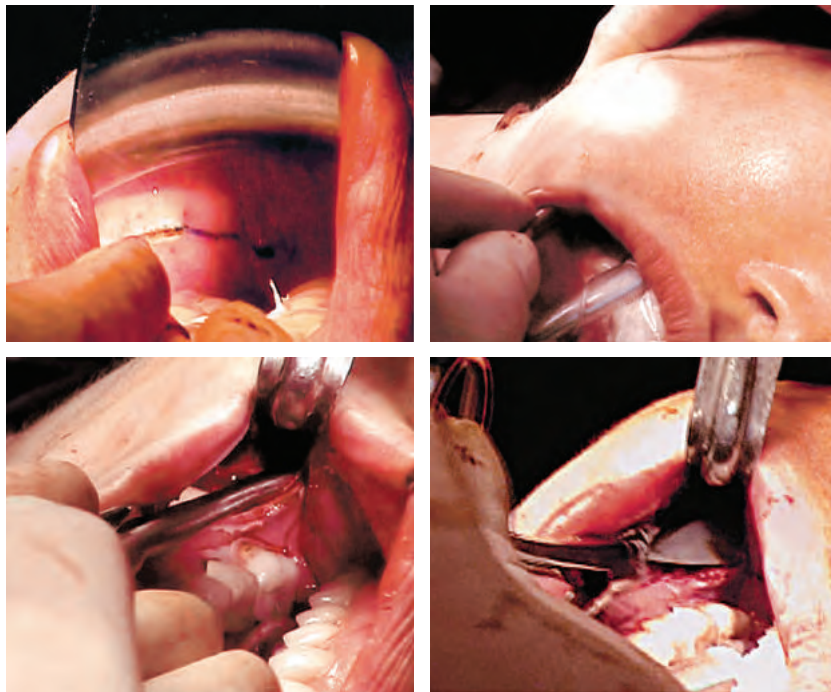


The central mentum space can be approached from the intraoral route or with an incision in the submental crease. The submental crease incision is preferred when there is to be dissection into the neck, either to remove fat or to manipulate and tighten the platysma muscle, or both. This incision is approximately 2.5 cm in transverse length and penetrates directly down onto the lower border of the mandible. From that location a subperiosteal dissection is done laterally in both directions. The intraoral incision is a transverse mucosal incision of 2 cm only, placed 1 cm superior to the gingival labial sulcus. Next a vertical penetration is then made between the two pillars of the mentalis muscle. The mentalis muscle should never be transected, because this would produce weakening and ptosis of the central chin mound. By dissecting vertically between the muscles and then developing the subperiosteal space inferior to them, the muscular support of the soft tissues of the chin mound is maintained.

In either dissection, the mental nerve should be located and identified. It is usually situated 8 to 12 mm above the inferior border of the mandible and 2.5 to 3.5 cm from the midline of the central mandible. Extreme variations of distances are reported, although these are rare.



The posterior mandibular angle space is created by an incision made 1 cm anterior to the molars in the gingival buccal sulcus and extending it laterally 4 cm. A sturdy 1 cm layer of mucosa and muscle must be preserved to ensure a secure closure. The dissection is then immediately directed onto the bone. The soft tissues elevate very easily from the inferior border and ascending ramus of the mandible. At the angle itself, there may be tendinous attachments of the masseter muscle, especially in men. These may need lysis with an electrocautery needle to enable the muscles to be disinserted from the angle and posterior border of the mandible. It is critical, however, to disinsert the fibrous attachments at the angle and the posterior border completely so that the implant will seat correctly. The masseter muscle itself is quite thick and strong and will hold it in proper position without fixation. Malpositions and extrusions are rare when the posterolateral space is dissected properly.



A long, curved clamp is placed on the implant to facilitate the posterior and upwards placement of the implant.

A peripiriform premaxillary implant is inserted through a single 4 to 5 mm nasal floor incision, although one on each side may be used if necessary. An intraoral incision in the superior labial sulcus should be avoided, because it may predispose to implant erosion through that area. The plane of dissection is developed deep to the orbicularis oris muscle to create a subperiosteal pocket for the implant.

Tear trough implants can be placed through an external subciliary blepharoplasty incision, a transconjunctival incision, or an intraoral route. The most important consideration is to carefully dissect around the infraorbital nerve under direct visualization to prevent nerve trauma and subsequent disabling symptoms. The tear trough implant is placed after cutting out a segment that allows it to surround the main trunk of the infraorbital nerve. If desired, it can be secured by one or two stitches to the medial orbicularis muscles or to the inferior orbital rim.

Postoperative Care

Postoperative care for facial implants is straightforward and uncomplicated. Oral antibiotics are used perioperatively; at present cephalosporins are favored. Before the procedure begins, the anesthesiologist administers cephazolin (Ancef) 1 g intravenously; 10 mg of dexamethasone (Decadron) is also administered intravenously during the surgery to control postoperative edema. During the postoperative period, a 5-day diminishing course of a steroid (methylprednisone; Medrol Dose-Pak) is taken orally. For the first 12 hours cold compresses are applied intermittently to the operative site either in the midface or premandibular region. No bandages are used. Removal of intraoral mucosal and external subcuticular sutures is unnecessary. A soft diet is maintained for 10 days. It is highly recommended that the patient recline at a 45-degree angle, supine, for at least 1 week. Vigorous physical activity is not permitted for 4 weeks, after which patients may engage in any and all types of exercise.

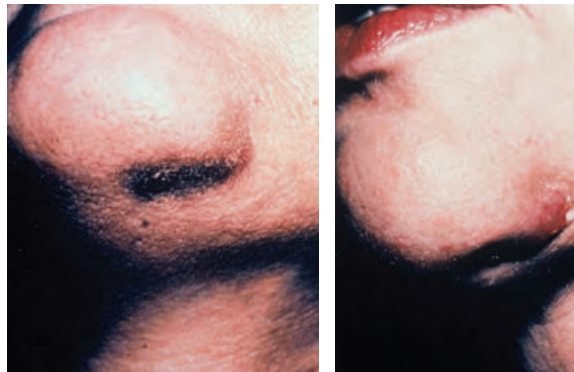
Problems and Complications



Cellulitis and inflammation developed in this 38-year-old woman after she underwent malar augmentation surgery. *Left and center:* She is seen 10 days after surgery. *Right:* At 3 weeks after surgery, the cellulitis has resolved after treatment with antibiotics and drainage.



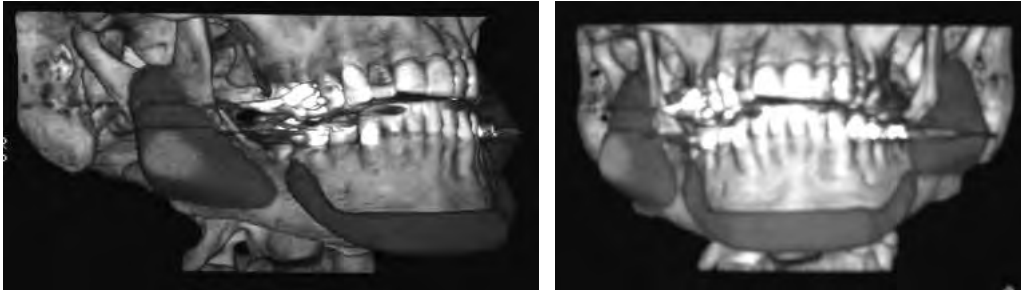
Percutaneous suction drainage can be combined with intensive antibiotic therapy to manage a midface suppurative infection.



Extrusion of a central mandibular chin implant is rare but can be caused by excessive trauma or internal pressures created by an inadequate space for the implant.



Intraoral extrusion of a midface implant can follow inferior placement of the implant with overlying pressure erosion caused by a dental prosthesis, hematoma and infection, or inadequate midface anatomic dissection.



A three-dimensional CT scan was used to diagnose the extrusion of this anatomic extended chin implant from the lower internal buccal sulcus mucosa.



The chin implant in this 48-year-old man was adjusted through the previous submental incision and the internal extrusion site was repaired to achieve a successful resolution.



A hematoma that developed during the first 24 hours after surgery caused pain and swelling in this 61-year-old woman. With the patient under local anesthesia, the clots were easily evacuated and the cavity irrigated copiously with antibiotic solution (1 g Ancef in 1 L of Ringer's lactate solution) after the implant was removed. It was immediately replaced and resutured, to heal uneventfully.



This 35-year-old patient sustained damage to the upper lip segment of the orbicularis oris muscle as a result of implant surgery. After 8 weeks, the injury had fully resolved.



Facial nerve injuries are rare following facial implant surgery and are usually temporary. These are examples of temporary damage to the frontalis and orbicularis branches of the left facial nerve after malar augmentation.

Avoiding Unfavorable Results and Complications

In 1991 and 1998, I conducted a survey of ASPRS and ASAPS members regarding their experiences in aesthetic surgery with alloplastic implants. In 2008, a similar survey was done with ASFPS and ASOMS surgeons. The most statistically significant categories for “unfavorable results” with facial implantation reported in all these surveys over the last 20 years were as follows:

1. Patient or doctor dissatisfaction
2. Lack of correction of asymmetries or asymmetries resulting from surgery
3. Inappropriate shape and/or malposition
4. Hematoma, seroma, and inflammation
5. Infection necessitating removal
6. Nerve dysfunction

Notably, in the 1998 survey more than 90% of the surgeons considered their “unfavorable results” to be relatively insignificant, both emotionally and physically. Perhaps this is because the majority of untoward sequelae were either temporary asymmetries and inappropriate shapes associated with the healing phase, reversible problems requiring implant removal, or nerve dysfunctions that in the vast majority were temporary and partial rather than permanent.

More than half of the responding surgeons in the 2008 survey had practices with over 80% cosmetic cases and approximately 10% reconstructive cases. Ninety percent of the surgeons surveyed use alloplastic materials. Silicone rubber implants scored 3 to 1 over the next contender, Medpor. Gore-Tex was used by 25% of the surgeons.

Further evaluation revealed silicone rubber to be the most desirable, as cited by two thirds of the surgeons, Medpor by 20%, and Gore-Tex by 16%. Nearly half of the surgeons stated that silicone (Silastic) was the only material that they used. It was cited for its low infectability; easy insertion, removal, or exchangeability; conformation to the bony skeleton; and stable, long-term, predictable volume. Two thirds of the reporting surgeons use silicone implants for the cheek-midface submalar region and 80% for the chin-mandibular facial aesthetic segment.

For chin implants, twice as many surgeons rated silicone rubber as exceptional or excellent by twice than those who rated the material as fair, good, or useful. In the malar region, Silastic implants were rated six times more successful in achieving exceptional or excellent results than those producing fair, good, or useful results. No one rated facial implants as poor.

Ninety percent of the surgeons surveyed rated facial implant surgeries as useful from 10% to 50% of the time, and 45% of the surgeons felt they would use them in 20% to 50% of cases. Forty percent of the surgeons considered facial volumization with alloplastic materials indispensable or mostly necessary; 60% rated them as desirable or useful at times. Only 0.5% considered them to have too many problems to be used. Although these numbers come from the latest 2008 survey, there has been a significantly increasing endorsement of facial implant technology since my first survey in 1999.

Concluding Thoughts

Clearly, the use of alloplastic facial augmentation has gained tremendous momentum in respectability and success over the past 20 years and apparently is considered one of the leading tools for a plastic surgeon's aesthetic armamentarium for faces.

Clinical Caveats

Always perform the anatomic space dissection directly on the bone and beneath the periosteum.

Maintain the dissecting elevator on the bone at all times.

Never push the tip of an elevator into adjacent soft tissues. This can create severe trauma to the facial nerve, infraorbital nerve and/or zygomaticus muscles disturbing facial expression in the malar-midface region. In the perioral and mandibular regions traumatic dissection into the soft tissues can produce mental nerve or marginal mandibular nerve damage, and even mimetic muscle dysfunction. Potential dangers in posterior angle dissections involve trauma to a large retromandibular vein behind the posterior border of the mandible or to the anterior facial artery just adjacent to the inferior border of the mandible. Disruption of these would produce profuse hemorrhaging.

External palpation of the lower mandibular border with the index finger facilitates an accurate and controlled dissection beneath the mental nerve as well as protecting the inferior soft tissues and marginal branch of the seventh nerve.

Manual palpation externally over the malar region facilitates a precise dissection of the malar space beneath the external preoperative ink markings on the midface skin. A small hockey stick incision with 1.5 cm limbs will facilitate a wide midfacial premaxillary and submalar dissection. Once again, the entry point should be beneath the muscles and onto the bone of the anterior maxillary buttress.

Continued

Clinical Caveats—cont'd

The intraoral chin space dissection should be done vertically between the mentalis muscle pillars to go beneath the muscle and onto the bone without transecting or damaging the mentalis muscle which can produce central chin ptosis.

All intraoral incisions should have a secure muscle and mucosal closure to prevent entrance of bacteria or wound dehiscence.

Intermittent irrigations with copious amounts of antibiotic solution should be performed inside the anatomic zonal spaces during the surgery.

A “no-touch” technique should be meticulously enforced when inserting implants. This is done by placing a clamp on the implant and immersing it in a Betadine and antibiotic solution before inserting it gently into the soft tissue anatomic space aperture.

Implants should be inserted as gently and atraumatically as possible. Finger manipulations are to be avoided. Silicone rubber implants have the advantage of being extremely flexible and therefore easily insertable or removable.

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The authors present a brief history of facial aesthetic surgery, with references to the source articles.

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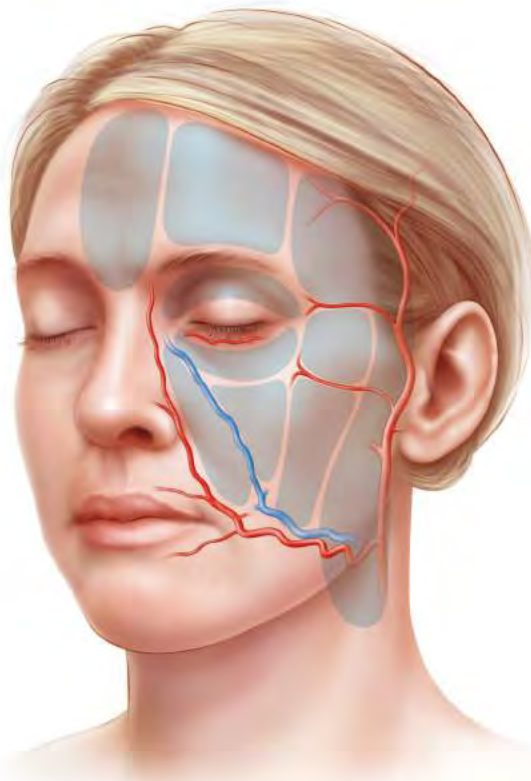
PART VIII

FACE LIFT AND NECK LIFT



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CHAPTER 40



Applied Anatomy of the Face and Neck

FOAD NAHAI, JUAN DIEGO MEJIA,
FARZAD R. NAHAI

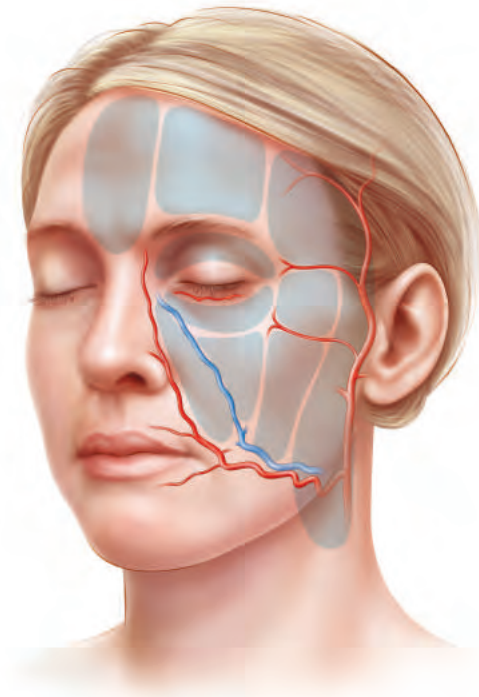
The first rule of anatomy is variation.

Precision in aesthetic surgery depends not only on the technical skills of the operator, but almost equally on the surgeon's detailed knowledge of anatomy. This is particularly pertinent in dealing with aesthetic surgery of the face. A thorough knowledge of the anatomic layers and structures of the face and neck is a prerequisite for successful and safe aesthetic surgery. This includes a comprehensive understanding of the anatomy in three dimensions. The relationship of the underlying bony skeleton, muscles, and subcutaneous tissues, including fascial layers and fat compartments, not only enhances our comprehension of the aging process but is also a key to successful rejuvenation. Anatomic structures and relationships are not consistent, and the surgeon must be aware of possible variations. The anatomy may vary from individual to individual as well as from one side to the other in the same person. Prior surgical interventions may also alter the anatomy and should be taken into account in all secondary aesthetic procedures of the face and neck as well as of the body.

Subcutaneous Fat Compartments of the Face



For many years the subcutaneous fat of the face was believed to be a confluent mass. However, recent anatomic studies by Rohrich and Pessa have demonstrated that this fat exists in distinct anatomic compartments, as shown. These fat compartments are separated by fascial septa that arise from the superficial fascia and insert into the dermis.



Perforating vessels arising from deep arteries travel through these septa to supply the skin and define the overlying vascular territories or angiosomes.

Anatomic Features

Forehead and Temporal Fat Compartments

The forehead is composed of three fat compartments: the central, middle temporal, and lateral temporal–cheek compartments. The central compartment is located in the midline region of the forehead. It is bounded by the middle temporal fat on either side. Its inferior border is the nasal dorsum. This central fat compartment is limited on each side by the central temporal septum. Perforators from the supratrochlear vessels travel through this septum, which explains why the subcutaneous boundaries of the central temporal septum coincide with the known clinical limits of the forehead flap. The middle temporal compartments lie on either side of the central forehead fat. Its inferior border is the orbicularis retaining ligament. Laterally, it is limited by the superior temporal septum and the lateral temporal–cheek compartment. The lateral temporal–cheek fat is the lateralmost compartment of the face. It spans from the forehead to the cervical region, connecting the temporal fat to the lateral cheek and cervical subcutaneous fat.

Orbital Fat Compartments

There are three periorbital fat compartments: the superior, inferior, and lateral orbital compartments. The superior fat is bounded by the orbicularis retaining ligament as it courses around the superior orbit. Medially and laterally, it is limited by the canthi. The inferior orbital fat lies immediately below the inferior lid tarsus. Inferiorly, it is bounded by the orbicularis retaining ligament. The medial and lateral extents are also the canthi. The lateral orbital fat is located in the temporal region. Its superior border is the inferior temporal septum, which carries perforators from the zygomaticoorbital branch. Inferiorly, its boundary is the superior cheek septum. The zygomatic major muscle adheres to this compartment.

Nasolabial Fat Compartment

The nasolabial fat is the medialmost of the facial compartments. The orbicularis retaining ligament represents its superior border. Laterally, it is bordered by the medial cheek compartment, and inferiorly by the nasolabial fat. The lower border of the zygomaticus major muscle is adherent to this fat structure. Perforator vessels from the angular artery run within the nasolabial septum located between the nasolabial fat and the upper lip fat.

Superficial Cheek Fat Compartments

There are three distinct superficial cheek fat compartments: the medial, middle, and lateral temporal–cheek fat.

Medial cheek fat is lateral to the nasolabial compartment. This limit is defined by a septum carrying perforators from the facial and infraorbital arteries. Its superior boundary is the orbicularis retaining ligament and the lateral orbital compartment. The lateral boundary is the middle cheek septum and the middle cheek fat. The jowl lies inferior to this compartment. The facial vein is consistently found at the deep surface of the medial cheek fat.

The middle cheek fat lies between the medial and lateral temporal–cheek compartments. The middle cheek septum is the medial boundary of this compartment; it carries perforators of the transverse facial artery to the skin. This fat compartment is found anterior and superficial to the parotid gland. The zone where the medial cheek fat meets the middle cheek fat corresponds to the location of the parotidomasseteric ligaments. Its superior border is defined by the superior cheek septum. The confluence of septa where this compartment meets the medial cheek fat and the inferior orbital fat forms the zygomaticus ligament. The middle cheek fat is adherent to the zygomaticus major muscle at its superior portion. Care must be exercised during a face lift, because the plane between the lateral and middle cheek compartments can easily lead into the buccal fat pad and deep neurovascular structures.

The lateral temporal–cheek fat is the most lateral compartment of the face. In the cheek, this fat lies immediately superficial to the parotid gland. It spans from the forehead to the cervical region, connecting the temporal fat to the cervical subcutaneous fat. The lateral cheek septum is located anterior to this compartment and corresponds to the first transition zone encountered during a face lift. Multiple perforator vessels from the superficial temporal artery travel through this septum up to the forehead region. The superior and inferior temporal septa represent its superior boundaries.

Deep Medial Cheek Fat Compartment

The deep medial cheek fat is deep to the medial and middle superficial cheek compartments of the face. It lies inferior to the orbicularis oculi muscle and has the orbicularis retaining ligament as its superior boundary. The inferior boundary is the suborbicularis oris fat. The most lateral boundary is the capsule of the buccal fat pad and the zygomaticus major muscle. The medial boundary is the pyriform ligament surrounding the nasal base. The posterior border is the periosteum of the maxilla and a potential space exists between the periosteum and the deep medial fat (Ristow's space), which is a potential site for fat transfer.

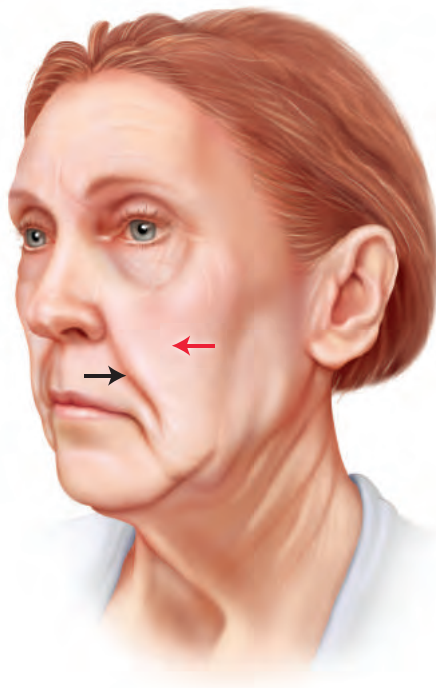
Functional Significance

It is unlikely that the face ages as a confluent mass. A smooth transition between subcutaneous fat compartments is characteristic of a youthful face. With aging, somewhat abrupt contour changes between these regions occur. Both volume and position affect the superficial and deep fat compartments in the aging face. These changes may occur as a combination of ligament laxity and volume loss as described by Lambros.

When performing a face lift, the surgeon encounters zones of adherence that alternate with zones of easy dissection, which suggests that barriers exist between different zones of facial fat. These areas occur in the transition between compartments. Transition zones between compartments are regions of potential injury to deeper structures, including branches of the facial nerve. This can occur when transition is performed in too deep a plane during a face lift.

There is a concept that deep cheek fat supports the overlying subcutaneous fat. Loss of volume of the deep medial cheek fat may be a primary determinant of midfacial aging and diminished midface projection. In the aging face, the downward migration of the nasolabial fat as a result of ligament laxity is not the only cause of the observed changes in this area. It seems that the volume of the nasolabial fat is preserved, whereas there is loss of projection of the medial and middle superficial fat compartments of the cheek secondary to deep medial fat atrophy. These findings suggest that one of the reasons for a prominent nasolabial fold with aging is, in part, a

form of pseudoptosis: loss of projection of the superficial medial and middle cheek fat makes the nasolabial fat appear more prominent, when in fact, its volume has not changed. Clinically, when fat is injected into the deep medial fat compartment (deep and medial to the zygomaticus major muscle), this improves midface projection, re-creates a youthful cheek, diminishes the prominence of the nasolabial fold, and improves the lid-cheek junction.



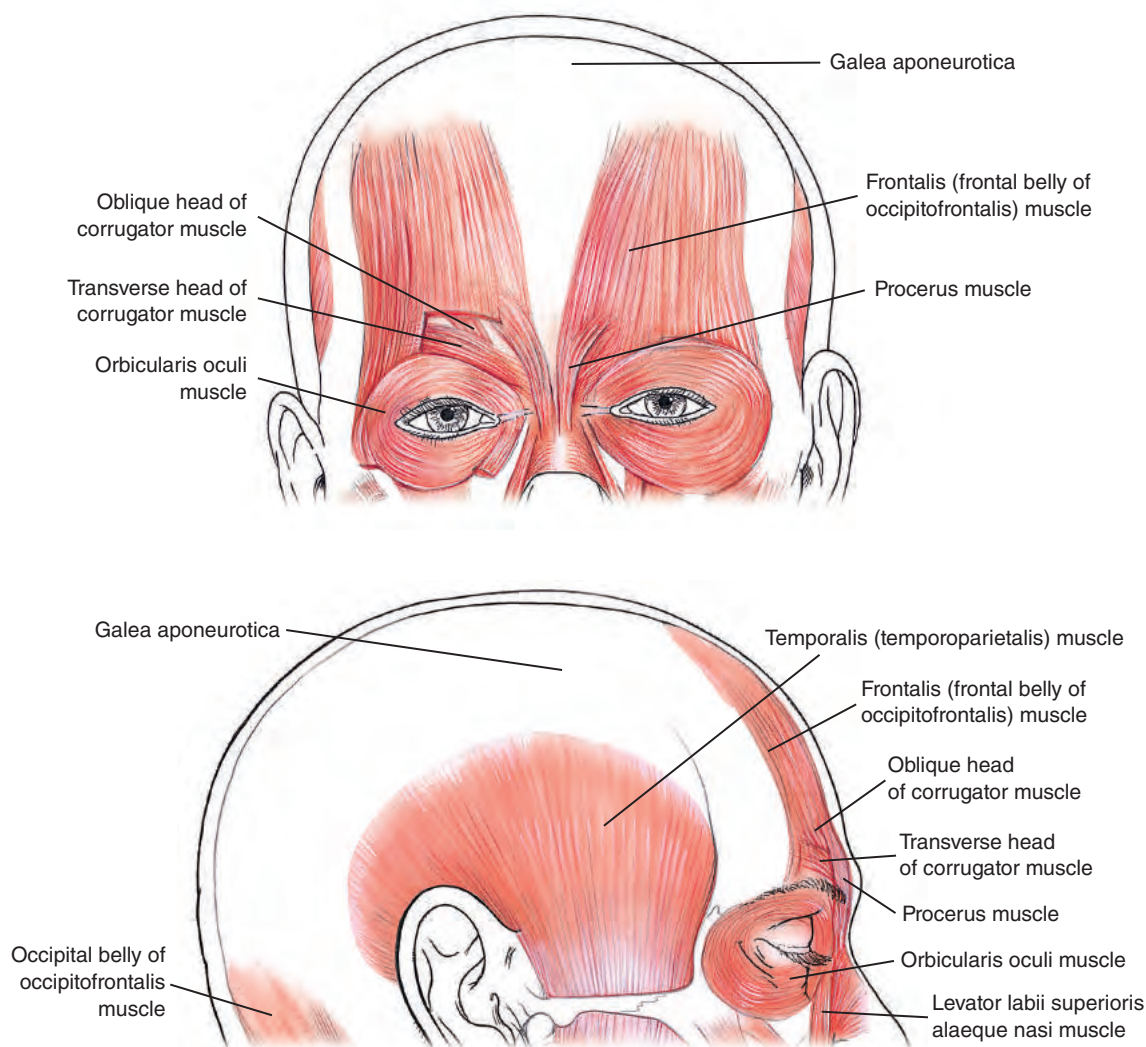
The volume of the nasolabial fat compartment is preserved with age (*black arrow*); however, there is loss of projection of the superficial cheek fat compartments (*red arrow*). A prominent nasolabial fold with age is, in part, a form of pseudoptosis: loss of projection of the superficial cheek fat makes the nasolabial fold appear more prominent.

Muscles of the Scalp and Brow

The muscles of the scalp, brow, and periorbital region are major contributors to facial animation and appearance. Emotional expressions and overall facial appearance depend on the actions of these muscles. With age and repeated contractions, these muscles produce lines or rhytids reflecting the insertion of the muscles into the overlying skin. These characteristic changes result in the familiar patterns of expression and aging on the face. The muscles of the scalp and brow include the epicranii, procerus, corrugator supercilii, and orbicularis oculi muscles. These muscles are responsible for movements of the scalp, forehead, and eyebrows and the rhytids that mark the forehead, glabella, and periorbital areas.

Epicranius

Anatomic Features



The epicranium or scalp muscle is made up of the occipitofrontalis, the major portion, and a variably developed temporoparietalis. The occipitofrontalis is a wide, fibromuscular layer that covers the entire scalp from the nuchal line to the eyebrows. It comprises two paired muscle bellies—the occipital bellies (occipitalis muscles) and the frontal bellies (frontalis muscles); these are connected by the galea aponeurotica. The frontal bellies or frontalis muscles, which are clinically significant, are thin, rectangular muscles without any bony attachments. These muscles are connected posteriorly to the galea aponeurotica at or in front of the coronal suture; they insert anteriorly into the glabellar musculature, where the medial fibers of the frontal belly intermingle with the procerus, while the intermediate fibers mingle with the corrugator supercilii and the orbicularis oculi. The medial fibers of the frontal bellies may be joined together for a variable distance above the root of the nose. Supratrochlear and supraorbital branches of the ophthalmic artery supply the frontalis; it is innervated by multiple branches of the frontal branch of the facial nerve.

Functional Significance

The frontal bellies, acting from above, elevate the eyebrows and forehead. Acting from below, they pull the scalp forward. The frontal bellies are responsible for the transverse forehead wrinkles, reflecting attachments or insertions of the muscle into the overlying forehead skin. Although transverse forehead wrinkles are produced by either action of the frontal bellies, increased tone in the brow depressors, corrugator, procerus, and orbicularis leads to an increase in frontalis tone. This muscle imbalance and increase in tone deepens the forehead lines. The occipital bellies draw the scalp backward, acting in opposition to the downward action of the frontalis. Improvement in brow position after a forehead lift may be attributable to reduced tone in the frontalis following modification of the brow depressors, allowing unopposed action of the occipitalis to elevate the brow. This relationship is the basis of the “functional brow lift” in which no brow fixation is performed.

Galea Aponeurotica

Anatomic Features

The galea aponeurotica is an integral part of the occipitofrontalis and epicranium muscles. It is a thick, fibrous layer with sagittally running fibers between the occipital and frontal bellies. Posteriorly between the separate bellies of the occipitalis, the galea is attached to the external protuberance and highest nuchal line of the occipital bone. Anteriorly it splits to enclose the frontal bellies and continues as a narrowing triangular portion between the two frontal bellies as they converge at the root of the nose. Laterally on each side, coronally running fibers encompass the temporoparietalis and the external ear muscles. The galea is firmly attached to the overlying skin by the firm superficial fascia, which continues as the temporoparietal fascia, eventually attaching to the zygoma. On its deep surface the galea is connected to the epicranium by loose connective tissue and allows movement of the galea and scalp. In the forehead above the level of the supraorbital ridge, there are no nerves or vessels deep to or within this loose connective tissue. This allows rapid, safe brow elevation in the subgaleal or subperiosteal plane. However, the endoscope is essential to visualize the area between the supraorbital rim and supraorbital ridge, where the supraorbital nerve may emerge through a foramen.

The temporoparietalis is a very thin sheet of muscle lying between the frontal bellies of the occipitofrontalis and the auricular muscles. It is variably developed and may be absent.

Procerus

Anatomic Features

The procerus is a small, thin, pyramid-shaped muscle extending from the nasal dorsum to the central forehead. It is considered one of the nasal muscles and may be as large as 2 by 8 cm. It takes origin from the fascia overlying the distal portion of the

nasal bones and upper lateral nasal cartilage and inserts into the skin of the lower forehead between the eyebrows, intermingling with the medial fibers of the frontalis. Branches of the facial artery supply the procerus. It is innervated by the upper buccal branches of the facial nerve.

Functional Significance

The function of the procerus is to pull downward on the medial eyebrows. This action augments the glabellar prominence, producing transverse glabellar wrinkles that are improved with procerus muscle excision.

Corrugator Supercilii

Anatomic Features

The corrugator supercilii is a long, narrow muscle measuring approximately 1 by 5 cm, wider at its origin, narrowing toward its insertion. It lies deep to the frontalis and orbicularis oculi at the medial end of the eyebrow. Originating from the medial end of the supraciliary arch, it has transverse and oblique heads, with fibers running laterally and slightly upward toward their insertion into the central part of the hair-bearing brow. It is supplied by the supratrochlear and supraorbital vessels. Although classically it has been thought that the muscle is innervated by the frontal branch of the facial nerve, Boyd showed that there is additional innervation of the muscle medially through the buccal branches of the facial nerve.

Functional Significance

The corrugator supercilii pulls the eyebrows medially and downward, producing vertical glabellar wrinkles. The depth of these frown lines is related to the thickness of the muscles, their constant contractions, and the thickness of the overlying skin. The transverse head may at times act as an elevator of the medial brow.

Orbicularis Oculi

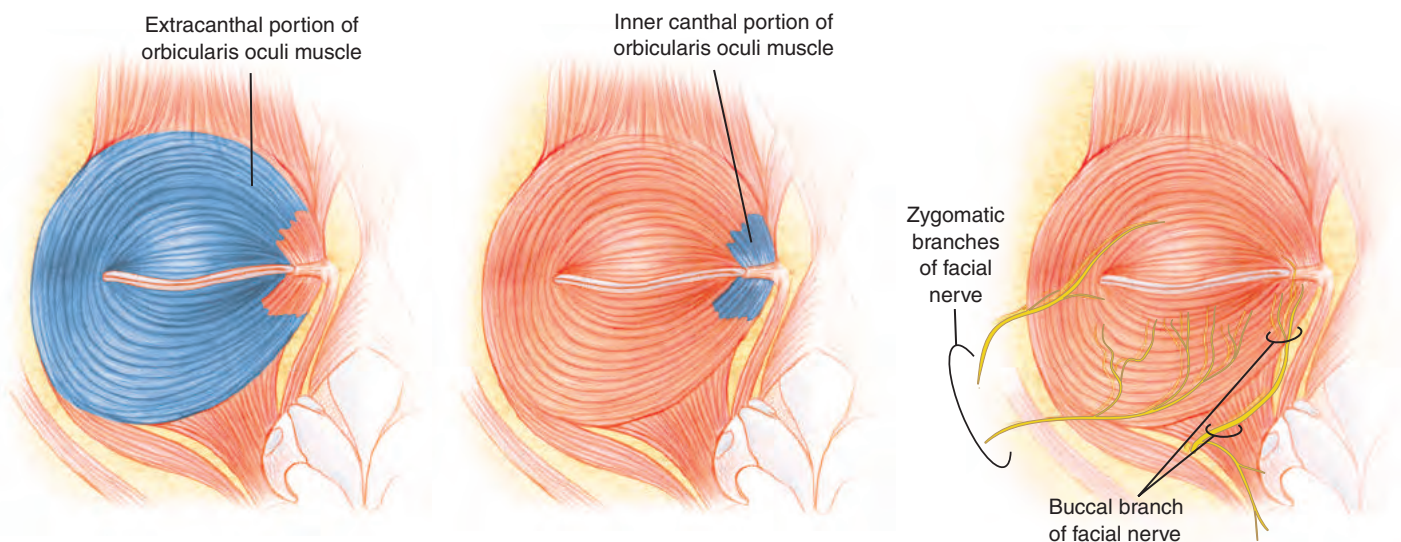
Anatomic Features

The orbicularis oculi, the most superficial muscle, is a relatively large, flat, broad, elliptical muscle that not only occupies the upper and lower lids and covers the orbit but also extends beyond the orbit onto the cheek and temporal regions. Its fibers form an uninterrupted ellipse. It comprises the orbital, palpebral, and lacrimal portions. The orbital portion is thicker and darker in color than the palpebral portion. Many of its fibers insert into the skin and subcutaneous tissues of the eyebrow and constitute the depressor supercilii. It takes origin from the nasal portion of the frontal bone and the frontal process of the maxilla. The fibers of insertion intermingle with the frontalis and corrugator muscles, inserting into the skin and subcutaneous tissues of the eyebrow. The palpebral portion is thinner and lies within the eyelids. The lacrimal portion of the muscle lies behind the lacrimal sac. The transverse facial, supratrochlear, and supraorbital vessels supply this muscle. The orbicularis is innervated by the temporal, zygomatic, and buccal branches of the facial nerve.

Functional Significance

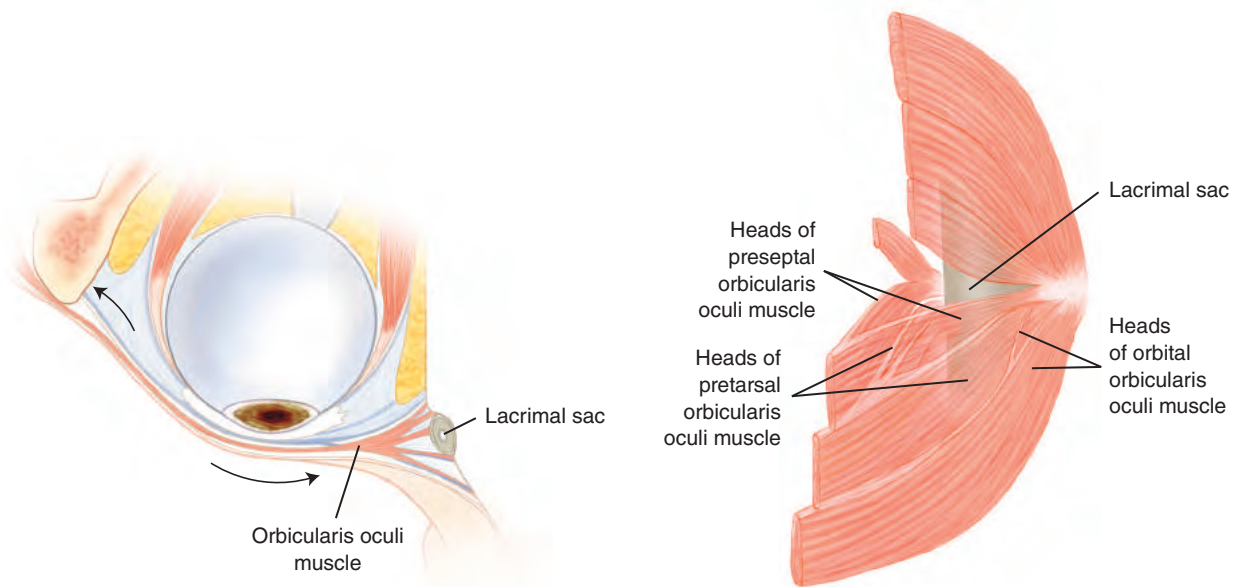
The orbicularis oculi is a powerful sphincter of the eyelids. It is innervated by the temporal and zygomatic and buccal branches of the facial nerve. The palpebral portion can act involuntarily to close the eyelid, or reflexively, as in blinking. The orbital portion is under voluntary control, and when the entire muscle contracts, in addition to closing the eyelids, the skin of the forehead, cheek, and temple are all drawn toward the medial and lateral canthus, resulting in crow's-feet and eyelid wrinkles. The medial fibers of the orbital portion, known as the depressor supercilii, will depress the medial eyebrow.

The orbicularis oculi is responsible for eyelid movement, both the sphincteric contracture of protective squeezing and normal blinking movements. Historically, the orbicularis has been classified anatomically as having a pretarsal, preseptal, and orbital division. Clinical surgical experience in patients who undergo deconstruction of the eyelids with myoneurectomy to relieve blepharospasm has shown that there is a division of labor between the extracanthal orbicularis and the inner canthal orbicularis.

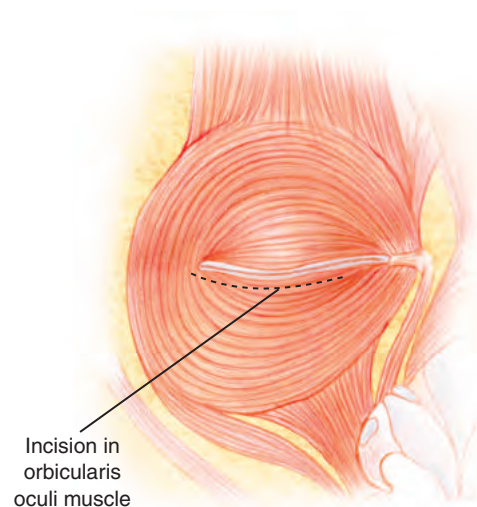


The extracanthal portion of the orbicularis (*left*) is responsible for squeezing and animation of the eyelid fissure, while the inner canthal portion of the orbicularis (*center*) is responsible for normal blinking, eyelid tone, and tear-pump movement. A division of labor in any muscle group implies a division of innervation, and it has been shown by both clinical experience and EMG studies to be true of the orbicularis muscle.

The extracanthal orbicularis (*right*) is animated primarily by the zygomatic branches of the facial nerve, and the inner canthal orbicularis is innervated by vertical extension of the buccal branch of the facial nerve.



The inner canthal orbicularis muscle segment is much thicker than the extracanthal, has multiple heads, and functions well as the sole motor for eyelid blinking, tone, and tear-pump movement. A counterpull at the lateral canthus to the inner canthal orbicularis contracture is necessary for the proper biomechanics of eyelid closure.



Dissections of branches of the facial nerve in the lower lid canthal area have verified this pattern of innervation. Other studies have shown vertical branches of the zygomatic nerve that run perpendicularly into the pretarsal area, and these researchers have raised concerns of possible denervation of the lower lid with surgical incisions in that area. Recent EMG studies have shown that traditional subciliary incisions and muscle flap dissections in this area produce no denervation.

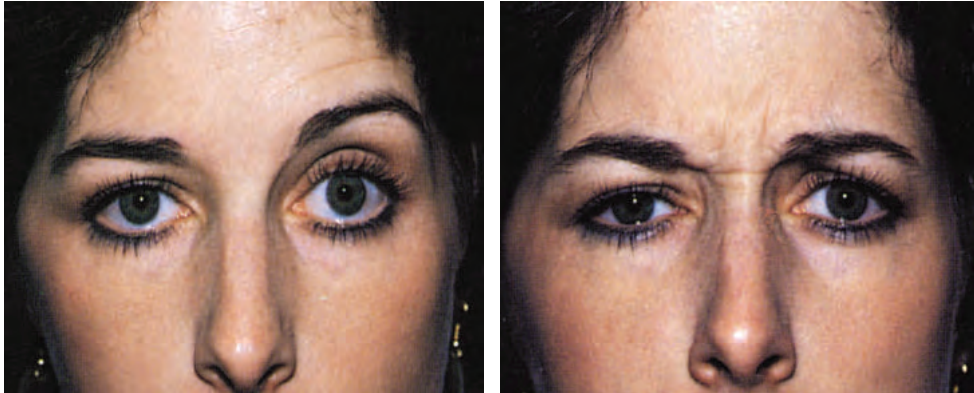
Other studies have shown that even if the zygomatic branches in the lower lid are removed by tumor resection, that lower lid reinnervation occurs rapidly and the lower lid quickly regains normal function. Intentional denervation of the zygomatic branches to the extracanthal orbicularis in the lower lid in patients undergoing myoneurectomy produces no alteration in blinking, tone, or lid position in these patients.

The muscles of the forehead, brow, and eyelids control brow position. Their actions may also influence facial appearance, creating a tired, angry, or surprised look in some individuals. Chronic contraction or muscle hypertrophy with associated muscle imbalance can cause the development of characteristic transverse forehead wrinkles, vertical and transverse glabellar frown lines, and medial eyelid folds and lateral crow's-feet. Repositioning and selective muscle resection can reverse these aging changes.

The frontalis, procerus, corrugator supercilii, and orbicularis are all intermingled in the medial brow. The degree of development or muscle bulk will vary from individual to individual, depending on habits such as squinting and frowning, which lead to muscle hypertrophy. The procerus, frontalis, and orbicularis are all on the same plane. The corrugator is in a deeper plane at its origin, but laterally it intermingles with the frontalis and orbicularis. As they exit the orbit, the supratrochlear and supra-orbital nerves are intimately involved with these muscles. The supratrochlear nerve is intermingled with the procerus as well as with the medialmost fibers of the corrugator. During resection of the procerus and medial corrugator fibers, the supratrochlear nerve must be identified and preserved. The nerve may not be immediately visible, and muscle separation or partial resection may be necessary for exposure. The supraorbital nerve is intermingled with the more lateral fibers of the corrugator supercilii. If it exits the orbit through a foramen, it is rarely involved with the muscles and is readily identified. However, if it exits through a notch, it is often surrounded by fibers of the corrugator, which may be separated or resected to clearly identify the nerve.

Brow position and dynamics are a function of the balance between the upward and lateral pull of the frontalis and the downward and medial pull of the procerus, corrugator, and orbicularis. Resection of the procerus, corrugator, and orbicularis muscles will alter this dynamic balance and allow the frontalis to elevate the brow with relatively less opposition. This is the underlying hypothesis of medial brow elevation after endoscopic forehead procedures. The lateral fibers of the orbicularis will pull the lateral brow downward; therefore resection of the lateral orbicularis fibers should facilitate lateral brow elevation.

The frontalis and corrugator supercilii are innervated by the frontal branch, the procerus by the upper buccal branches, and the orbicularis by the zygomatic and buccal branches of the facial nerve. Therefore, if the frontal branch is injured or paralyzed, some forehead movement is preserved, especially brow depression around the root of the nose.

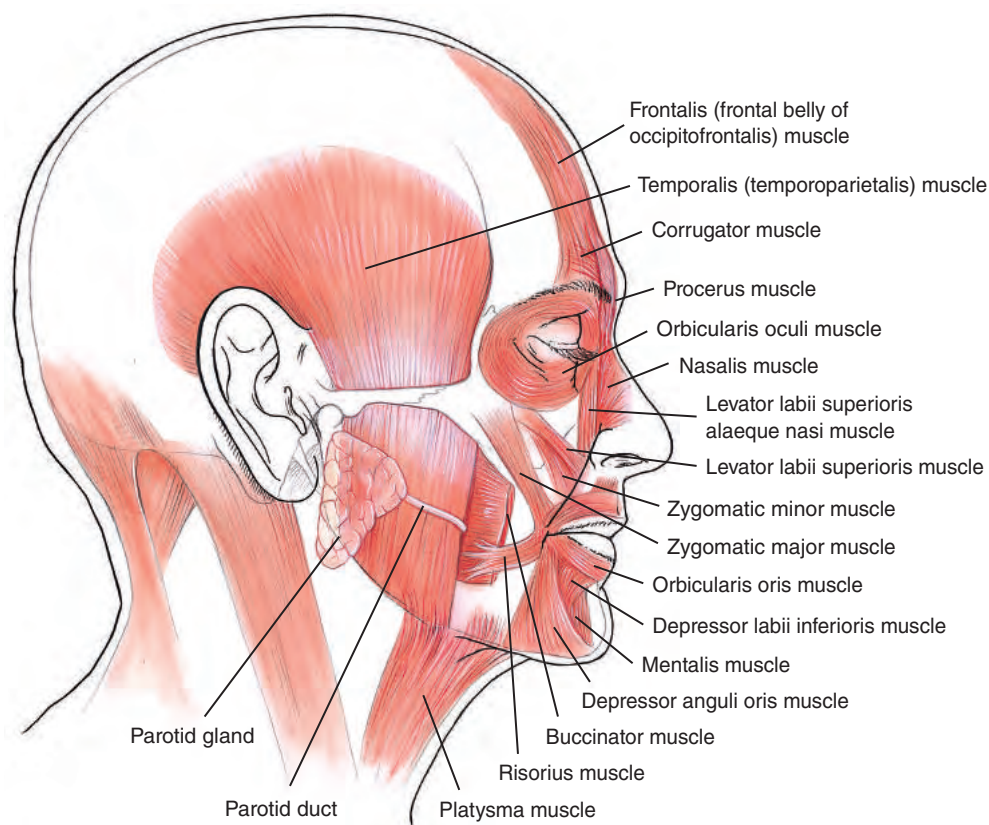
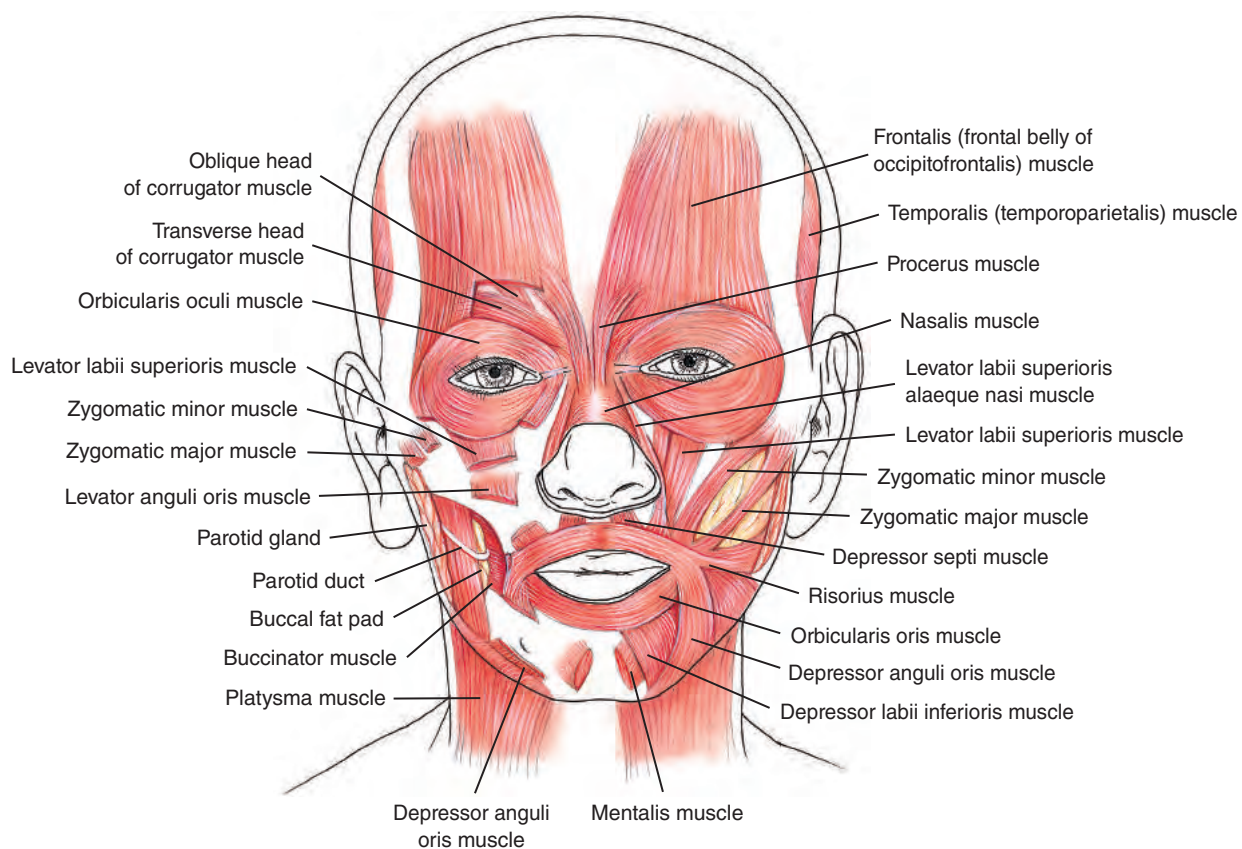


This young woman, in undergoing a meningioma resection, had an injury to the frontal branch of the facial nerve on her right side; the asymmetry of the brow position is evident (*left*). With forceful contraction to produce a frown (*right*), the left corrugator produces a vertical line; the right corrugator is paralyzed and the medial brow remains smooth. However, the procerus, innervated by buccal branches of the facial nerve, contracts forcefully, producing typical transverse wrinkling.

Muscles of the Face

The position, tone, and function of the muscles of the face are important for conveying facial expression; an understanding of the anatomy of these muscles, especially their innervation, is essential to avoid injury during aesthetic surgery. The mimetic muscles move the skin of the midface and lips and control the size and shape of the mouth. Freilinger et al described them in four layers. The superficial layer includes the depressor anguli oris, the zygomaticus minor, and the orbicularis oculi. The next layer includes the depressor labii inferioris, the risorius, the platysma, the zygomaticus major, and the levator labii superioris alaeque nasi. The next layer includes the orbicularis oris and the levator labii superioris. The deepest layer includes the mentalis, the levator anguli oris, and the buccinator.

The muscles of the first three layers are innervated by the facial nerve on their deep surface, but the muscles in the fourth layer are innervated by the facial nerve on their superficial surface. The superficial musculoaponeurotic system (SMAS) and the muscles of the upper three layers that it invests can be thought of as a unit controlling facial skin movement, similar to the arrangement of muscles and fascia controlling scalp and forehead movements.



Muscles of the Mouth

The shape and size of the mouth and the position of the lips are controlled by an extensive collection of small muscles: a group of muscles that elevates and retracts the upper lip, a group that depresses and retracts the lower lip, and a sphincter that controls the size and shape of the mouth. Elevators and retractors of the upper lip include the levator labii superioris alaeque nasi, levator labii superioris, zygomaticus major, zygomaticus minor, levator anguli oris, and risorius. Depressors and retractors of the lower lip are the depressor labii inferioris, depressor anguli oris, and mentalis. The sphincter function is controlled by the buccinator and orbicularis oris (see the illustrations on p. 1286).

Levator Labii Superioris Alaeque Nasi

Anatomic Features

The levator labii superioris alaeque nasi is a long, narrow muscle that takes origin from the upper part of the frontal process of the maxilla. The fibers pass obliquely downward and laterally along the nasofacial line superficial to the levator labii superioris. This muscle has two slips of insertion: the medial slip inserts into the lower lateral cartilage of the nose and the lateral slip inserts into the lateral part of the upper lip, blending with the levator labii superioris and orbicularis oris fibers. It is innervated by the buccal branches of the facial nerve and receives its blood supply from the facial artery.

Functional Significance

The medial insertion slip dilates the nostril and the lateral insertion slip elevates and everts the upper lip.

Levator Labii Superioris

Anatomic Features

The levator labii superioris is a narrow, triangular muscle lying deep to the levator labii superioris alaeque nasi that takes origin from the zygoma and maxilla along the inferior orbital rim just above the infraorbital foramen. The fibers course medially from this orbital origin toward the lip where they insert into the muscular substance of the upper lip between the lateral slip of the levator labii superioris alaeque nasi and the levator anguli oris. The blood supply is through the transverse facial artery, and the muscle is innervated by the buccal branch of the facial nerve.

Functional Significance

The levator labii superioris elevates and everts the upper lip, and, along with the zygomaticus minor, it forms the nasolabial sulcus.

The zygomaticus major and zygomaticus minor muscles are important considerations during dissection deep to the mobile SMAS, as in deep plane and composite face lifts. These muscles lie superficially just below the malar fat pad and the dissection of the deep plane lift is just above them. The lower margin of the orbicularis oculi is also beneath the malar fat pad but superficial to these two muscles.

Zygomaticus Major

Anatomic Features

The zygomaticus major is a relatively long, thin (1 by 7 cm) muscle that originates from the zygoma behind and above the origin of the zygomaticus minor. The fibers course medially toward their insertion in the lip. It is supplied by the transverse facial artery and innervated by buccal branches of the seventh nerve that enter its deep surface.

Functional Significance

The zygomaticus major draws the angle of the mouth upward as well as laterally.

Zygomaticus Minor

Anatomic Features

The zygomaticus minor is also a long, thin (1 by 4 cm) superficial muscle that originates on the lateral surface of the zygoma just behind the zygomaticomaxillary suture. The fibers also insert into the muscular substance of the upper lip. It lies superficial to the levator labii superioris and is supplied by the transverse facial artery and innervated by the buccal branches of the facial nerve.

Functional Significance

The zygomaticus minor elevates the upper lip and forms the nasolabial sulcus with the levator labii superioris.

Levator Anguli Oris

Anatomic Features

The levator anguli oris, a small quadrangular muscle, lies deep to the zygomaticus minor and levator labii superioris. It originates on the maxilla just below the orbital foramen and inserts into the muscle substance of the lip.

Functional Significance

The levator anguli oris raises the angle of the mouth and deepens the nasolabial fold. The infraorbital neurovascular bundles lie between the levator anguli oris and the levator labii superioris.

Depressor Labii Inferioris

Anatomic Features

The depressor labii inferioris is continuous with the platysma at its origin from the oblique line of the mandible between the mental foramen and the symphysis. Its fibers run upward and medially, inserting into the lip.

Functional Significance

The depressor labii inferioris draws the lip downward and laterally.

Depressor Anguli Oris

Anatomic Features

The depressor anguli oris pulls the angle of the mouth downward and is continuous with the platysma at its origin from the oblique line of the mandible below and lateral to the origin of the depressor labii inferioris. The platysma produces similar actions in the lower lip.

Mentalis

Anatomic Features

The mentalis is a very thick, small muscle that originates from the incisor foramen of the mandible and inserts into the chin.

Functional Significance

The mentalis raises and protrudes the lower lip, creating chin wrinkles.

Buccinator

Anatomic Features

The buccinator is a relatively large, thin, deep muscle that lies in the cheek in the interval between the maxilla and mandible. It is innervated by the buccal branches of the facial nerve.

Functional Significance

The buccinator compresses the cheek against the teeth. The name *buccinator* (trumpeter) reflects its function of expelling air between the lips, as in blowing. Superficial to the buccinator posteriorly, the buccal fat pad separates it from the mandibular ramus, masseter, and temporalis. The parotid duct pierces the muscle opposite the upper third molar, and this muscle is spread when the buccal fat pad is removed through an intraoral incision. The facial artery and buccal branches of the facial nerve cross the muscle.

Orbicularis Oris

Anatomic Features

The orbicularis oris is a very superficial muscle constituting the bulk of the lips and acts as an oral sphincter. The majority of the muscles of facial expression insert into this muscle, which is made up of several layers of muscle fibers all running in different directions. The fibers from nine muscles converge at the oral commissure, forming the modiolus. The zygomaticus major, levator anguli oris, and depressor anguli oris can fix the modiolus in any given position, thus influencing the position of the oral commissure.

Functional Significance of the Mimetic Muscles

The muscles of facial expression are innervated by the seventh nerve, and their function must be preserved during aesthetic facial surgery. The fascial layers of the face have a constant position relative to the nerves and muscles; precise facial dissection technique and knowledge of the location of these muscles and nerves will minimize the risk of postoperative muscle weakness and asymmetry.

The mimetic muscles control facial expression (such as smiling and grimacing), the position and shape of the mouth, and even to a certain extent the position of the eyelid and eye shape. The effect of these muscles on the nasolabial fold is not clearly established. The nasolabial fold deepens when the face is animated, as in smiling, and the nasolabial fold disappears with facial paralysis. Rubin et al showed that the nasolabial fold is composed of subcutaneous fat, muscle fibers of the lip elevators, and striated muscle fibers originating from the fascia. The authors hypothesized that the fold becomes more prominent with age as a result of loss of subcutaneous fat. Pessa and Brown showed that resection of the levator labii alaeque nasi and partial resection of the levator labii superioris muscle decrease the medial nasolabial fold and soften the acute nasolabial angle seen with aging. Experience with *botulinum* toxin injections has confirmed these findings. These authors further studied the effect of individual mimetic muscles on the nasolabial fold in cadavers. They identified the levator labii alaeque nasi as the primary facial muscle responsible for creating the medial nasolabial fold. They demonstrated that the levator labii superioris defined the middle nasolabial fold and the zygomaticus major had a slight effect, deepening the lateral portion of the nasolabial fold. Hypothetically, subperiosteal face lifts in which the origins of several of these mimetic muscles are rearranged may alter the depth and prominence of the nasolabial fold.

Muscles of the Neck

Platysma

Anatomic Features

The platysma is key to the changes in the neck attributed to aging, and modification of this muscle not only is necessary to improve the appearance of the aging neck, but also has a dramatic effect on neck reshaping. With aging, the platysma descends and tends to become redundant centrally in the submental region. This is manifest by vertical platysmal bands that are first seen with animation but later become permanently visible. The amount of subcutaneous tissue overlying and attached to the platysma, especially in the jowl and submental region, can also cause descent of the platysma, which contributes to submental fullness and flattening of the cervicomental angle.

The platysma is a large, broad, thin sheet of muscle spanning the neck from the mandible to below the clavicle. It originates from the fascia overlying the pectoralis and deltoid muscles. The fibers cross the clavicle and course upward and medially. The anterior fibers interlace and mingle with fibers from the opposite side below the symphysis of the mandible, inserting into it and laterally along the border of the mandible into which they also insert. Posteriorly, fibers cross the lower border of the mandible and insert into the SMAS. The dominant pedicle is a branch of the submental artery, and the minor pedicle is a branch of the suprasternal artery. It is innervated by the cervical branch of the facial nerve.

Functional Significance

Within the submental area the anatomy of the muscle varies greatly from individual to individual. Cardoso de Castro's anatomic studies led him to classify the relationship of the two platysma muscles and their interdigitations or decussation in the submental area into three types:

- Type I Most common: occurs in 75% of cases; demonstrates a limited decussation of the platysma muscles extending 1 to 2 cm below the mandibular symphysis
- Type II Occurs in 15% of cases; demonstrates decussation of the platysma from the mandibular symphysis to the thyroid cartilage
- Type III Occurs in 10% of cases; demonstrates no decussation or interdigitations

This confirms our clinical impression that in the majority of patients there is very limited interdigitation of the muscles medially, as evidenced by the two visible platysma bands in an aging neck.

Functionally, the platysma draws down the lower lip and the angle of the mouth and diminishes the neck-jaw angle. The platysma may vary in size and extent. Asymmetry of the platysma is not uncommon, and rarely, the platysma may be absent on one side. In a thin neck, tightness and youthful contour of the facial-mandibular line as

well as the submental and anterior neck regions are influenced by the tone of the platysma. When the tone is normal, these angles are sharp and well defined; when the tone is poor, the angles may become blurred and indistinct. Baker and colleagues stated that retaining ligaments within the neck support the platysma and tightly maintain it in position against the deep cervical fascia, creating the acute cervicomental angle characteristic of youth. These fibers or ligaments are present along the posterior mandibular border throughout the subplatysmal fat and extend between the platysma and hyoid and upper aspect of the thyroid cartilage. Thus, as this platysmal support weakens with age, the anterior free edge of the muscle no longer firmly adheres to the deep cervical fascia and droops, forming platysmal bands. Loss of skin elasticity is also a contributing factor. With these changes, the acute cervicomental angle is gradually lost and assumes an oblique direction. Excess fat may accumulate superficial to the platysma in the jowl, in the submental region, and centrally in the subplatysmal region. Hypertrophy of the anterior belly of the digastric muscles may add further fullness to this midline region. The platysma covers the submandibular glands, and with platysmal laxity or glandular hypertrophy, a bulge gradually becomes visible below the jawline laterally, within the submental triangle.

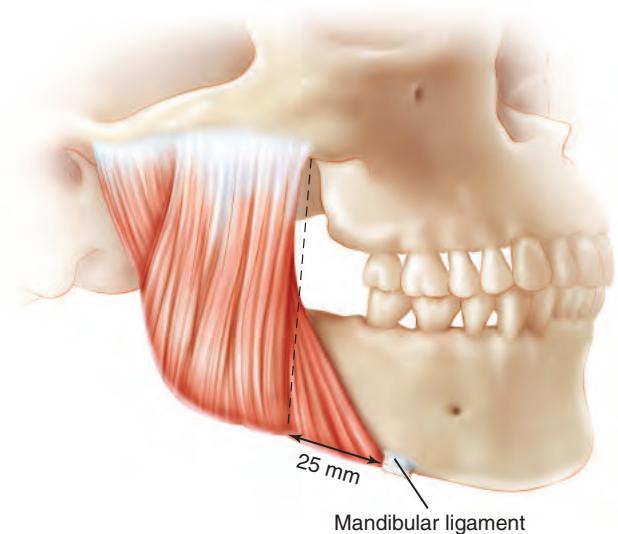
Correction of the aging neck focuses on tightening the platysma centrally and in its upper lateral region by tightening its attached SMAS. Usually the medial platysma is approached through a submental incision, and the skin and subcutaneous tissues are separated from the muscle and the redundant muscle tightened after contouring the fat superficial and deep to the platysma. When the submandibular glands are prominent, the platysma can be tightened over them, although gland resection is more effective.

Muscles of Mastication

Masseter

Anatomic Features

The masseter is a large, quadrilateral muscle originating in three layers that fuse anteriorly. The fibers run downward and backward from the maxillary and zygomatic origins to the mandibular insertion. The superficial layer, the largest portion of the muscle, has a thick aponeurotic origin from the zygomatic process of the maxilla and the lower border



of the anterior two thirds of the zygomatic arch. The middle and deep layers take origin from the deep surface of the zygomatic arch.

The anterior edge of the masseter has a concavity that faces the oral commissure. In the upper part, the anterior border of the masseter angles backward parallel to the nasolabial fold. At the level of the oral commissure, the anterior border of the muscle changes direction and angles forward to insert into the body of the mandible. This anterior curvature of the masseter is associated with an attachment on the body of the mandible that is 25 to 30 mm more anterior than is usually illustrated. This triangular-shaped forward prolongation of the muscle's lower anterior part is the basis for the jowl recess.

Superficial to the masseter lie the SMAS, platysma, risorius, zygomaticus major, parotid gland, and parotid duct. The masseter is lined by the thin but strong masseter fascia. After exiting the parotid gland, branches of the fascial nerve travel beneath this fascia, which acts as a protective layer. The transverse facial artery crosses the muscle. On its deep surface lie the ramus of the mandible, the insertion of the temporalis, and the buccal fat pad that separates it from the buccinator.

Temporalis

Anatomic Features

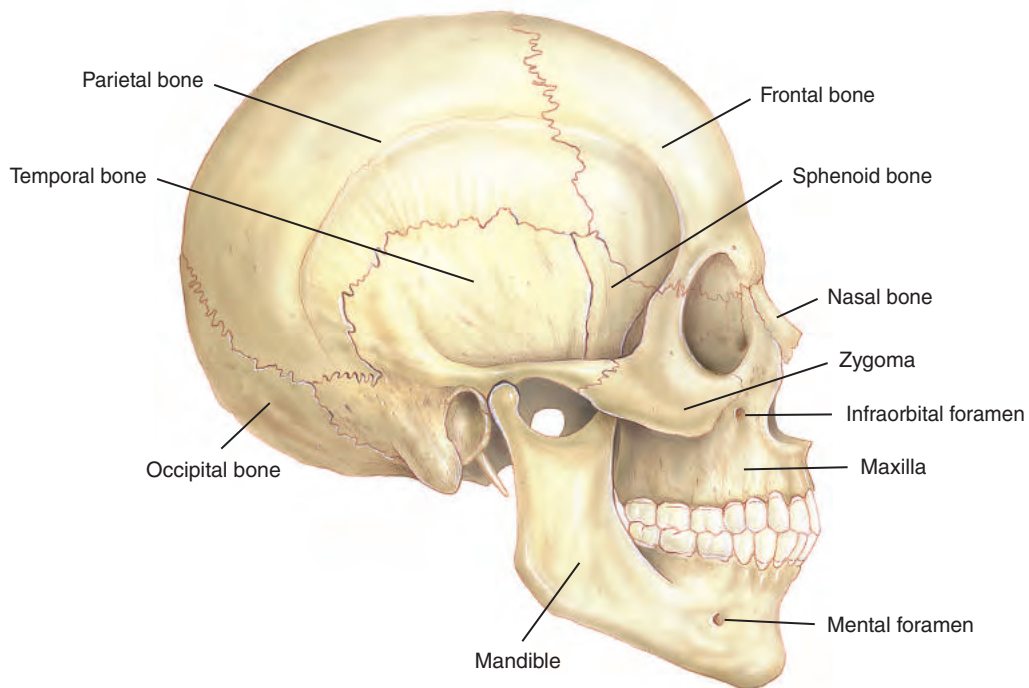
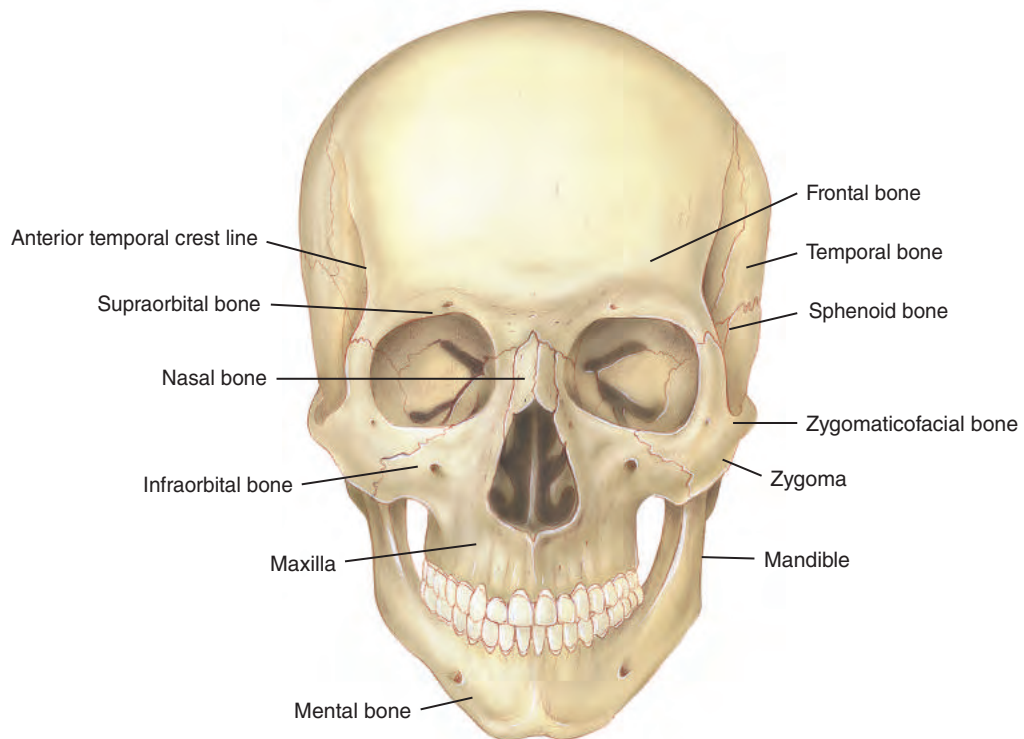
The temporalis is a large, fan-shaped muscle originating from the entire temporal fossa and the deep temporal fascia. Its fibers converge and descend deep to the zygomatic arch to insert onto the coronoid process of the mandible. The outer border is separated from the zygoma by the deep temporal fat pad. The temporalis muscle is covered by several fascial layers that are important for safe elevation of the forehead and lateral upper face.

Functional Significance

These large muscles of mastication are important landmarks during forehead and subperiosteal face lifts. The origins of the superficial layer of the masseter from the zygomatic process of the maxilla and the lower border of the zygomatic arch are taken down during a subperiosteal face lift. Branches of the facial nerve, transverse facial artery, and parotid duct cross the superficial surface of the masseter muscle.

The buccal fat pad lies between the masseter and buccinator. The temporalis is invested by the deep temporal fascia and separated from the zygoma by the deep temporal fat pad. The temporal crest lines represent the origin of the temporalis.

Facial Bones



Knowledge of the bony anatomy is essential to performing both open and endoscopic techniques for facial rejuvenation. It is especially important for subperiosteal lifts of the forehead and midface.

Detailed knowledge of the shape and contour of the bone, its foramina, the vessels and nerves they emit, and the muscles that take origin and insert into the bone will facilitate endoscopic as well as open dissection and minimize the risk of injury.

Frontal Bone

Anatomic Features

The frontal bone forms the forehead and is connected anterolaterally with the zygoma and centrally with the nasal bones, frontal process of the maxilla, and lacrimal bone. The central portion of the frontal bone is rounded. This frontal tuberosity lies on either side of the midline approximately 3 cm above the orbit. It is variable in size and is usually more pronounced in women and children. This convexity will influence access incisions and endoscopic pathways across the forehead and mandates the use of curved instruments. Below the frontal tuberosity and approximately 1 cm above the orbit there is a pair of curved superciliary arches. These arches are more pronounced in men. The smoother area between the two arches is the glabella. These upper orbital rims are sometimes reduced to give the lateral brow a lighter, more open look. The orbital rims lie below the superciliary arches.

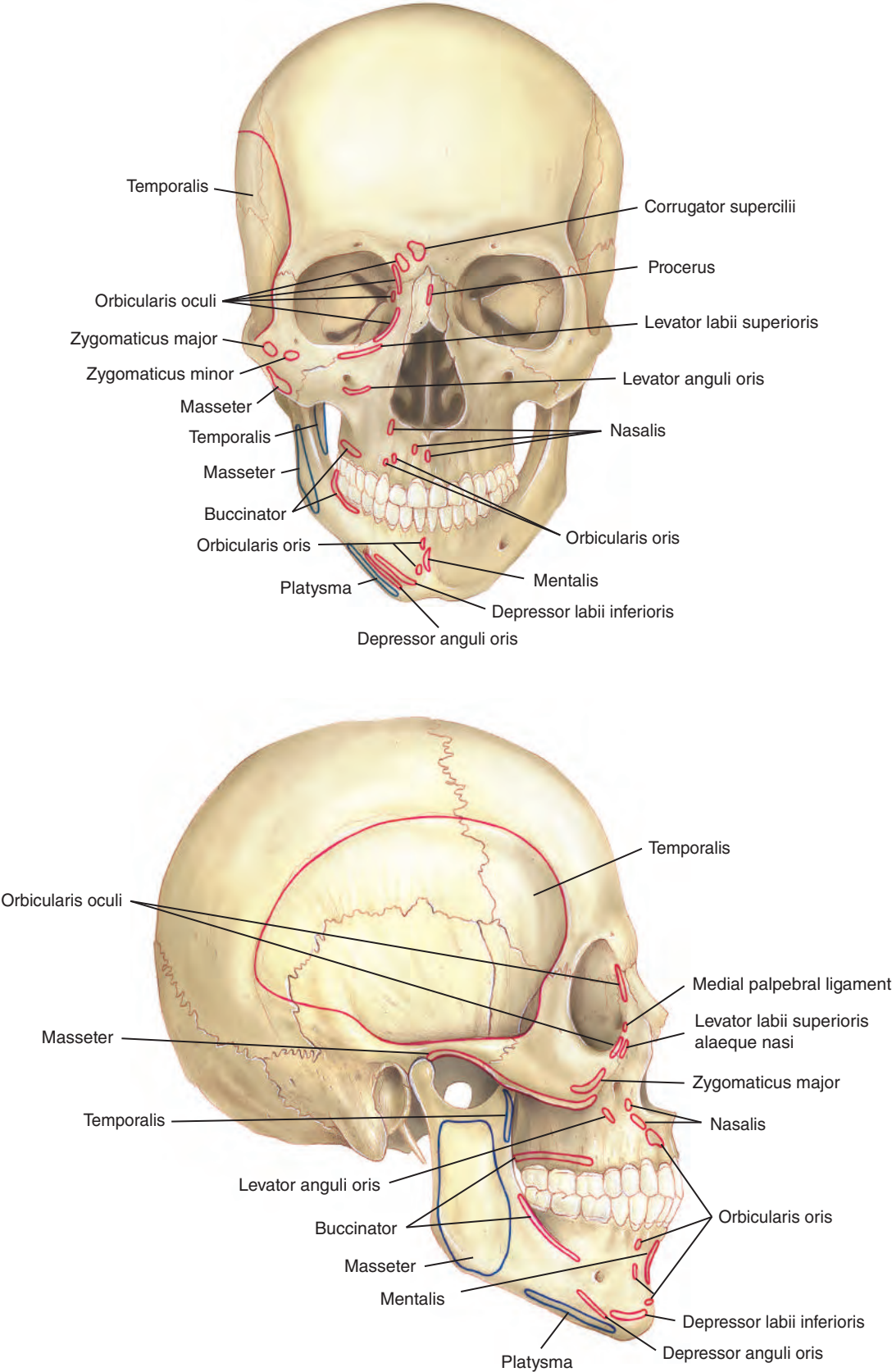
Foramina

The supraorbital notch, or foramen, is located at the junction of the medial third and lateral two thirds of the orbital rim (midpupillary line). This foramen contains the supraorbital nerve and vessels. Approximately 1 cm medial to the supraorbital foramen is the frontal notch or foramen. It is present in only 50% of patients. The supratrochlear vessels and nerves pass through this foramen.

Muscle Origins and Insertions

The temporalis muscle originates from the temporal fossa, which is located primarily on the temporal bone, but anteriorly is made up of the greater wing of the sphenoid and a small portion of the frontal bone. The temporal line or crest originates along the zygomatic process of the frontal bone and extends upward and backward across the frontal and parietal bones. It usually begins as a single line or crest, and as it passes posteriorly, it divides into two. The origin of the temporalis includes this line or crest, and the deep temporal fascia is firmly adherent to this line. The transition from subperiosteal to subgaleal forehead dissection takes place at this line. The corrugator supercilii takes origin from the medial end of the superciliary arch. The orbicularis oculi takes origin from the nasal part of the frontal bone. None of the forehead muscles inserts into bone. They exert their actions directly on the overlying skin.

MUSCLE ORIGINS AND INSERTIONS



Functional Significance

The shape—specifically, the convexity—of the frontal bone will influence the location of incisions and endoscopic access to the forehead. If there is significant curvature of the forehead, the central access incision should be placed closer to the hairline to reduce the arc that the rigid endoscope must traverse. Conversely, if the forehead is relatively flat, the access incision may be placed farther back on the scalp, still affording access to the glabella and orbital rim. The curved forehead instruments are designed to overcome this contour barrier.

Along the supraorbital margin, where the orbital rim is smooth medially, the periosteum appears less adherent. The supraorbital nerve exits the orbit through the supraorbital notch or foramen. If a foramen is present, it is usually located approximately 5 to 10 mm above the orbital rim, but may rarely be as high as 20 mm or so.

The periosteum and deep temporal fascia are firmly adherent to the temporal crest. The transition from subperiosteal to subgaleal forehead dissection takes place at this line, making this an important landmark during endoscopic forehead dissection. This line also represents an important preoperative landmark; if the lateral access incisions are placed lateral to this line, brow fixation can be done by suturing the galea to the superficial layer of the deep temporal fascia. Incisions lateral to the line also protect the lateral branch of the supraorbital nerve. If the incision is medial to the anterior temporal crest line, other methods of fixation may be required, because there will be no strong fascial layer under the access incision. This crest line is readily palpable in most patients. If it is not, forced contraction of the temporalis (clenching of the teeth) will delineate the anteromedial border of the muscle, indicating its origin from the anterior crest line.

Zygomatic Bone

Anatomic Features

The zygomatic bone forms the cheek prominence and contributes to the lateral wall of the orbit and the walls of the temporal and infratemporal fossae. The orbital border (anterosuperior) is smooth and forms part of the orbital rim. The frontal process articulates with the zygomatic process of the frontal bone anteriorly and with the greater wing of the sphenoid posteriorly. On the orbital aspect of the frontal process approximately 1 cm below the frontozygomatic suture line, there may be a tubercle into which the lateral canthal ligament inserts. The temporal process runs posteriorly and articulates with the zygomatic process of the temporal bone.

Foramina

Along the lateral surface of the zygoma near the orbital border, one or perhaps two zygomaticofacial foramina are present. Through this foramen (or foramina) the zygomaticofacial nerve and vessels pass. The zygomaticotemporal foramen, which contains the zygomaticotemporal nerve as it leaves the orbit, is located more superiorly and posteriorly within the temporal fossa.

The masseter has an extensive area of origin from the posteroinferior border of the zygoma. The zygomaticus major originates on the lateral surface of the zygoma just above and behind the origin of the zygomaticus minor, whereas the zygomaticus minor originates on the lateral surface of the zygoma just below and anterior to the origin of the zygomaticus major. The origin of the levator labii superioris is along the lateral portion of the infraorbital rim of the zygoma.

Functional Significance

Deep plane face-lift dissection is above the origin of the zygomaticus major. During subperiosteal face-lift dissection the periosteal attachments to the zygoma are completely freed. This includes portions of the zygomatic origin of the masseter, the origin of the zygomaticus major and minor, and the levator labii superioris. The attachment of the temporoparietal fascia to the zygoma is also divided. Subperiosteal dissection along the zygoma through a temporal, eyelid, or intraoral incision may lead to disruption of the zygomaticofacial nerve, which can be easily identified and preserved. The zygomaticotemporal nerve is not involved in this dissection.

Nasal Bones

Anatomic Features

The nasal bones are small paired, oblong bones that vary in size and shape from individual to individual. A small vascular foramen on the external surface transmits a small vein. The nasal bones are covered by the nasalis and procerus muscles. The procerus muscle takes origin from the nasal bone and upper lateral cartilage. Removal of the procerus requires dissection down onto the nasal bones. With elevation of the forehead, some of the pull can be transferred to the nasal tip.

Maxilla

Anatomic Features

The maxilla is the second largest facial bone; it forms the entire upper jaw and contributes most of the roof of the mouth, lateral wall and floor of the nose, and floor of the orbit. It contains the maxillary sinus. The maxilla comprises a body and four processes: zygomatic, frontal, palatine, and alveolar. The zygomatic process articulates with the zygoma and the frontal process articulates with the frontal bone and nasal bones.

Foramina

Above the canine fossa and approximately 1 cm below the orbital rim is the infra-orbital foramen, which contains the infraorbital nerve and vessels. Above is the origin of the levator labii superioris and below is the origin of the levator anguli oris. The nerve is located between these two muscles as it exits the infraorbital foramen, in the midpupillary line.

The orbicularis oculi originates from the frontal process of the maxilla. The levator labii superioris alaeque nasi originates from the upper part of the frontal process of the maxilla and the levator labii superioris originates immediately above the infra-orbital foramen. The levator anguli oris takes origin from the canine fossa just below the infraorbital foramen and the buccinator from the alveolar process above the three molars.

Aging Changes

At birth the vertical length of the maxilla is much smaller than its horizontal diameters (transverse and anteroposterior). The frontal process is well developed, but the body is little more than the alveolar process with tooth sockets lying just below the orbit. With growth, as the maxillary sinus enlarges and the alveolar processes develop, the vertical height increases significantly. With age, especially after loss of the teeth, vertical height diminishes, and there is a gradual regression toward the neonatal state.

Functional Significance

During subperiosteal face-lift dissection, the infraorbital foramen must be identified and the nerve and vessel preserved. It is easily identified 1 cm below the orbital rim in the midpupillary line. The origin of the mimetic muscles from the maxilla is taken down during subperiosteal face-lift dissection.

Mandible

Anatomic Features

The mandible is the largest and strongest of the facial bones; it has a U-shaped body and two vertical rami extending upward from the posterior part of the body. The external surface of the body is marked in the midline by a line or ridge, the symphysis mend representing the line of fusion of the two halves of the fetal mandible. The symphysis extends inferiorly to the mental protuberance in the midline and the mental tubercles on each side. The mental tubercle and protuberance represent the chin prominence.

Foramina

The mental foramen is located 1 cm below the second premolar or the gap between the first and second premolars. Through this foramen pass the mental nerve and vessels. The midpupillary line is also a good landmark for identification of the nerve.

The buccinator originates from the outer surface of the alveolar process of the mandible opposite the three molars. The mentalis takes origin from the incisive fossa of the mandible. The depressor labii inferioris takes origin from the oblique line of the mandible above the origin of the depressor anguli oris between the symphysis and the foramen. The depressor anguli oris originates from the oblique line of the mandible below the origin of the depressor labii inferioris and below the mental foramen. The temporalis inserts into the coronoid process. The masseter inserts into most of the outer surface of the ramus. The platysma inserts along the outer inferior border of the mandible.

Aging Changes

After all of the permanent teeth have erupted, the mandible undergoes constant change and remodeling. The depth of the body increases, the alveolar portion of the bone grows larger, and the bone becomes thicker and deeper. The mental foramen in the early years is much closer to the upper border of the bone and opens midway between the upper and lower borders of the bone in the adult. With old age, especially when the teeth are lost, the bone is reduced in size. After loss of the teeth, the alveolar portion is absorbed so that the mental foramen is closer to the alveolar border. With age, the angle between the ramus and the body also decreases. At birth this is an obtuse angle, but it eventually reaches a 90-degree angle in adulthood and in old age reverts to a more obtuse angle.

Blood Supply of the Facial Soft Tissues

Arterial Supply

The face and scalp are extremely well vascularized through an extensive network of intercommunicating vessels. These vessels not only communicate with each other but across the midline with corresponding vessels on the opposite side. The facial soft tissue blood supply is abundant, and a clear understanding of the communications between the underlying vessels and the overlying subcutaneous tissues and skin makes it possible to perform aesthetic facial surgery safely with minimal risk of skin necrosis, even in patients who smoke.

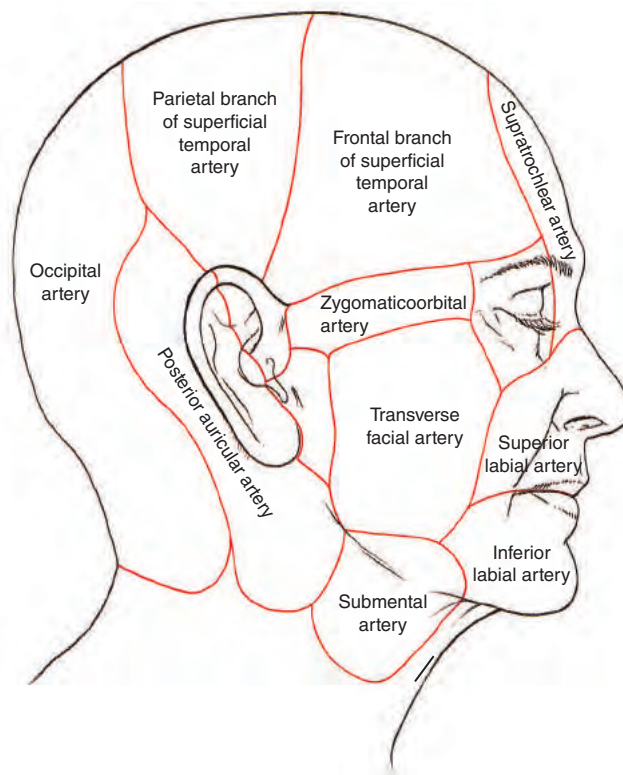
The entire blood supply of the face and scalp is based on the carotid system. Almost all of this circulation is based on the external carotid artery and its branches, with a small contribution to the eyelid, brow, forehead, and scalp through the palpebral supratrochlear and supraorbital branches of the ophthalmic division of the internal carotid artery.

In their exhaustive study of the blood supply of the face and scalp, Whetzel and Mathes described 11 vascular territories based on 14 individual arteries. They further subdivided the face into an anterior region supplied by five vessels, a lateral region supplied by four vessels, and a scalp and forehead region supplied by five vessels.

Vascular Territories of the Face and Scalp

Anterior Face	Lateral Face	Scalp and Forehead
Facial	Transverse	Superficial temporal
Superior labial	Submental	Frontal branch of superficial temporal
Inferior labial	Zygomaticoorbital	Temporal branch of superficial temporal
Supratrochlear	Anterior auricular	Posterior auricular
Supraorbital		Occipital

In each of the three major scalp and face regions, the pattern of arterial vascularization is distinct. The anterior face is supplied by a large number of small, densely populated musculocutaneous perforating branches; the lateral face by a small number of large, sparsely populated fasciocutaneous perforators with predictable locations; and the forehead and scalp region by a large number of small, densely populated fasciocutaneous perforators.



External Carotid Artery

The external carotid artery contributes to the facial soft tissue blood supply through its facial, occipital, posterior auricular, superficial temporal, and maxillary branches.

The facial artery takes origin from the front of the carotid artery in the carotid triangle above the lingual artery and just above the greater cornu of the hyoid bone. It runs medial to the ramus of the mandible, arching upward and grooving the posterior surface of the submandibular gland. Between this gland and the medial pterygoid it runs downward to the border of the mandible where the submental artery branches off. The facial artery then hooks around the lower border of the mandible at the anterior edge of the masseter muscle insertion. It is superficially located here just under the platysma and is crossed by the marginal mandibular branch of the facial nerve. It may even groove the mandible as it curves around the mandible and ascends to the angle of the mouth over the buccinator and deep to the mimetic muscles. At the angle of the mouth the superior and inferior labial arteries branch off and the facial artery ascends along the nasofacial line to end in an anastomosis with the dorsal nasal branch of the ophthalmic artery. During this portion of its course it runs deep to or within the levator labii superioris alaeque nasi. Branches of the facial artery contribute to the blood supply of soft tissue and skin of the face and include the submental artery, inferior labial artery, superior labial artery, and lateral nasal vessel. Most of the contribution from the facial artery and its branches to the overlying skin is through densely populated multiple musculocutaneous vessels.

The submental artery takes origin from the facial artery just as it turns upward over the inferior border of the mandible. It runs forward below the body of the mandible lying on the mylohyoid muscle. It supplies the surrounding muscles, then courses over the mandible at the chin where its branches anastomose with branches of the inferior labial and mental arteries to supply the skin of the chin through musculocutaneous perforators. The inferior and superior labial arteries arise at the angle of the mouth. The superior labial artery is the larger of the two vessels. The inferior labial artery runs deep to the depressor anguli oris and then penetrates the orbicularis oris muscle, running a tortuous course just deep to the vermilion border to form an anastomosis with the inferior labial artery from the other side. Similarly, the superior labial artery runs deep to the levator anguli oris and then enters the orbicularis oris, and through musculocutaneous perforators these two vessels supply the skin and mucosa of the lip and chin.

The labial vessels run within the orbicularis oris muscle just deep to the vermilion border, where they may be at risk during injection of filler materials for lip augmentation.

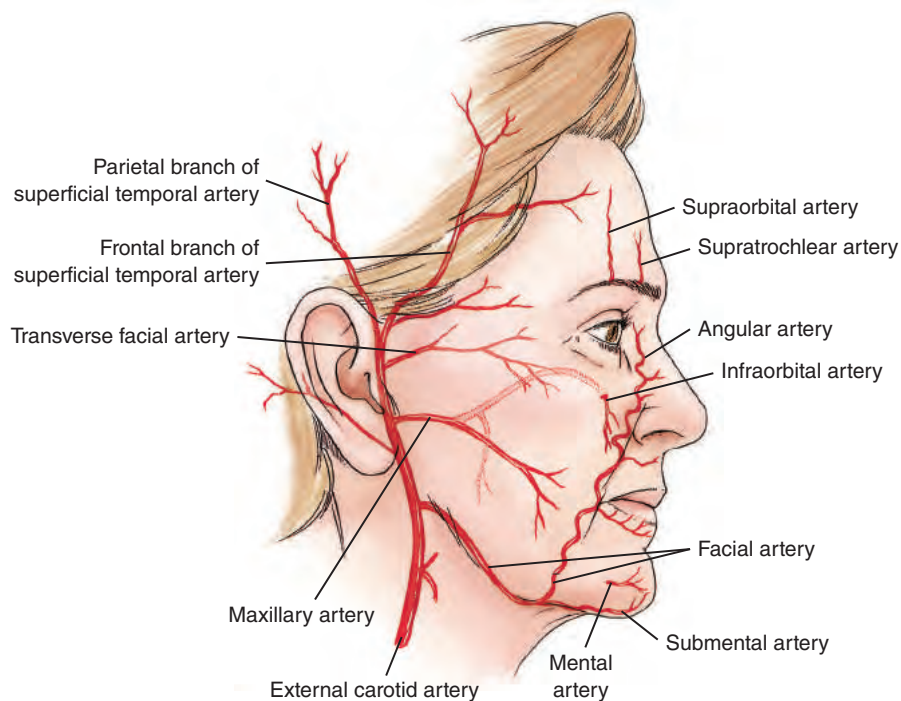
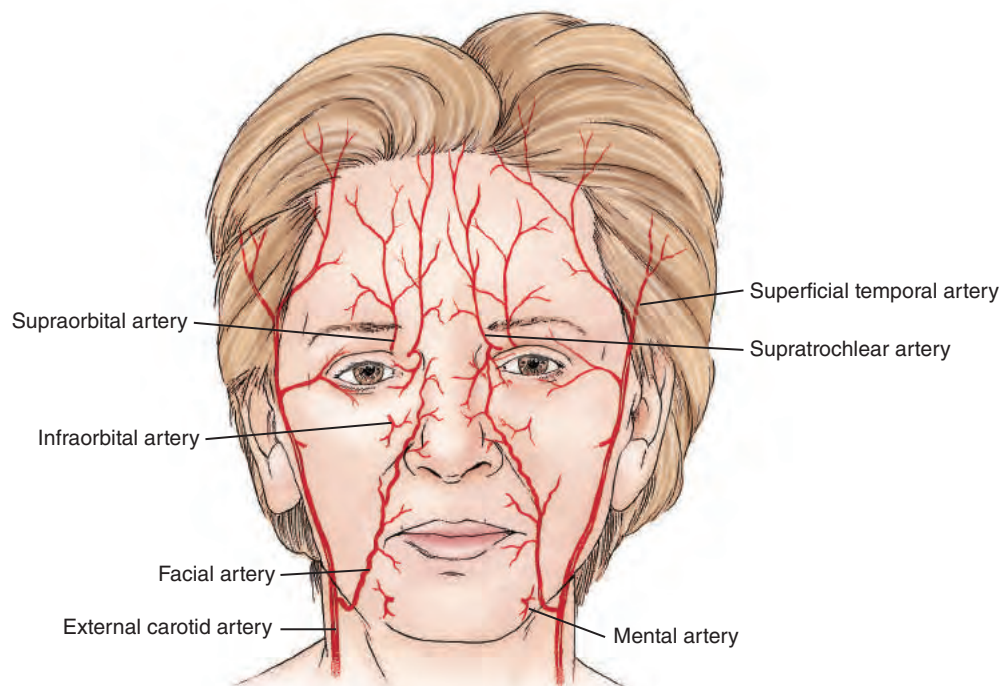
The occipital artery takes origin from the posterior aspect of the external carotid artery opposite the origin of the facial artery and runs posteriorly along the deep border of the posterior belly of the digastric muscle to the posterior scalp. It supplies the posterior scalp and eventually forms an anastomosis with the supratrochlear and supraorbital vessels.

The posterior auricular artery is a small branch that takes origin from the posterior aspect of the external carotid artery just above the digastric and the stylohyoid muscles. It runs upward between the parotid gland and the stylohyoid process of the temporal bone to the groove between the ear cartilage and the mastoid process. It then divides into an auricular branch supplying the cranial skin (medial surface) of the ear and an occipital branch that supplies the retroauricular skin and will eventually form an anastomosis with branches of the occipital artery.

The superficial temporal artery is the smaller of the two terminal branches of the external carotid artery. It takes origin within the parotid gland and courses upward, crossing the zygoma, and approximately 5 cm above the zygoma it divides into its two terminal branches—the frontal and parietal. Within the parotid gland it is crossed by the temporal and zygomatic branches of the facial nerve and in the scalp it is accompanied by the auriculotemporal nerve that lies deep to it. The five branches of the superficial temporal artery that supply the face and scalp are the transverse facial, anterior auricular, zygomatic orbital, and its two terminal branches—the frontal and parietal.

The transverse facial artery takes origin from the superficial temporal artery within the parotid gland and runs forward through the gland. It crosses the masseter below the zygomatic arch and above the parotid duct accompanied by the zygomatic and buccal branches of the facial nerve. It supplies a large area of the lateral midface and has a large number of terminal branches that form an anastomosis with branches of the facial and infraorbital arteries. The transverse facial artery supplies the overlying skin through large fasciocutaneous perforators. The most prominent of these perforators is usually located at the junction of the lateral third and medial two thirds of the line drawn from the auditory canal to the nasal spine.

The zygomaticoorbital artery may sometimes take origin from the middle temporal rather than the superficial temporal artery. It runs along the upper border of the zygomatic arch accompanied by a vein to the lateral orbital rim and within the two layers of the temporal fascia. It supplies the overlying skin through three or four fasciocutaneous perforators, the largest of which is usually located at the junction of the lateral third with the medial two thirds of the line from the auditory canal to the nasion.



The frontal branch of the superficial temporal artery takes origin 5 cm above the zygoma and runs anteromedially. It forms multiple anastomoses with the vessel on the opposite side and with branches of the supraorbital and supratrochlear vessels. It supplies the overlying skin through musculocutaneous perforators. The parietal or posterior branch of the superficial temporal artery is the larger of the two terminal branches. It runs upward and backward, forming multiple anastomoses with the vessel on the opposite side and with the postauricular and occipital arteries.

The internal maxillary artery contributes to the blood supply of the facial soft tissues and skin through the mental and infraorbital branches. The mental artery is the terminal branch of the inferior alveolar artery, which is a branch of the first or mandibular portion of the internal maxillary artery. The small vessel emerges through the mental foramen of the mandible accompanied by the mental nerve. Its branches form an anastomosis with the inferior labial and submental branches of the facial artery. Through musculocutaneous perforators it contributes to the blood supply of the chin and lips.

The infraorbital artery is a branch of the third (pterygopalatine) portion of the maxillary artery. It enters the orbit through the posterior part of the inferior orbital fissure and runs along the infraorbital groove and canal with the infraorbital nerve to emerge onto the face through the infraorbital foramen deep to the levator labii superioris. It descends between the levator labii superior and levator anguli oris. Its branches form an anastomosis with branches of the facial, superior labial, and transverse facial artery to supply the overlying skin through musculocutaneous perforators.

Internal Carotid Artery

The internal carotid artery contributes to the blood supply of the forehead and scalp through the supraorbital and supratrochlear branches of its ophthalmic division and the eyelids through the palpebral branches. The supraorbital artery accompanied by the supraorbital nerve leaves the orbit through the supraorbital foramen or notch and divides into superficial and deep branches. It supplies the overlying muscle and through musculocutaneous perforators the forehead skin. Its terminal branches form an anastomosis with the supratrochlear and frontal branch of the superficial temporal artery. The supratrochlear artery is one of the terminal branches of the ophthalmic artery and leaves the orbit accompanied by the supratrochlear nerve along the superior and medial aspect of the orbit. There may be a definite notch in the orbit where the vessel and nerve exit. This vessel supplies musculocutaneous perforators to the overlying skin and forms an anastomosis with branches of the supraorbital artery.

The small paired palpebral arteries supply the eyelids. The medial palpebral arteries (superior and inferior) take origin directly from the terminal portions of the ophthalmic artery below the trochlear head of the superior oblique muscle. They enter the eyelids and then run along the tarsus to form an anastomosis with the lateral palpebral vessels. The lateral palpebral arteries are branches of the lacrimal artery.

Functional Significance

The facial vessels lie primarily in the deepest plane of the face with the parotid duct and buccal and zygomatic branches of the facial nerve. These vessels are avoided in a subperiosteal face lift as well as in deep plane and composite face lifts. The contribution of the facial vessels to the blood supply of the skin is through a network of musculocutaneous perforators located along the oral commissures and the nasolabial

folds. As noted by Whetzel and Mathes, the anterior region of the face receives its blood supply through a dense network of musculocutaneous perforators, whereas the lateral face is supplied through a network of sparsely populated fasciocutaneous perforators. Skin undermining during rhytidectomy will divide these fasciocutaneous perforators located laterally. The blood supply to the facial flap is then dependent on the medially located musculocutaneous perforators. Further separation of skin from subcutaneous tissue toward the nasolabial fold will divide these perforators. The deep plane approach preserves these musculocutaneous perforators and thus enhances and maintains skin flap circulation.

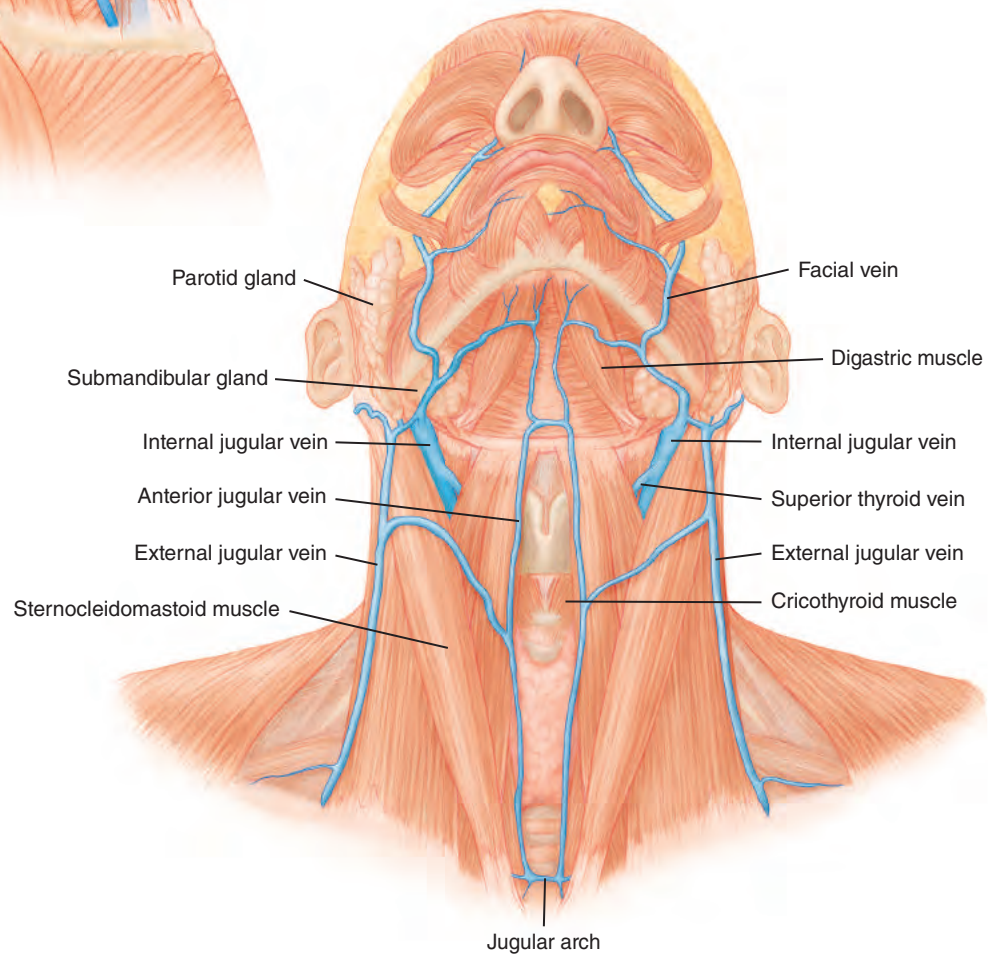
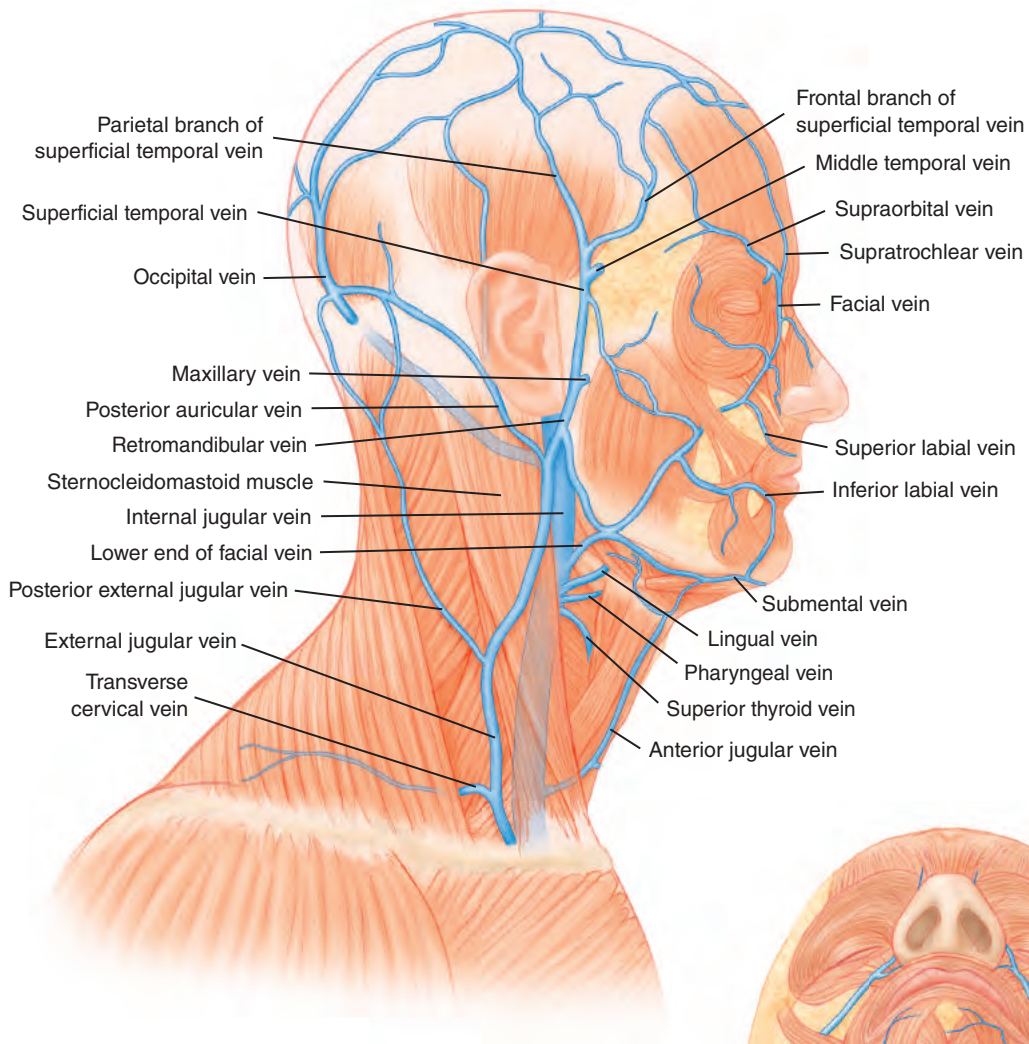
The forehead blood supply is plentiful, and ischemia of the forehead and scalp is rare even following the transcoronal approach, because the blood supply to the overlying skin is through musculocutaneous perforators, which are not disturbed except with the subcutaneous brow-lift technique. The blood supply to the scalp hairs is plentiful. However, it can be compromised by excess tension or by sutures that strangle the blood supply to incision margins. Since the length of skin incisions is limited and the surrounding subdermal plexus is preserved, endoscopic approaches should help to prevent or limit hair loss.

Injection of filler materials should be performed with caution in the glabellar region and lips. Intraarterial injection, especially under pressure, may lead to vascular compromise and in the periorbital area may lead to visual problems through forceful retrograde flow into the central retinal artery. The safer and preferred method is to push the syringe plunger while withdrawing the needle.

Venous Drainage of the Face and Neck

Although not as critical to the survival of soft tissues and flaps during facial rejuvenation, knowledge of the venous drainage of the head and neck is essential, because some of the veins bear a close anatomic relationship to nerves we strive to protect during facial dissection (for example, the frontal branches of the facial nerve and the sentinel vein, great auricular nerve, and external jugular vein). Intraoperative injury of the veins will lead to profuse bleeding. Although rare, postoperative hematoma may be related to intraoperative venous injury. Knowledge of the venous drainage will contribute to our understanding of postoperative facial swelling.

The following discussion of the venous drainage of the head and neck is not as detailed as that of the arterial supply; only the significant anatomic points and relationships as they affect face and neck dissection are presented. The venous drainage of the head and neck is divided into a superficial and a deep system. Aesthetic surgeons normally encounter only the superficial system.



Facial Vein

Anatomic Features

The supratrochlear and supraorbital veins drain the forehead and anterior scalp. These vessels start in the anterior scalp and forehead and join each other along the medial border of the orbit to form the facial vein. The facial vein then runs along the medial border of the orbit and root of the nose, coursing downward and backward with the facial artery. It passes under the zygomaticus major, descending obliquely toward the mandibular border. Along this part of its course, it is related to the facial artery and the branches of the facial nerve. It crosses the border of the mandible and runs superficial to the submandibular gland, posterior belly of the digastric muscle and courses posteriorly to join the internal jugular vein at the level of the hyoid bone.

Functional Significance

The facial vein has no valves, and through its tributaries, the supraorbital vein and the superior ophthalmic vein, it communicates with the cavernous sinus. The clinical relevance is that any infection involving the facial vein may extend into the intracranial venous system. The facial vein lies deep to the zygomaticus major and should be safe during deep plane dissections over the zygomaticus major muscle.

Superficial Temporal Vein

Anatomic Features

The superficial temporal vein drains the temporal and posterior scalp region and communicates with the supratrochlear and supraorbital veins through tributaries. This vein takes a more superficial route than the facial vein, crossing the zygomatic arch and running across the superficial surface of the parotid gland. It receives numerous tributaries and is eventually joined by the posterior auricular vein to become the external jugular vein. The occipital vein drains the lateral and posterior scalp, piercing the trapezius muscle at the junction of the head and neck to join the deep cervical and vertebral veins, and through its tributaries communicates with the posterior auricular vein.

Functional Significance

On rare occasions, extensive posterior dissection in the retroauricular area may expose the occipital vein.

The posterior auricular vein courses along the retroauricular area and is a communicating vein between the occipital and the external jugular, which is made up of the union of the postauricular and superficial temporal veins. These are all superficial veins and may be injured during facial dissections.

Veins of the Neck

The veins of the neck are divided into superficial and deep, depending on their relationship to the deep fascia of the neck. The superficial veins are tributaries of the external jugular and drain the subcutaneous structures of the neck. The deep veins all drain into the much larger internal jugular vein and are rarely exposed during aesthetic surgery.

External Jugular Vein

The external jugular vein receives most of the blood from the face and scalp. It is made up of the union of the superficial, temporal, and posterior auricular vein. It originates at the level of the mandibular angle and runs down the neck to the middle of the clavicle, entering the subclavian vein just behind the clavicle. The external jugular is covered by the platysma muscle along most of its length, and it lies over the deep cervical fascia. The great auricular nerve ascends along the vein toward the face.

Functional Significance

The external jugular vein is at risk during dissection deep to the platysma and is in close relationship with the great auricular nerve, as the nerve courses upward toward the ear.

Anterior Jugular Veins

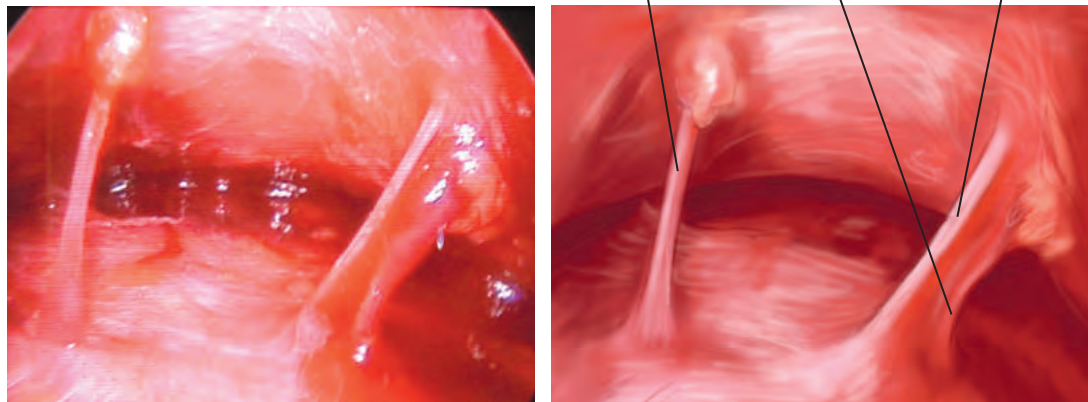
Several small veins in the submandibular region join on each side to become the anterior jugular veins, which descend along the mylohyoid muscle and the sternohyoid muscles toward the sternal notch, draining eventually into the external jugular vein or directly into the subclavian. These veins are of variable size.

Functional Significance

The anterior jugular veins are often at risk during subplatysmal dissection and may bleed profusely. They are easily identified, running from above downward along the medial border of the strap muscles.

Sentinel Vein

Anatomic Features



The zygomaticotemporal veins (two of them) are communicating veins between the superficial and deep system. They connect the superficial system through the temporalis to the deep venous system of the face. These paired vessels are located above the zygoma and lateral to the orbital rim. The more lateral of the two is usually smaller in size and is accompanied by the zygomaticotemporal nerve. The larger, more medial vessel is called the sentinel vein. It is a very useful anatomic landmark for identifying clinically, preoperatively and intraoperatively, the course of the frontal branches of the facial nerve. When present, the vein is easily identified during a brow lift, whether by an open or endoscopic approach. The branches of the facial nerve usually course 1 cm above this vein. The name “sentinel vein” may be a misnomer, because by the time the dissection has reached the vein, it has already passed deep to the nerves.

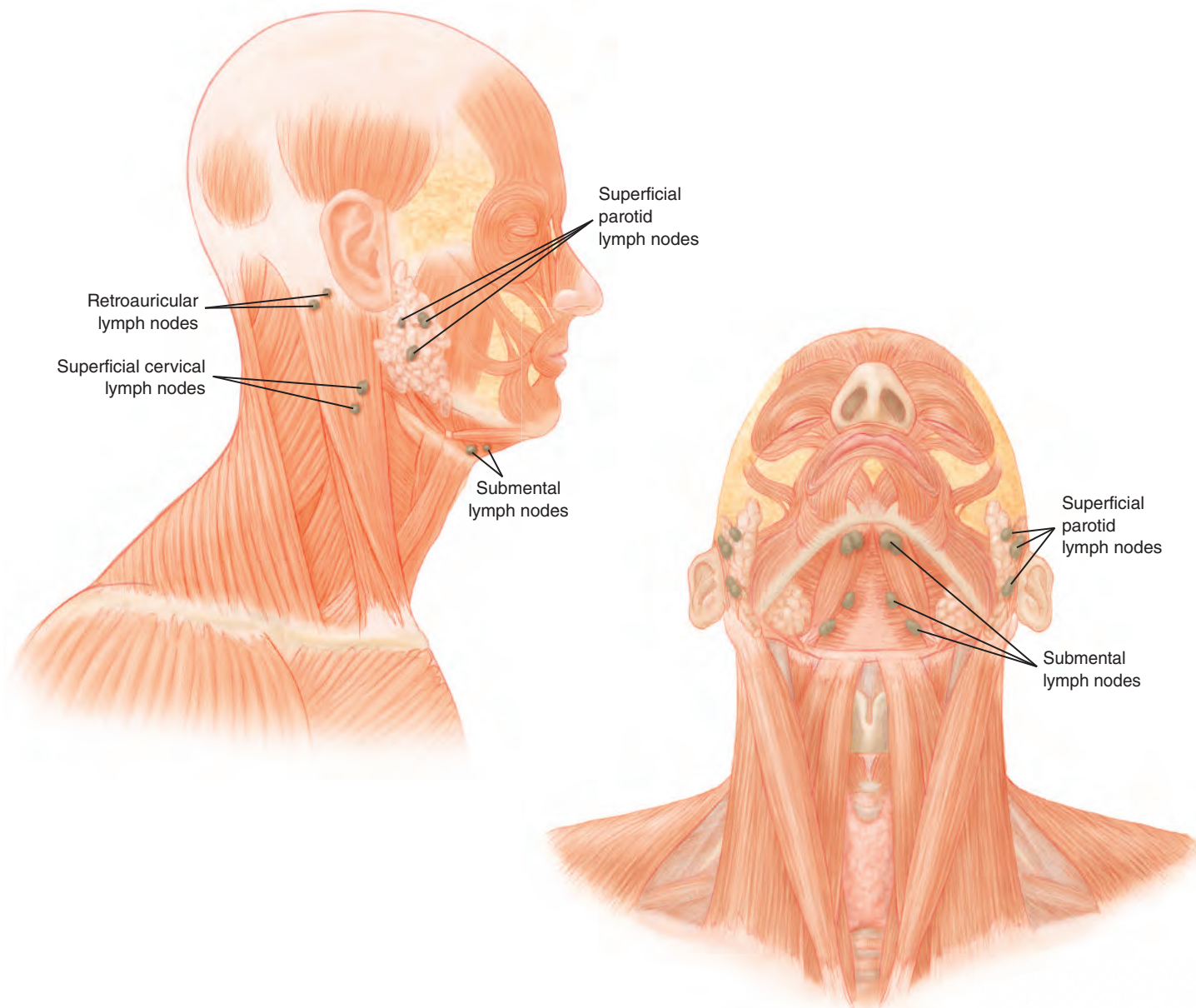
Functional Significance

In most patients the location of the sentinel vein is visible when the patient is in the recumbent position. A centimeter above the vein, a mark is made on the skin indicating the course of the frontal branch of the facial nerve. Brow-lift dissection can proceed rapidly up to that point, then slowly and carefully, under endoscopic or open control, until the sentinel vein has been identified. This is a useful guideline for avoiding possible injury to the frontal branches of the facial nerve that run in or just superficial to the temporoparietal fascia.

Whenever possible, these communicating veins should be preserved. Cauterization or tying off of these veins will lead to further prominence of veins in the periorbital area.

Lymph Nodes of the Face and Neck

Anatomic Features

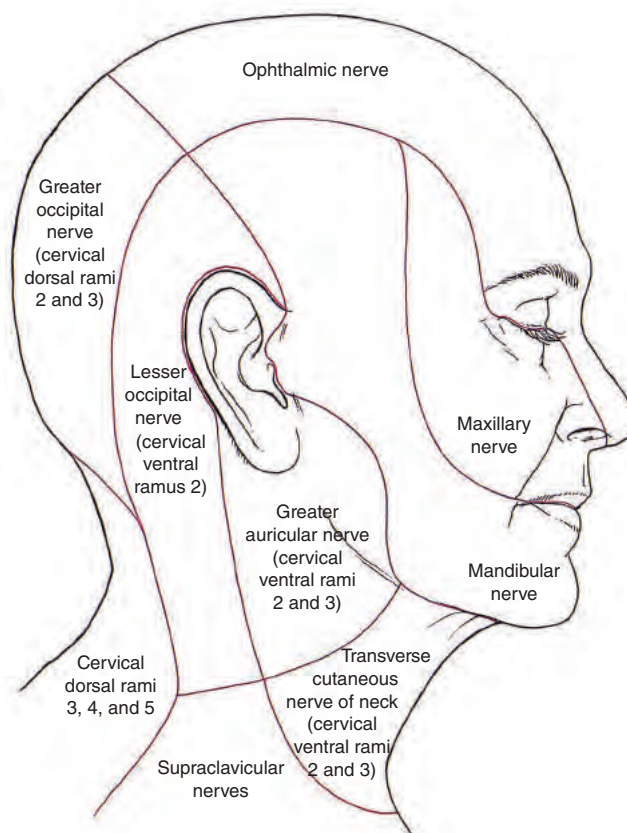


During face and neck lifts it is not uncommon to encounter superficial lymph nodes. The most commonly encountered lymph nodes are the retroauricular nodes lying behind the ear over the sternomastoid, and the superficial cervical nodes on the superficial surface of the sternomastoid. These lymph nodes may be encountered during the retroauricular and neck dissections. Anteriorly on occasion the superficial parotid nodes may be encountered during sub-SMAS dissection. The submental lymph nodes are encountered during subplatysmal or interplatysmal dissections.

Functional Significance

If lymph nodes are encountered during the dissection for face or neck lifts, they should be evaluated and dealt with appropriately. These lymph nodes are usually small and normal. However, if they have an unusual appearance or are large in size, it would be advisable to do an excisional biopsy. The presence of these lymph nodes or encountering them during the dissection should not affect the conduct of the operation in any way, nor will it affect the final result.

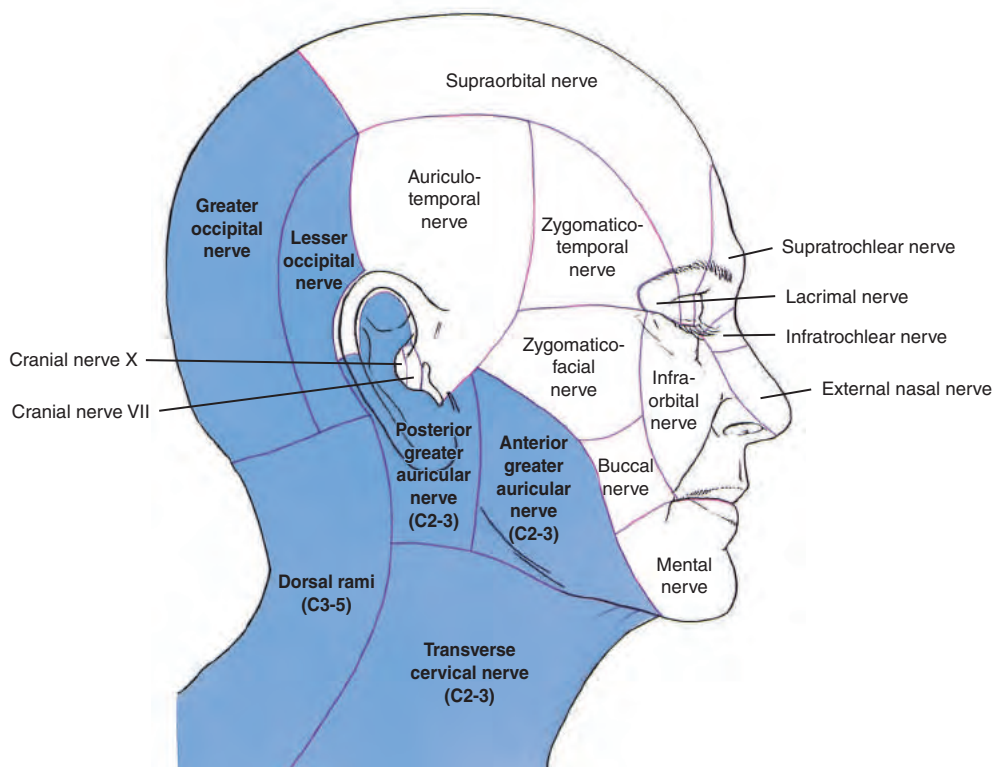
Sensory Nerve Supply



The sensory innervation of the face and scalp is based on the trigeminal nerve and cervical spinal nerves with a small contribution to the auditory canal through the eighth and tenth cranial nerves. Each of the branches of the trigeminal nerve has its own well-delineated skin territory. That of the ophthalmic division is supplied through the supraorbital, supratrochlear, infratrochlear, lacrimal, and external nasal branches; that of the maxillary through the zygomaticotemporal, zygomaticofacial, and infraorbital branches; and the mandibular through its auricular temporal, buccal, and mental branches.

Ophthalmic Division

Anatomic Features



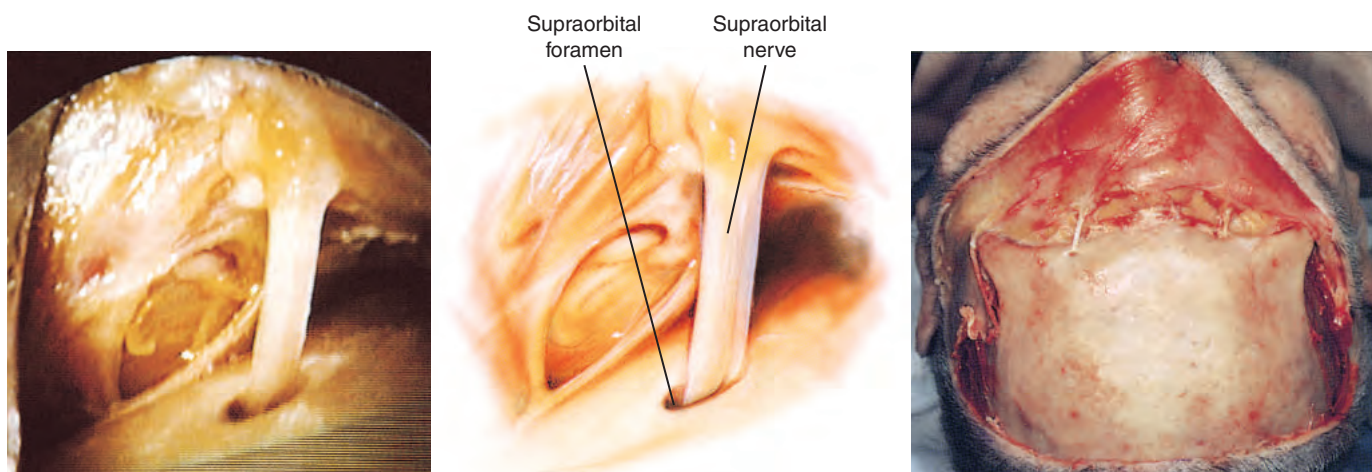
The frontal nerve is the largest branch of the ophthalmic division entering the orbit through the superior orbital fissure above the muscles. It runs forward in the orbit and divides into a small supratrochlear branch and a larger supraorbital branch. The supratrochlear branch runs medially forward above the trochlea of the superior oblique muscle emerging from the orbit medially. It curves upward accompanied by the supratrochlear branch of the ophthalmic artery to innervate the central portion of the forehead. The supraorbital is the larger of the two branches and passes forward to the supraorbital notch or foramen to exit with the supraorbital branch of the ophthalmic artery to innervate the forehead and scalp. The lateral branch of the supraorbital nerve is the major sensory nerve of the scalp and enters the hair-bearing scalp medial to the temporal crest.

The infratrochlear nerve is a small branch of the nasociliary nerve that runs along the medial wall of the orbit near the pulley of the superior oblique muscle. It receives a branch from the supratrochlear nerve and leaves the orbit to supply the medial eyelid and a small area on the upper medial side of the nose. The lacrimal nerve, the smallest branch of the ophthalmic artery, innervates the lacrimal gland and leaves the orbit to innervate the eyelids and a small area of the adjacent temporal region.

Functional Significance

The supraorbital and supratrochlear nerves are important considerations when performing a brow lift. These nerves course in a paramedial position upward in the forehead to the scalp and dividing them causes hypesthesia of the dome of the scalp. There is slow return of sensibility after division of these nerves, and patients often experience paresthesia, pruritus, and other annoying side effects. The supraorbital nerves are usually spared during an endoscopic forehead lift. With midline and lateral temporal incisions, the main branches of these nerves are left undisturbed. The endoscopic forehead approach benefits from the magnification by permitting the surgeon to remove the corrugator and procerus muscles while sparing the branches of the supraorbital and supratrochlear nerves.

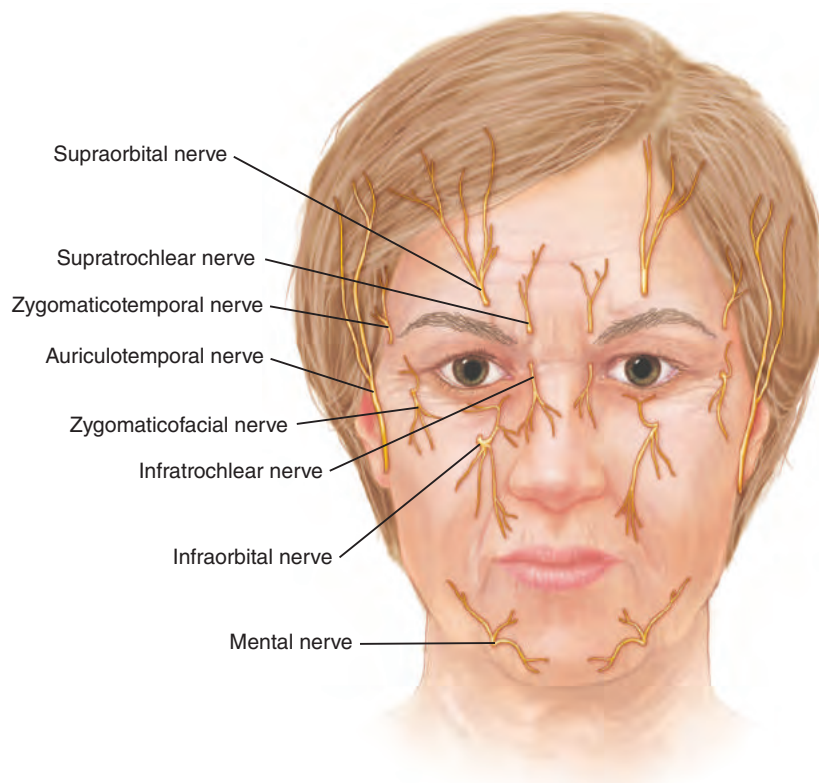
The supraorbital nerve is much larger than the supratrochlear nerve. It leaves the orbit through a definite notch or occasionally through a foramen located approximately 1 cm above the orbital rim. Whereas the supraorbital nerve is usually a single thick nerve, the supratrochlear nerve may have several branches rather than a thick trunk. The supraorbital nerve can be marked on the skin at the supraorbital rim above the midpupillary line. This corresponds well with the skin markings for the infraorbital nerve located 1 cm below the infraorbital rim in the midpupillary line. This same midpupillary line, continued below the lip, marks the location of the mental nerve. The lateral branch of the supraorbital nerve represents the main sensory innervation of the scalp and runs along the temporal crest or medial to it. Incisions in the scalp crossing medially past the temporal crest risk injury to the nerve and scalp numbness.



The supratrochlear nerve lies within or deep to the medial fibers of the corrugator muscle, and its medial branches may be associated with the fibers of the procerus. The supraorbital nerve is also associated with the lateral fibers of the corrugator. During subperiosteal endoscopic or open myectomy, part of each muscle must usually be removed to fully expose these nerves. When these nerves lie deep to the muscle, they are seen before muscle dissection, because the subperiosteal endoscopic approach allows visualization of these structures from their deep surface.

Maxillary Division

Anatomic Features



The maxillary division innervates the skin of the midface through its zygomaticotemporal, zygomaticofacial, and infraorbital branches. The zygomatic nerve arises in the pterygopalatine fossa and enters the orbit through the inferior orbital fissure. It courses along the lateral border of the orbit and divides into two branches, the zygomaticotemporal and zygomaticofacial nerves.

The zygomaticotemporal nerve passes along the inferior wall of the orbit and exits through a foramen into the temporal fossa and ascends between the bone and the temporalis, piercing the deep temporal fascia 2 cm above the zygomatic arch to innervate the skin of the temple region. Along the terminal part of its course it is accompanied by one of the zygomaticotemporal veins, the lateral one. The zygomaticofacial branch passes along the inferolateral border of the orbit and exits through a foramen in the zygomatic bone and then through the orbicularis oculi to innervate the skin of the cheek below the zygoma. The maxillary nerve is a purely sensory nerve when it enters the orbit through the inferior orbital fissure and becomes the infraorbital nerve. It runs along the infraorbital groove to exit through the infraorbital foramen accompanied by the infraorbital branch of the internal maxillary artery. It innervates the skin of the cheek and upper lip.

Functional Significance

The skin marking for the infraorbital nerve is in the midpupillary line 1 cm below the infraorbital rim. The zygomaticotemporal nerve pierces the deep temporal fascia 2 cm above the zygoma and 2 cm lateral to the orbit. It is easily identified and just as readily injured during open or endoscopic subgaleal dissection in the lateral brow–temporal region. Division of the nerve leads to some minor sensory loss in the temporal region. The zygomaticofacial nerve exiting through a foramen in the zygoma just lateral to the orbit is located directly in the path of subperiosteal dissection. This nerve is easily identified and preserved. Division of the nerve will result in a small area of sensory loss below the zygoma. The zygomaticotemporal nerve is often identified during endoscopic brow lifts, accompanied by the more lateral of the two zygomaticotemporal veins.

Mandibular Division

Anatomic Features

The mandibular nerve innervates facial skin through the auriculotemporal, buccal, and mental branches. The auriculotemporal nerve arises from two roots encircling the middle meningeal artery. It runs backward under the lateral pterygoid muscle on the surface of the tensor veli palatini to pass between the sphenomandibular ligament and the neck of the mandible. The buccal branch of the mandibular nerve passes forward between the two heads of the lateral pterygoid muscle and then deep to or through the lower part of the temporalis muscle to emerge from under the mandibular ramus and anterior border of the masseter. It communicates with buccal branches of the facial nerve and then innervates the skin of the cheek over the buccinator. The mental nerve, the continuation of the alveolar nerve, exits the mandible through the mental foramen to innervate the chin and lower lip.

Functional Significance

The auriculotemporal nerve courses with the superficial temporal artery and is easily and quite often injured or divided during open face-lift and brow-lift procedures. The mental nerve exits through the mental foramen at the level of the second premolar and the skin markings are 2 cm below the lip in the midpupillary line, making it easily identified and preserved during open or endoscopic exposure for alloplastic implant placement.

Nerves of the Cervical Spine

Anatomic Features

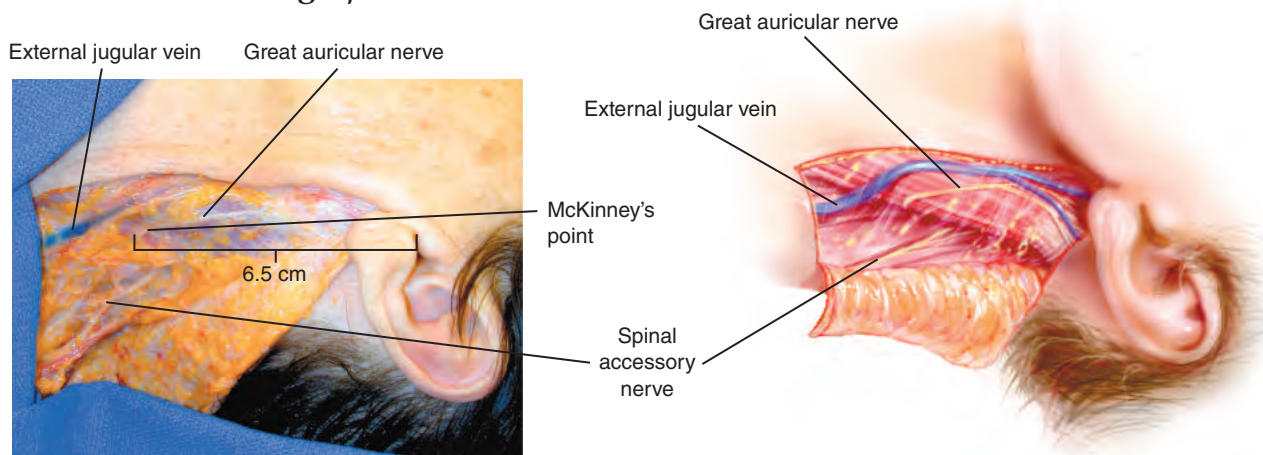
The cervical spinal nerves innervate the neck, ear, lower face, and posterior scalp. The greater occipital nerve is the medial branch of the dorsal ramus of C2. It ascends obliquely between the inferior oblique and semispinalis capitis, which it pierces. It then pierces the trapezius and runs upward and forward to innervate the scalp up to the vertex. The superficial ascending branches of the cervical plexus are branches of the ventral rami; the lesser occipital C2, greater auricular C2-3, and transverse cu-

taneous C2-3 innervate the lower lateral face, upper neck, submental area, and most of the ear. The lesser occipital nerve arising from C2-3 curves around the accessory nerve ascending along the posterior border of the sternocleidomastoid and continues upward on the side of the skull behind the ear. It innervates a small portion of the medial surface of the ear and the posterolateral neck and scalp.

The greater auricular nerve is the largest of the ascending branches of the cervical plexus. It arises from the dorsal rami of C2-3, encircles the posterior border of the sternocleidomastoid muscle, perforates the deep fascia 6.5 cm below the external auditory canal, and then courses upward. At this point it may lie deep to the platysma and is accompanied by the jugular vein. However, during its upward course toward the parotid gland, it lies within the subcutaneous tissues. At the level of the parotid it divides into anterior and posterior branches. The anterior branch innervates the skin of the face over the parotid and the posterior branch and continues upward to innervate the skin over the mastoid process and most of the medial and lateral surfaces of the ear, including the concha and lobule.

The transverse cutaneous nerve of the neck arises from the dorsal rami of C2-3 and turns around the posterior border of the sternocleidomastoid muscle at about its midpoint. It then runs obliquely forward and upward deep to the platysma and external jugular vein toward the anterior border of the sternocleidomastoid muscle where it divides into an ascending and a descending branch. The ascending branch innervates the submandibular and submental regions, and the descending branch innervates the side and front of the neck.

Functional Significance

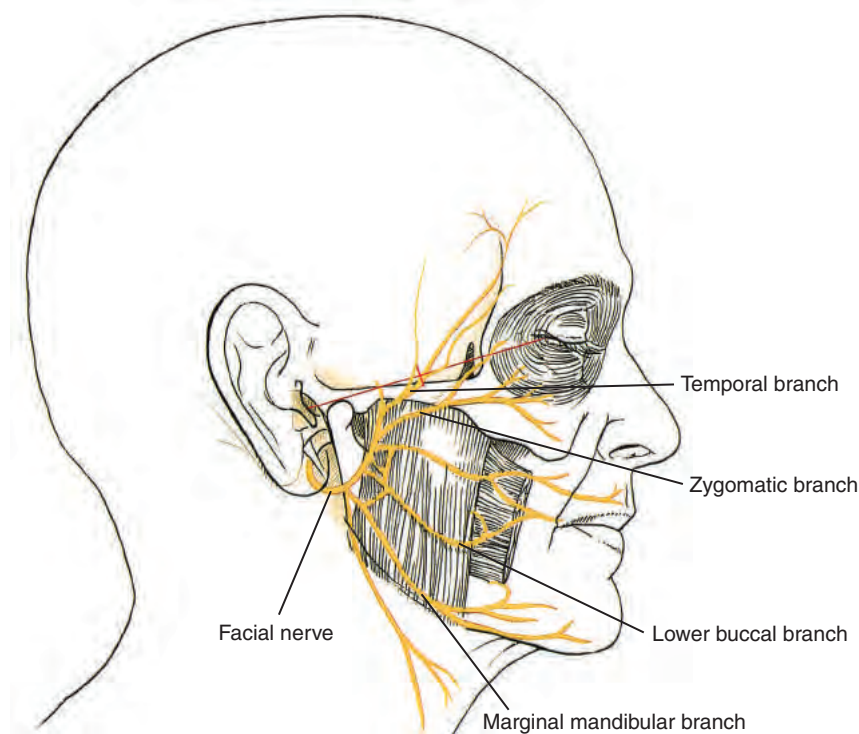


The great auricular nerve is the most commonly injured nerve during open rhytidectomy. It is at greatest risk in its superficial location on the sternocleidomastoid muscle, 6.5 cm below the external auditory canal. Division of the nerve will lead to numbness of portions of the ear. Although this numbness is a nuisance, the possibility of a neuroma developing in the cut end of the nerve poses even greater problems. These nerves can be blocked as they exit the posterior surface of the midsternocleidomastoid muscle.

Motor Nerve Supply

Facial Nerves

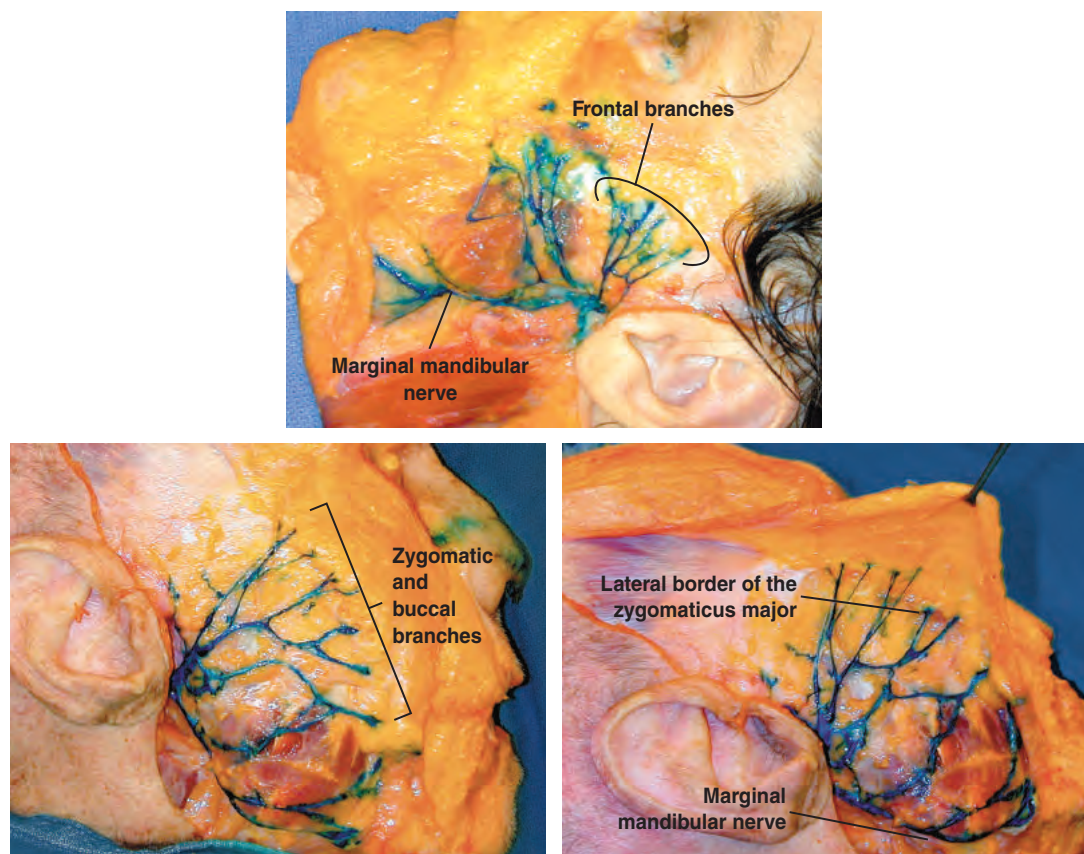
Anatomic Features



Surgeons performing facial aesthetic surgery must have a clear understanding of the facial nerve. Damage to a single branch of this nerve causes a visible muscle palsy and significant facial asymmetry, distressing to both patient and surgeon. Fortunately, most postoperative facial muscle weakness is caused by reversible stretch injuries to the facial nerve branches; however, division of the nerve, although rare, is always a possibility.

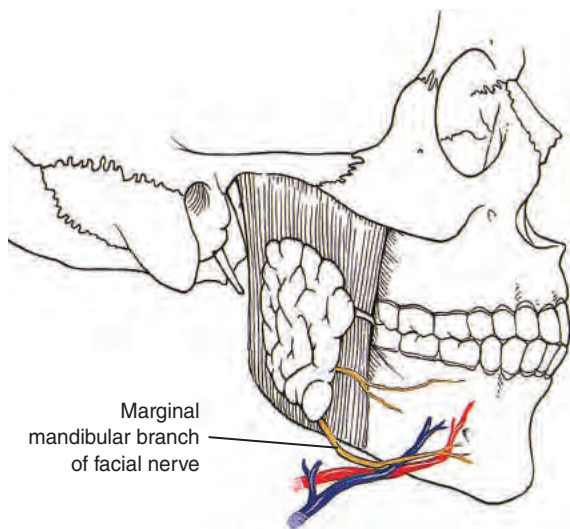
The facial nerve emerges through the stylomastoid foramen and is immediately protected by the parotid gland. Within the parotid gland it divides into an upper and lower portion and then into its five major branches: the temporal (frontal), zygomatic, buccal, marginal mandibular, and cervical. The branches then emerge medially from the parotid gland lying initially on the superficial surface of the masseter and deep to the parotideomasseteric fascia (deep facial fascia). Beyond the masseter muscle, the branches lie over the buccal fat pad, and at this level the facial nerve branches, the parotid duct, and the facial vessels are all at the same depth. Facial nerve branches proceed medially and innervate the mimetic muscles on their deep surface, except for the deepest level muscles, the mentalis, levator anguli oris, and

buccinator, which are innervated on their superficial surfaces. Dissection during deep plane or composite face-lift procedures, either endoscopic or open, superficial to the zygomaticus muscles will also be superficial to the facial nerve branches.



Although the facial nerve branches are deep and well protected during facial dissection, the frontal branches and marginal mandibular branch are most at risk. The frontal branches, unlike the others that lie deep to the facial fascial layers, assume a superficial course once they cross the zygomatic arch. They cross the zygomatic arch at approximately the midpoint of a line drawn from the tragus to the lateral canthus. At this level they assume a superficial course running within the sub-SMAS fat just deep to the temporoparietal fascia. More distally they pierce the temporoparietal fascia to innervate the frontalis on its deep surface.

Along the medial portion of its course, the marginal mandibular branch is well protected by the parotid gland. Beyond the parotid it is protected by the rather thick SMAS platysma layer. Here it usually runs at or below the mandibular margin. As it crosses the facial vessels deep to the platysma it courses upward and is usually located well above the mandibular margin. At the level of the facial vessel, the platysma and fascia are usually thinner.



The marginal mandibular branch in its peripheral course follows the mandibular border. Before crossing the facial vessels it may extend 1 or 2 cm below the border of the mandible. However, once it has crossed the facial vessels, it always runs above the border of the mandible. It is deep to the platysma throughout its course; however, as the platysma thins, this nerve could be in jeopardy. To prevent injury to the nerve, any subplatysmal dissection should begin at least 2 cm below the angle of the mandible. Dissection above the platysma laterally and deep to the platysma centrally will avoid nerve injury.

Functional Significance

Injuries to the buccal and zygomatic branches of the facial nerve are extremely rare. These branches of the facial nerve are located deep to the SMAS and the deep facial fascia. For injury to occur during rhytidectomy not only must the SMAS layer be penetrated but also the deep facial fascia. Since there are multiple interconnections between the buccal and zygomatic branches, injury to one or more branches would probably not result in a clinically noticeable deficit.

Dissection deep to the fixed or immobile portion of the SMAS (the portion adherent to and overlying the parotid gland) is safe and best performed sharply with a scalpel or scissors, but dissection deep to the mobile SMAS, beyond the parotid gland, must be done cautiously and should be performed bluntly by spreading rather than cutting.

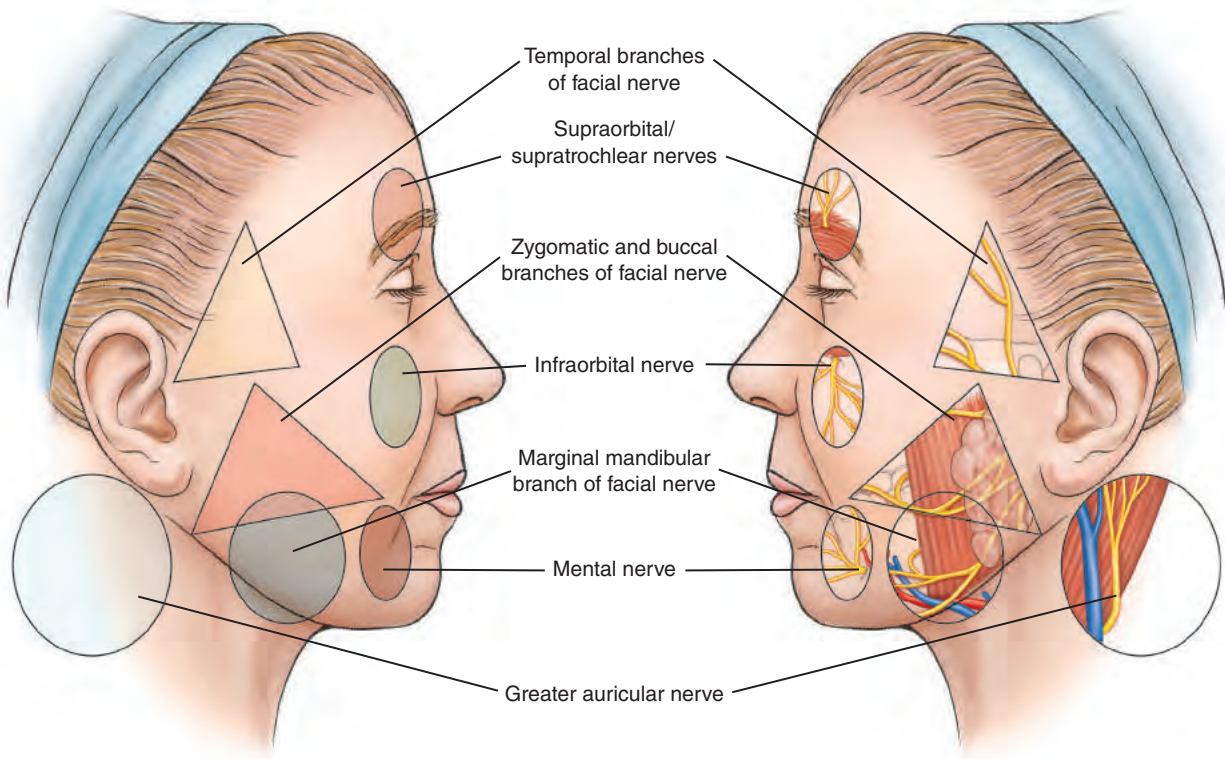
The frontal and marginal mandibular branches are at greater risk. The frontal branch assumes a superficial course after it crosses the zygomatic arch. In this area a violation of the SMAS or superficial fascial layer (temporoparietal fascia) may result in nerve injury. Lower on the cheek, however, the SMAS and deep facial fascia must be penetrated before the buccal or zygomatic branches are placed at risk. Therefore a safe plane of dissection in the temporal region would be either deep or superficial to the frontal branch. When combining an open coronal brow lift with a face lift, the dissection above the zygoma is in the loose areolar plane deep to the temporoparietal fascia on top of the superficial layer of the deep temporal fascia and below the temporoparietal fascia. Below the zygoma the dissection is in the more superficial subcutaneous level, leaving an intervening “mesentery” to protect the nerve.

During an endoscopic brow lift, injury to the frontal branch can be avoided in several ways. Lateral dissection in the plane immediately above the superficial layer of the deep temporal fascia in the lateral brow must proceed cautiously in a medial to in-

ferolateral direction. The location of the nerve should be anticipated from its anatomic course, and the surgeon should be aware of the sentinel vein, which indicates proximity to the nerve. Elevation in this plane using a sweeping motion with smooth rounded elevators allows identification of this vessel. Alternative routes of dissection involve flap elevation in a deeper plane, either below the superficial or deep layers of the deep temporal fascia. Either location further separates the plane of dissection from the nerve. Undue upward force during these deep dissections (including subperiosteal elevation of the zygomatic arch) may cause trauma to the nerve and should be avoided.

During an open or endoscopic subperiosteal face lift, the superficial layer of the deep temporal fascia is incised and dissection proceeds deep to this layer within the superficial temporal fat pad to the zygoma. This keeps the dissection well below the course of the frontal branch.

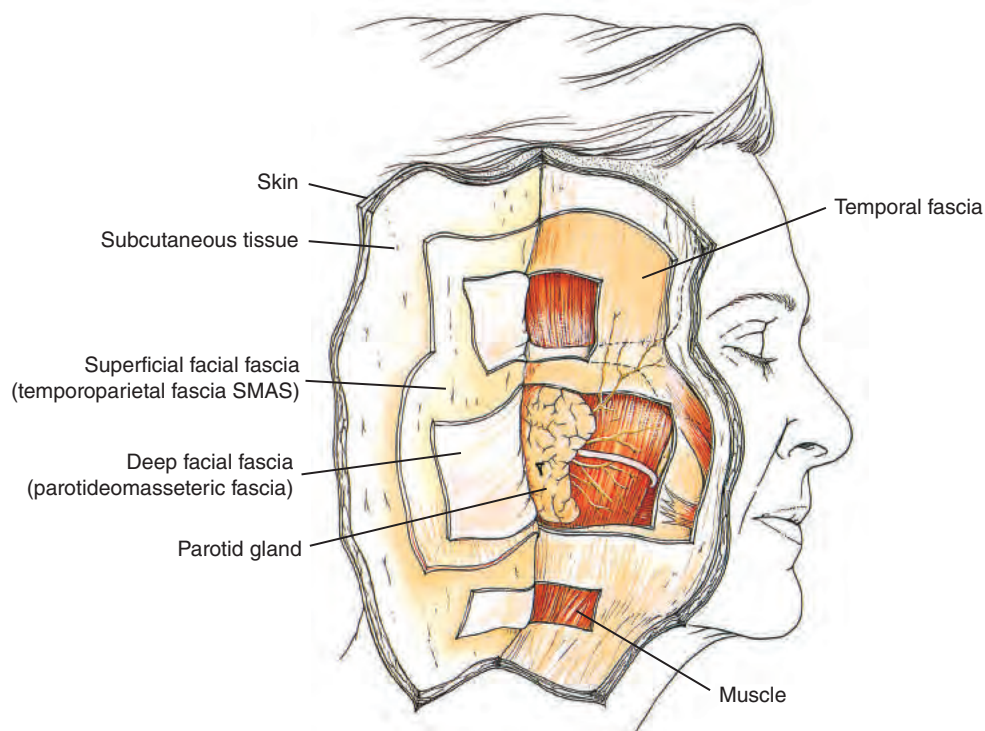
Facial Danger Zones



Facial danger zones have been described by Seckel where motor branches and sensory nerves are at greatest risk during facial rejuvenation. These include the frontal, zygomatic, buccal, and marginal mandibular branches of the facial nerve, the great auricular nerve, supraorbital, infraorbital, and mental nerves.

Fascial Layers, Adhesions, and Ligaments of the Face

Knowledge of the fascial layers, adhesions, and ligaments of the face contributes to surgeons' understanding of the changes resulting from the aging process and enables us to precisely prepare surgical procedures, not only within the appropriate layer of the face, but also in planning the release of adhesions and ligaments to mobilize the tissues and easily reposition them. Adequate mobilization and repositioning of facial tissues depends on complete release of the adhesions and ligaments before mobilization. An understanding of the layers of the face clarifies the anatomic relationships and defines the planes of dissection for mobilization of tissues in facial rejuvenation.



If the facial soft tissues are conceptualized as a series of concentric layers, as proposed by Stuzin, Baker, and Gordon, the aesthetic surgeon will understand that dissection within one anatomic plane can proceed without disturbing the other layers. From superficial to deep, these layers include skin, subcutaneous tissue, superficial facial fascia (SMAS), premasseter space, mimetic muscles, and deep facial fascia (parotidomasseteric fascia); the deepest plane contains the facial nerve, parotid duct, buccal fat pad, and facial vessels. These layers and various structures, although

anatomically distinct, function as one unit to convey facial expression. Changes within each layer and the effects that these changes have on the other layers produce the visible signs of facial aging.

Subcutaneous Layer

The thickness of the subcutaneous layer varies not only from individual to individual but within different areas of the same face. There is scant, if any, subcutaneous fat overlying the zygoma; it is most plentiful over the cheek, jowl, and submental areas. Fullness and descent in these areas causes cheek flattening, accentuation of nasolabial folds, jowl formation, and fullness of the central neck.

Superficial Facial Fascia, Superficial Musculoaponeurotic System *Anatomic Features*

The SMAS is considered to be a well-defined portion of the superficial facial fascia. This superficial facial fascia is a discrete fascial layer forming a continuous sheath through the face and neck and extending into the malar region, the lip, and even the nose. It extends into the forehead, temporal area, and scalp as the temporoparietal fascia. This layer separates the subcutaneous tissues from the underlying muscles and the deep facial fascia and facial nerves.

The SMAS represents an upward extension of the superficial cervical fascia into the face, and the temporoparietal fascia can be considered an extension of the SMAS into the temporal and scalp regions. This layer varies in thickness. It is very thick over the parotid gland (SMAS), the temporal region (temporoparietal fascia), and the scalp (galea); it is much thinner over the masseter muscle and becomes thinnest in the malar region. Just like the subcutaneous fatty tissues, it will vary in thickness from individual to individual.

The attachment of the SMAS throughout the face is not uniform. It has areas of tight adherence to the underlying structures in some areas, whereas in others it separates with less difficulty making a SMAS elevation possible even with blunt dissection.

In surgical terms, we often divide the SMAS into the fixed and mobile portions. The fixed portion lies over the parotid gland; it is firmly adherent to the gland and is immobile. The mobile portion, beyond the parotid gland, lies directly over the mimetic muscles, facial nerves, and parotid duct. It is not adherent to the structures and is highly mobile. It is mobilization and traction on this part that results in movement of the midface and lower face.

Functional Significance

The muscles of facial expression, the mimetic muscles, are bound by the superficial fascial layer and arranged in four layers, as described by Freilinger et al. The muscles most likely to be visualized during rhytidectomy—the orbicularis oculi, platysma, and zygomaticus major and minor—are all superficially located and all innervated by the facial nerve on the deep surface.

Only the deepest muscles—the buccinator, mentalis, and levator anguli oris—lie deep to the plane of the facial nerve and are innervated on their superior surface. Clinically, this is significant in that SMAS elevation can be performed safely as long as the plane of dissection stays above these muscles. In deep plane rhytidectomy, dissection along the anterior surface of the zygomaticus major muscle can be performed safely, since this dissection is superficial to the nerve branches and the muscle is innervated on its deep surface.

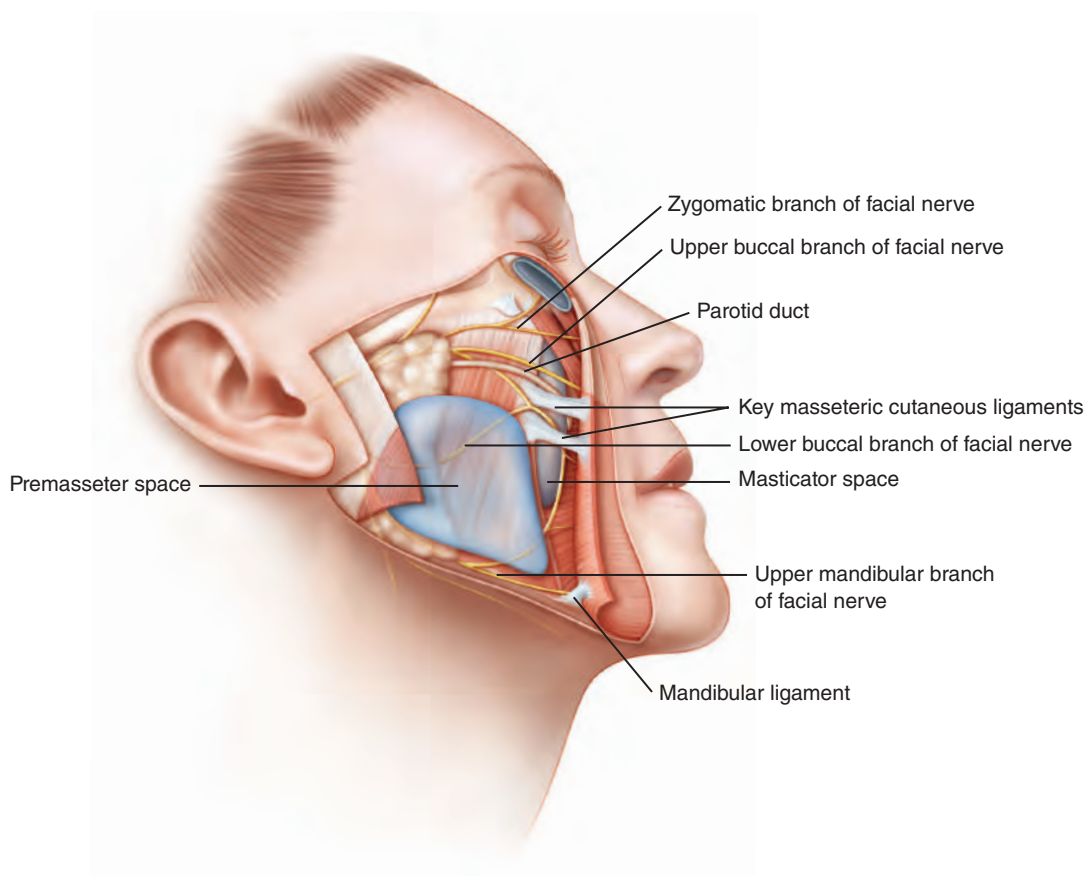
It is only through mobilization and traction on the mobile SMAS that the facial tissues can be effectively mobilized, elevated and repositioned.

Premasseter Space

Anatomic Features

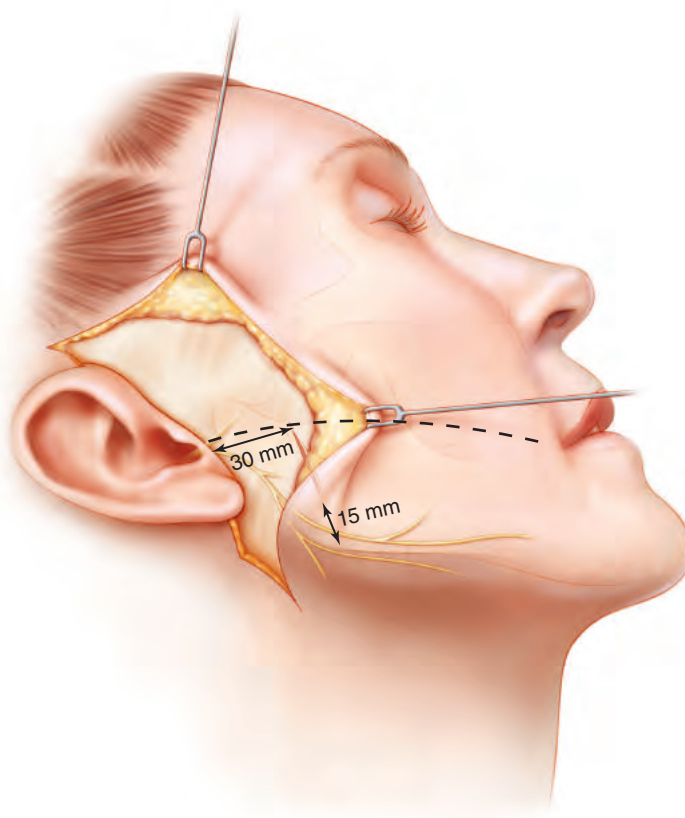
The soft tissues overlying the masseter can be divided into two separate areas. An oblique line that goes from the inferior edge of the tragus to just below the oral commissure separates the upper masseteric area from the lower masseteric area. The upper area contains the zygomatic branch of the facial nerve, the accessory lobe of the parotid and parotid duct, and the upper buccal trunk of the facial nerve.

The lower area contains what is referred to as the *premasseter space*. This is an avascular cleavage plane that contains no facial nerves, where the SMAS is easily elevated. This space underlies the SMAS and platysma and is superficial to the masseter fascia. It is a true space with a rhomboid shape and defined boundaries where the SMAS separates with less difficulty, making a safe SMAS elevation possible even with blunt dissection.



The floor of the premasseter space is made up of the masseter fascia. No facial nerve branches are at risk while dissecting through this space as the branches course beneath the fascia of the masseter. The roof of the premasseter space is formed by the superficial fascia that encloses the upper aspect of the platysma. This fascia is strongly adherent to the platysma fibers. The platysma continues up from the neck in an oblique fashion over the premasseter space. At the anterosuperior border of the space, the platysma has a strong deep fixation to a key masseteric cutaneous ligament. There are no facial nerve branches within the roof of the premasseter space.

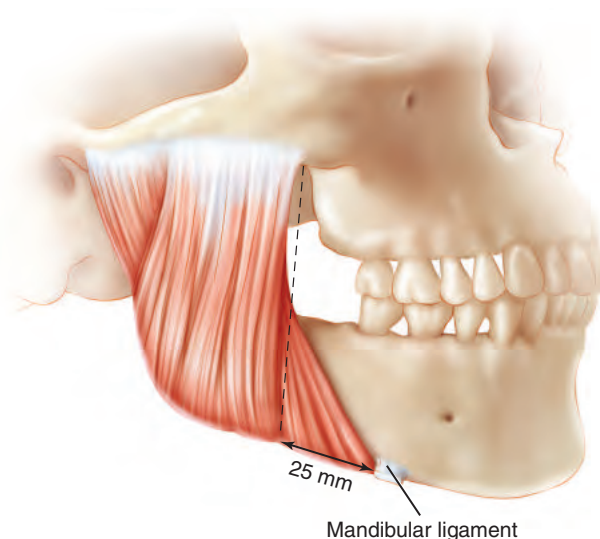
The superior border of the premasseter space is limited by a strong septum that is tightly bound by a posterior ligament and an anterior key masseteric cutaneous ligament. The location of this septum is represented by a line that crosses the surface of the masseter from the inferior edge of the tragus to the oral commissure. This is the line that bisects the masseter into an upper and a lower area. The lower area (premasseter space) is the safe area where sub-SMAS dissection can be performed with ease.



The posterior border of the pre-masseter space starts 25 to 30 mm anterior to the tragus and extends down to about 15 mm above the angle of the mandible. The area between the ear and the posterior border of the space is lined by immobile SMAS that is tightly adherent to the underlying structures, particularly the parotid capsule. The posterior border of the pre-masseter space (25 to 30 mm anterior to the tragus, just anterior to the edge of the parotid) represents the end of these dense attachments, and the beginning of the mobile SMAS. When a sub-SMAS dissection is planned, it should be started 25 to 30 mm anterior to the tragus where the pre-masseter space begins. The presence of a defined space under the SMAS makes this dissection easier and safer. When in the space, further dissection of the SMAS should be blunt and atraumatic which further reduces the chances of nerve injury. There is no advantage in performing this dissection in the tightly adherent immobile SMAS. An additional benefit that comes from not dissecting the immobile SMAS is that a segment of firm adherent tissue remains to anchor the newly surgically repositioned mobile SMAS.

The inferior border of the space is made up of a thin membrane that extends from the previously described posterior border, approximately 15 mm superior to the angle of the mandible, all the way to the mandibular ligament at the labiomandibular crease. The upper mandibular branch of the facial nerve crosses the posterior border of the masseter approximately 8 mm above the angle of the mandible then continues below the inferior border of the pre-masseter space. This makes the inferior

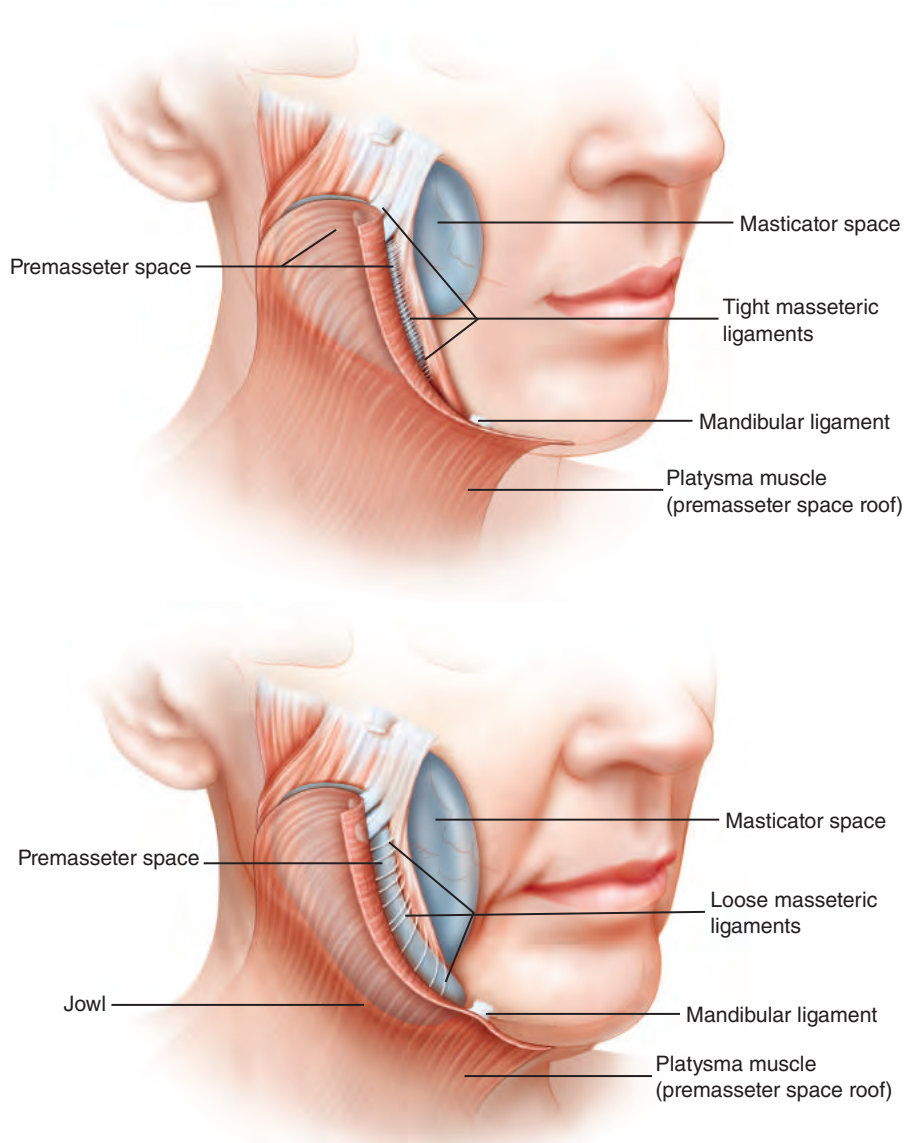
border of the premaseter space cephalad to the mandibular branch, which remains outside the operative field at all times. Clinically, there is no advantage to be gained in extending the sub-SMAS dissection to the rim of the mandible. Except for the mandibular ligament anteriorly, there are no ligamentous fixations along the inferior septum. This makes the inferior boundary of the space more predisposed to inferior displacement when there is descent of the tissues with age.



The anterior border of the premaseter space is defined by the anterior border of the muscle. The forward prolongation of the muscle's lower anterior part for 20 to 25 mm is the basis for the jowl recess at the anteroinferior corner of the premaseter space. Medial to the anterior membrane is a sheet of masseteric ligaments that provide structural support and form a "picket fence"-like reinforcement of the border. This ligamentous support extends from the key masseteric cutaneous ligament at the anterosuperior border of the space down to the mandibular ligament. The mandibular ligament is located immediately in front the jowl recess and it demarcates the transition between the jowl and the labiomandibular fold. The more the jowl descends, the more apparent this demarcation becomes.

Anterior to the premaseter space, on the medial side of the ligaments, course several branches of the facial nerve that came from beneath the floor of the space. Further medial to the premaseter space, between the masseteric ligaments and the oral commissure, is the masticator space which contains the buccal fat pad. In youth, the inferior border of the masticator space is at the oral commissure, separate from the jowl recess. With significant aging changes and ligament laxity, this space, along with the buccal fat, can extend down so low as to contribute to the heaviness of the jowls and labiomandibular folds. Adequate rejuvenation of the jowls and labiomental folds may sometimes require management of the buccal fat pad. Surgical access to the buccal fat can be obtained through the attenuated anterior border of the premaseter space.

Functional Significance



The jowl and labiomandibular fold are classical signs of aging. Correction of the jowls and labiomandibular folds are two of the most essential elements for a successful face-lift. The SMAS and the jowls seem to be closely related since the manipulation of the SMAS during a face lift achieves improvement of the jowl. The pre-masseter space is implicated in the formation of jowls. With aging, a progressive attenuation of the masseteric ligaments causes laxity of the anterior and inferior border allowing the roof to slide down. The changes along the anterior border are not uniform. There is less laxity above where there is a stronger fixation by the thick key masseteric ligaments, and there is more laxity below in the jowl recess. With ligament laxity, there is descent of tissues into the anteroinferior area of the pre-masseter space extending below the mandible rim, resulting in the development of the jowl. Improvement in the laxity of the jowls and labiomandibular folds can be obtained

through a posterosuperior pull of the mobile roof (SMAS) of the premassester space. Sub-SMAS dissection through this avascular space is easy and safe since it contains no vital structures. The amount of pull possible increases in older patients because of the laxity of the masseteric cutaneous ligaments. If a SMASectomy is required, it becomes an effective and safe technique since a strip of SMAS is being resected from the roof of the space without any risk of nerve damage. The nearest facial nerve branches (buccal) are under the floor of the space.

Deep Facial Fascia

Parotideomasseteric Fascia

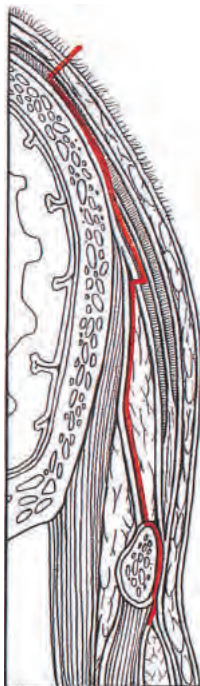
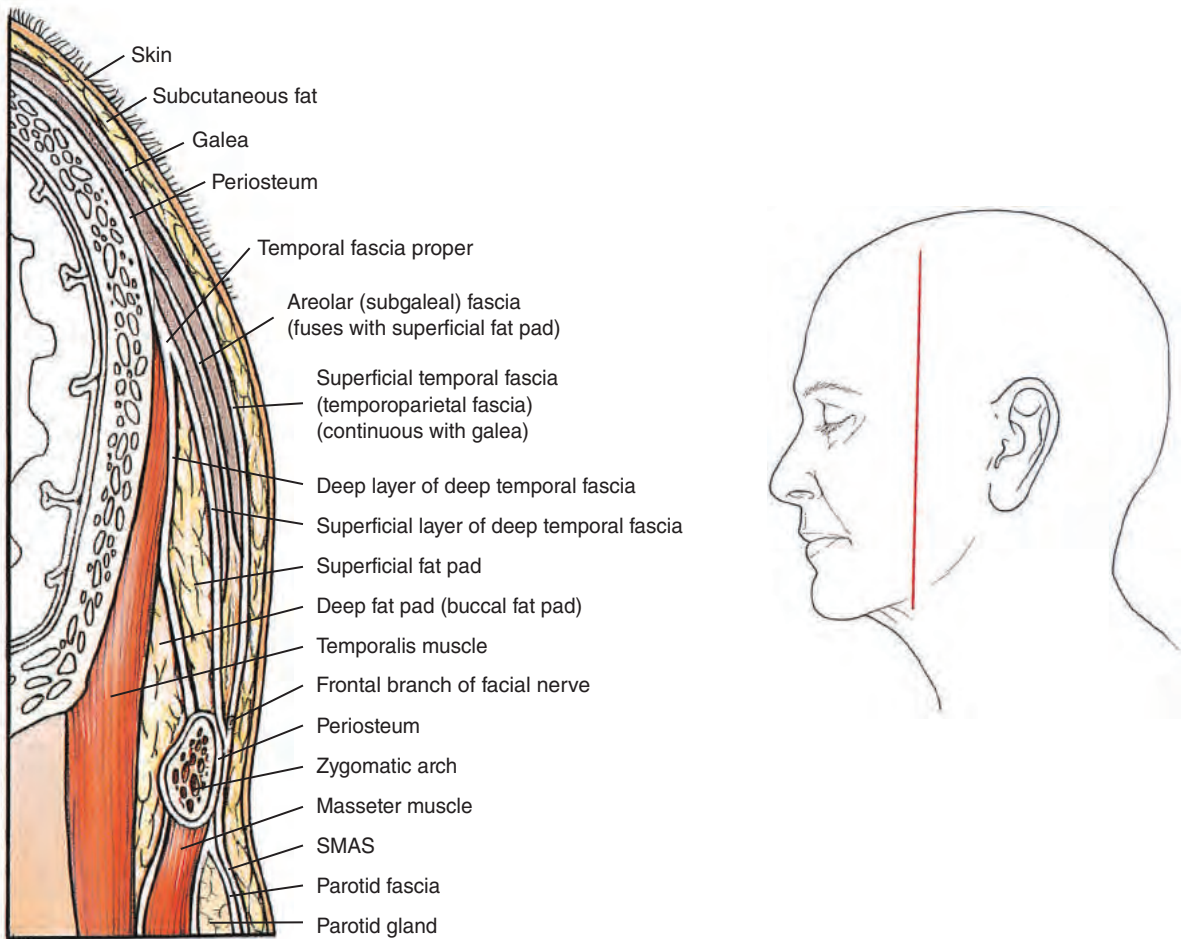
The superficial layer of the deep cervical fascia continues onto the face as the deep facial fascia. In the area overlying the parotid it is referred to as the investing fascia of the parotid and over the masseter it is called the masseteric fascia. The deep facial fascial layer extends to the malar region lying deep to the lip elevators, and its extension above the zygomatic arch is the deep temporal fascia. The clinical significance of this layer is that the facial nerve branches within the cheek all lie deep to it. The superficial fascia and deep facial fascia are separated by loose areolar tissue typical of the usual arrangement between fascial layers elsewhere in the body. However, these two layers are firmly attached to each other in certain anatomic locations. In the temporal region there is an areolar plane between the temporoparietal (superficial facial fascia) and the deep temporal fascia (deep facial fascia). In the areolar tissue between them lie the temporal artery and the frontal branch of the facial nerve. A similar plane is found in the cheek between the SMAS (superficial facial fascia) and the parotideomasseteric fascia (deep facial fascia) over the masseter muscle and between the platysma and the strap muscles in the neck. The two facial fascial layers are firmly attached to each other along the zygomatic arch over the parotid gland and along the anterior border of the masseter.

The Deepest Plane

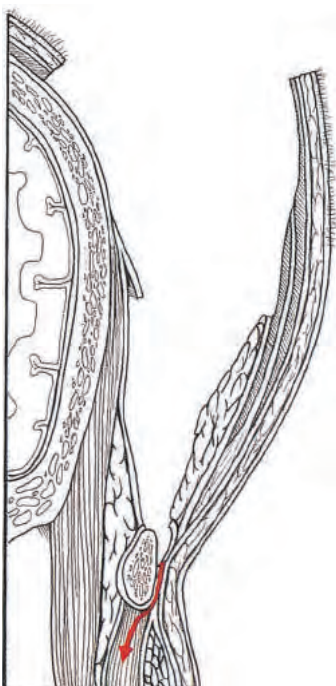
The deepest plane lying deep to the deep facial fascia or parotideomasseteric fascia contains the zygomatic and buccal branches of the facial nerve, the buccal pad, the parotid duct, and the facial artery and vein.

Functional Significance

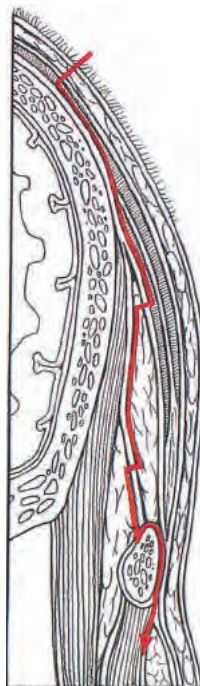
The clinical significance of these four facial layers involves their relationship to the branches of the facial nerve and their preservation during rhytidectomy. Any dissection superficial to the SMAS is obviously well away from the underlying nerves. Below the SMAS and above the deep facial fascia, dissection within the cheek will protect the buccal and zygomatic branches. However, the frontal branch requires special attention once it crosses the zygoma and assumes a superficial course. Since the zygomaticus muscles are innervated on their deep surface, deep plane rhytidectomy superficial to the zygomaticus muscles does not place the facial nerve branches at risk.



Path of dissection



Continued path of dissection

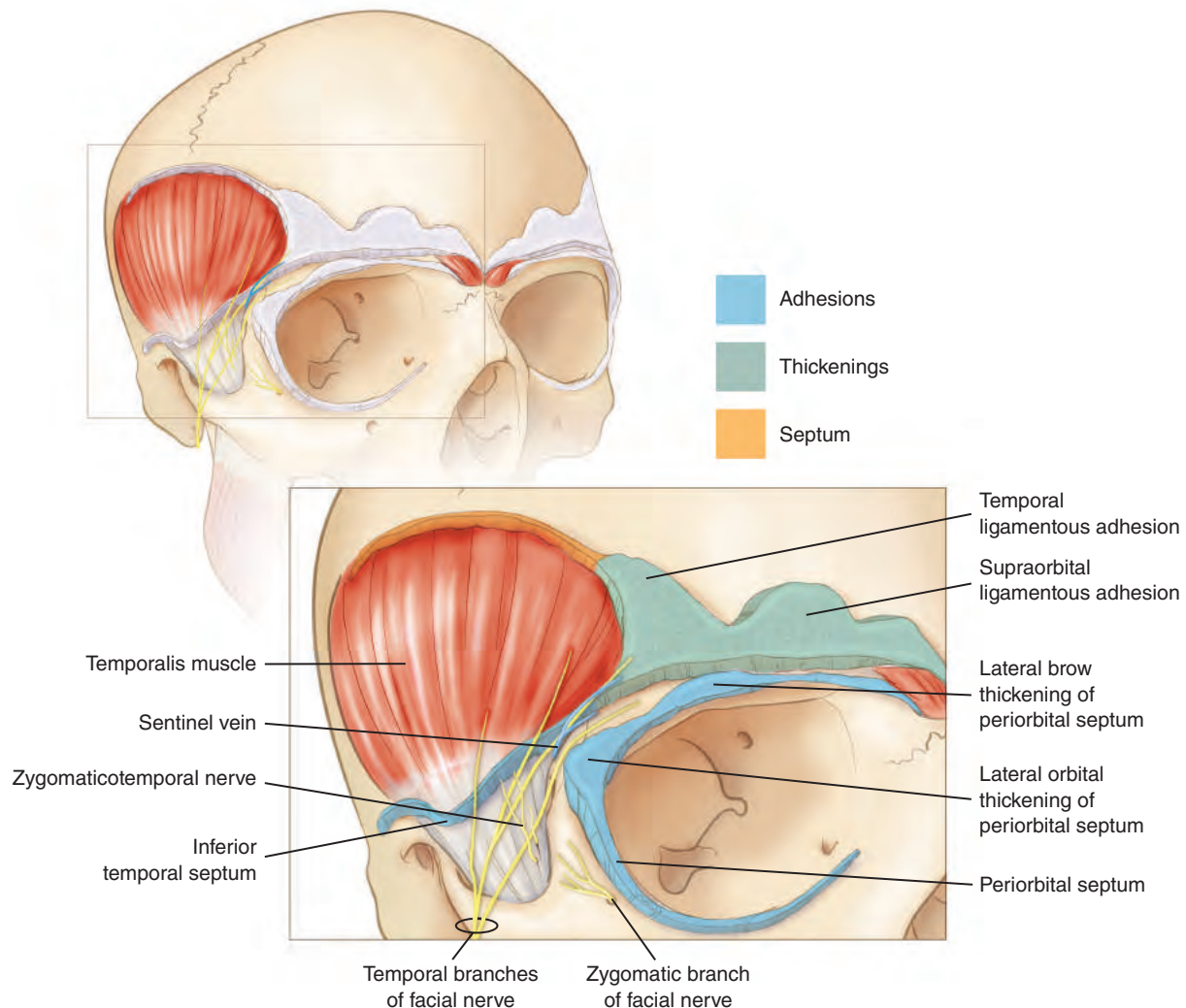


Variation

Retaining Ligaments and Adhesions of the Face and Neck

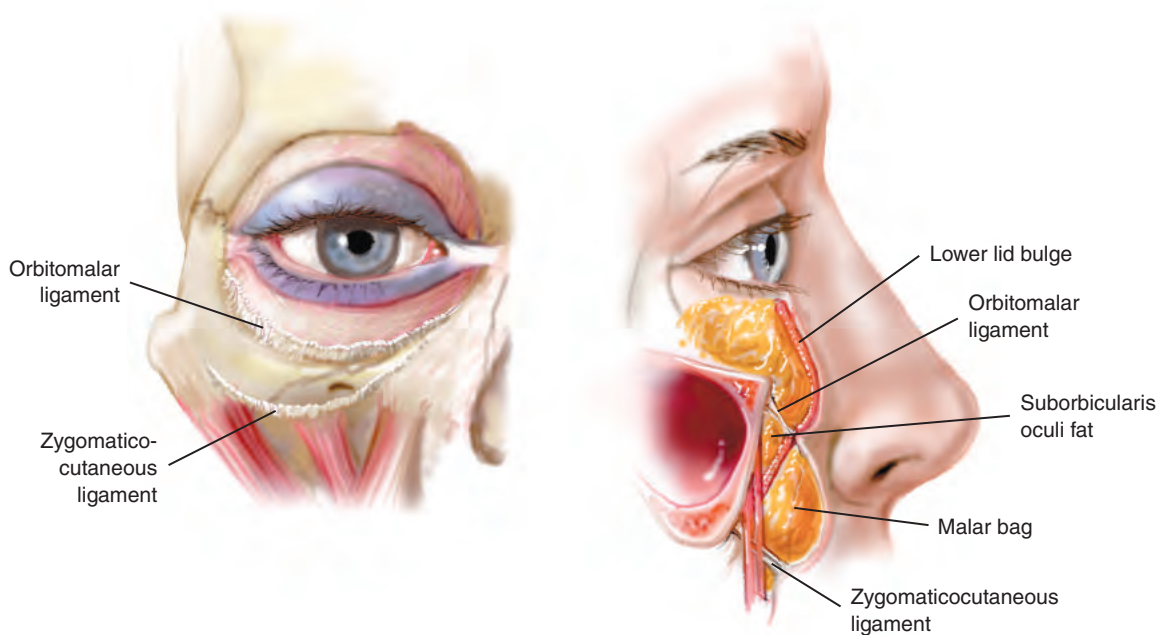
Temple and Periorbital Region

Temporal Ligamentous Adhesions



Proper elevation and rejuvenation of the periorbital area, specifically the lateral brow and lower lid-cheek junction depends on appropriate release of a variety of adhesions and ligamentous attachments. There are numerous adhesions and attachments in this area. They have been given different names and described as different types of structures by various authors. Some of the adhesions and ligaments in this area have been referred to as tendons, though no real tendons in the anatomic sense are present in the region.

The medial and lateral third of the eyebrow above the orbit is held in position by the temporal ligamentous adhesions. These extend posteriorly along the temporal crest as the superior temporal septum or the temporal line of fusion. These adhesions extend medially toward the medial orbit as the supraorbital ligamentous adhesions. Laterally from the supraorbital rim the adhesion extends toward the posterior and upper border of the zygoma in the form of the inferior temporal septum. More anteriorly, directly over the orbital rim—starting medially and extending counterclockwise around the orbit—are the periorbital septum superiorly, extending laterally to the lateral brow thickening of the periorbital septum, farther down laterally along the orbital rim to the lateral orbital thickening of the periorbital septum, and then around the lower lateral portion of the orbit and along its inferior border as the lower extent or continuation of the periorbital septum. As described by Moss, Mendelson, and Taylor, essentially the periorbital septum extends around the orbit from the upper medial area of the orbit to the lower medial portion covering three quarters of the circumference of the orbit.



Periorbital Ligaments

Functional Significance

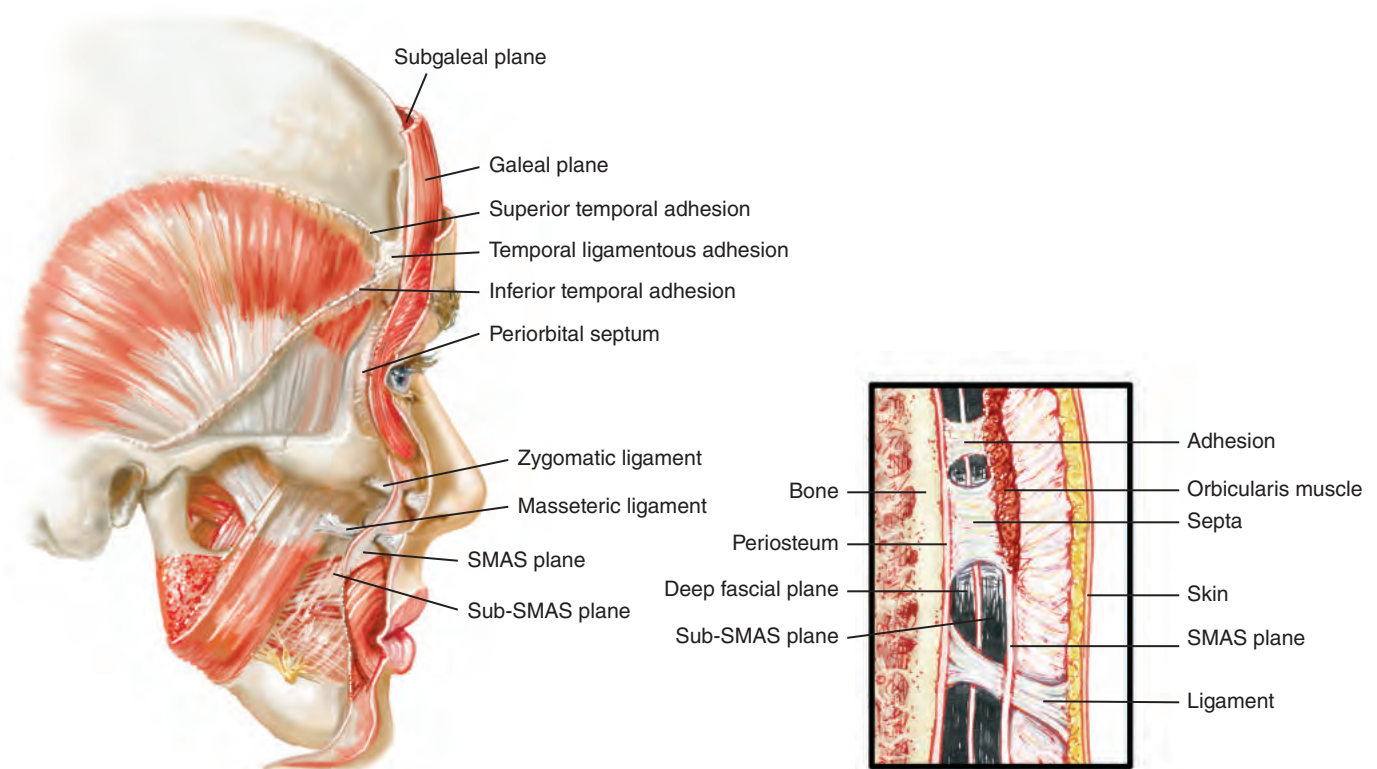
Complete division of these adhesions and septa is essential for repositioning of the lateral brow and periorbital tissues. These adhesions are usually very easily dissected with a periosteal elevator. However, sometimes the lateral brow thickening of the periorbital septum may require division using the scissors rather than a periosteal elevator.

Remembering and recounting the names of these various adhesions and attachments is not as important as remembering that it is essential to divide all of them to allow adequate mobilization of the lateral brow and periorbital tissues.

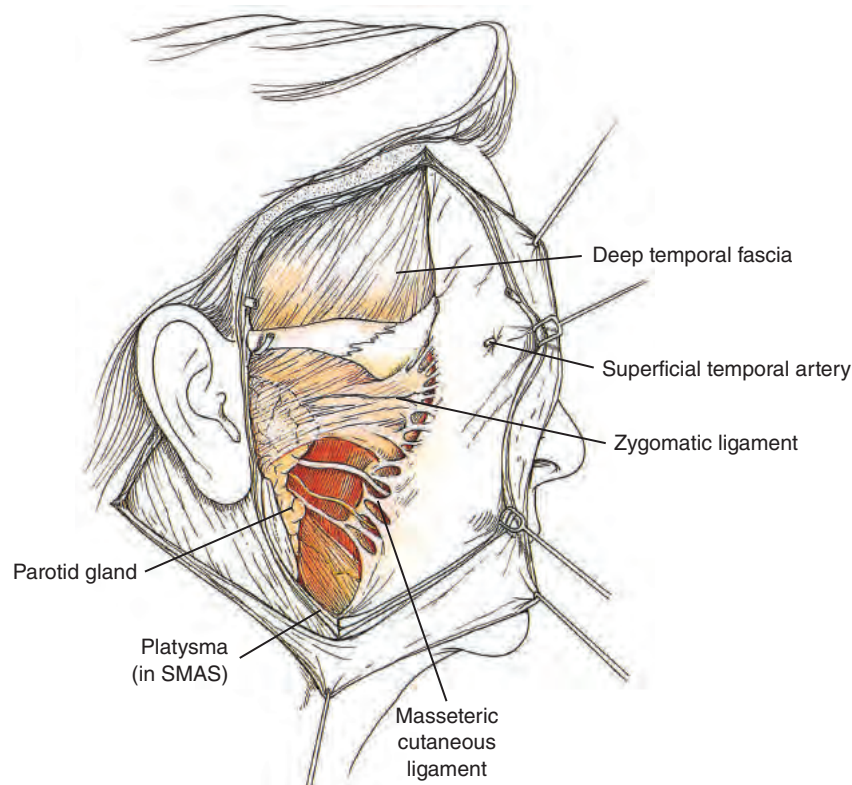
Midlateral Face

Anatomic Features

Retaining ligaments of the midlateral face run from underlying fixed bony origins into the overlying dermis. The ligaments serve to support the facial skin in its normal anatomic position. Based on their anatomic studies, Stuzin and colleagues described two types of retaining ligaments. The first, or true osseocutaneous ligaments, run from the periosteum to the dermis (for example, the zygomatic and mandibular ligaments). The second system is formed by the coalescence of the superficial facial fascia and the deep facial fascia that fixes the facial layers to underlying structures such as the parotid and masseter and are attached to the overlying dermis by fibrous septa. The parotid cutaneous and masseteric cutaneous ligaments are examples of this second system. These much finer structures also serve to maintain facial soft tissue in its normal position. The zygomatic ligaments take origin from the body of the zygoma and the zygomatic arch and extend through the malar fat pad to the overlying dermis. The mandibular ligaments originate in the parasymphyseal region of the mandible and extend to the overlying dermis. Masseteric cutaneous ligaments are located along the entire anterior border of the masseter, where the superficial facial fascia and deep facial fascia are firmly adherent. A series of fibrous bands extends vertically up to the dermis to support the cheek skin. The parotidocutaneous ligaments lie along the parotid gland, where the superficial facial fascia and the deep facial fascia are firmly adherent to each other and similar septa anchor the overlying skin down to the fascia.



Functional Significance

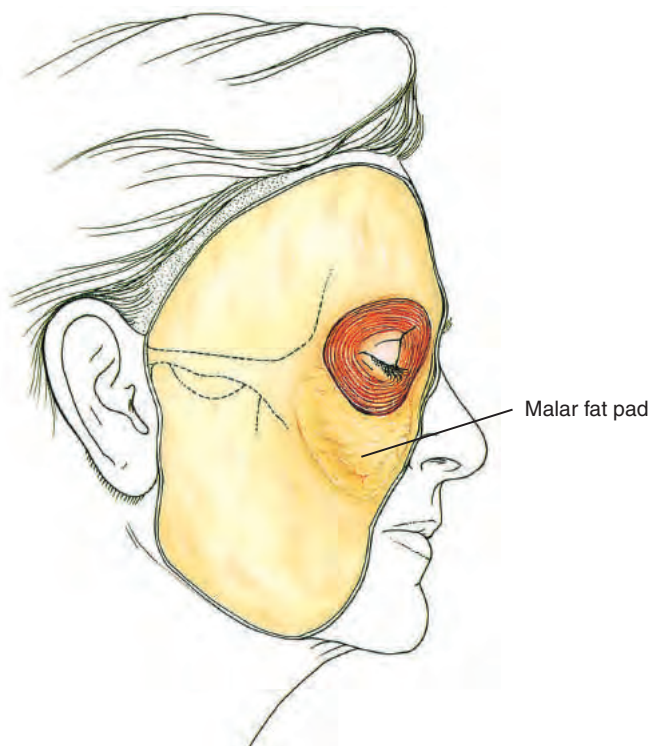


These ligaments are essentially fixed structures extending from underlying bone to dermis. Facial tissue, especially fat pads, can pivot around them, producing creases such as the marionette grooves of the lower face. With age, these ligaments attenuate and relax. This, combined with the loss of skin elasticity and soft tissues, will lead to the stigmata of aging. The zygomatic ligaments suspend the malar soft tissues and fat pad over the zygomatic prominence. As this support weakens, the malar soft tissues gradually migrate downward, and redundant skin hangs over the fixed nasolabial sulcus. Rather than the nasolabial sulcus deepening with age, it is the downward migration of the soft tissues against the fixed nasolabial sulcus that accounts for the observed changes. Surgical correction of the prominent nasolabial fold should concentrate on repositioning the malar soft tissues and restoring malar support. In a similar fashion, attenuation and weakness of the masseteric cutaneous ligaments will allow a downward shift of the cheek tissues below the mandibular margin, where tethering by the mandibular ligament will lead to the formation of jowls. Surgical correction of jowls should include a rearrangement and resuspension of the deep tissues. These ligaments that extend from bone to dermis must be released during a face lift to achieve the desired result. Left intact, they limit mobility.

Malar and Buccal Fat Pads

Malar Fat Pad

Anatomic Features



A youthful appearance with the associated cheek prominence is related to the prominence of the underlying zygoma as well as the position and fullness of the malar fat pad. Owsley noted that the malar fat pad is an area of increased thickening of the subcutaneous tissues extending from the malar region to the nasolabial crease. This fat pad is located superficial to the SMAS and mimetic muscles. It is roughly triangular in shape, with the base along the nasolabial fold and the apex toward the zygomatic prominence. When the malar fat pad descends, it adds fullness to the nasolabial fold and deepens it.

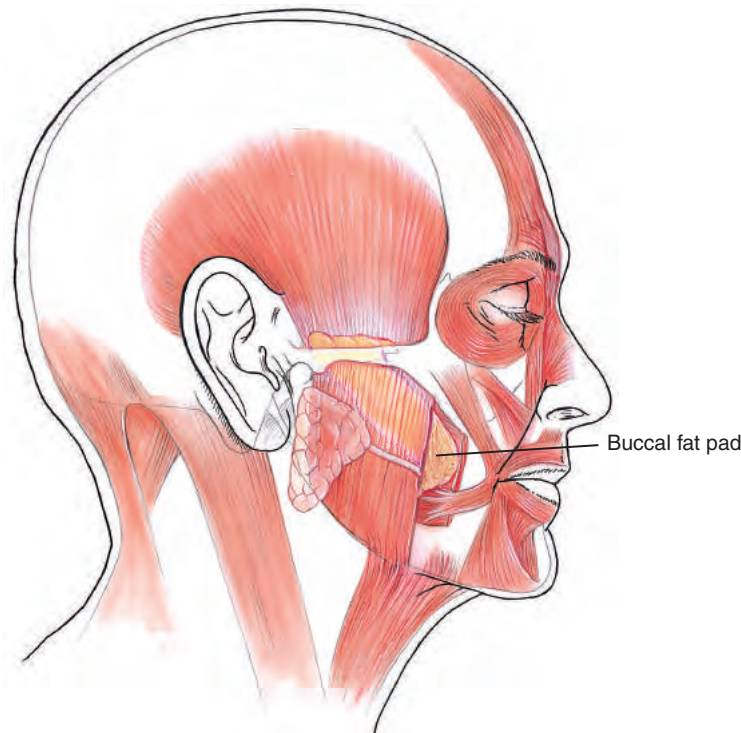
Functional Significance

The malar fat pad must be repositioned to improve midfacial appearance. This may be accomplished with subperiosteal, deep plane, and composite face-lift techniques. With the deep plane lift, the fat pad remains attached to the overlying skin and tension on the skin elevates the cheek.

With age, not only is there descent of the malar fat pad, but also loss of volume. The recent work of Lambros has demonstrated that volume loss may be clinically more relevant than descent. Currently, our approach to facial rejuvenation includes a combination of malar fat pad elevation as well as volume replacement.

Buccal Fat Pad

Anatomic Features



The buccal fat pad lies deep to the deepest of the facial layers and contributes to cheek and facial contour. This specialized type of fat, called syssarcosis, enhances muscular motion. It resembles orbital fat in color, function, and form.

The buccal fat pad is intimately related to the temporalis, masseter, and buccinator muscles, the zygomatic and buccal branches of the facial nerve, and the parotid duct. The space that is occupied by the buccal fat pad is called the masticatory space. The buccal fat pad within this space separates the muscles of mastication from each other and from the mandible, maxilla, and zygoma.

The buccal fat pad weighs approximately 8 to 12 g and consists of a central body and three extensions. The temporal extension extends superiorly deep to the zygoma, the pterygoid extension extends backward deep to the ramus of the mandible, and the buccal extension, which is the most superficial extension, lies within the cheek. The body and buccal extensions are clinically significant and contribute to cheek contour.

The central body is located above the parotid duct and extends along the upper anterior border of the masseter muscle. It lies deep to the masseter muscle and over the upper fibers of the buccinator extending to the maxilla where it lies over the second maxillary molar. Posteriorly it is wrapped around the maxilla.

The buccal extension lies below the parotid duct, which separates it from the central body. Deep to it lie the buccinator and oral mucosa and the facial vessels; the zygomatic and buccal branches of the facial nerve lie superficial to it. The parotid duct passes through the fat pad and buccinator into the oral mucosa opposite the second maxillary molar. The pterygoid portion passes downward and backward on the deep medial surface of the ramus of the mandible lying on the lateral surface of the medial and lateral pterygoid muscles. The deep temporal portion extends upward deep to the zygoma lying directly over the temporalis muscle and its tendon.

Functional Significance

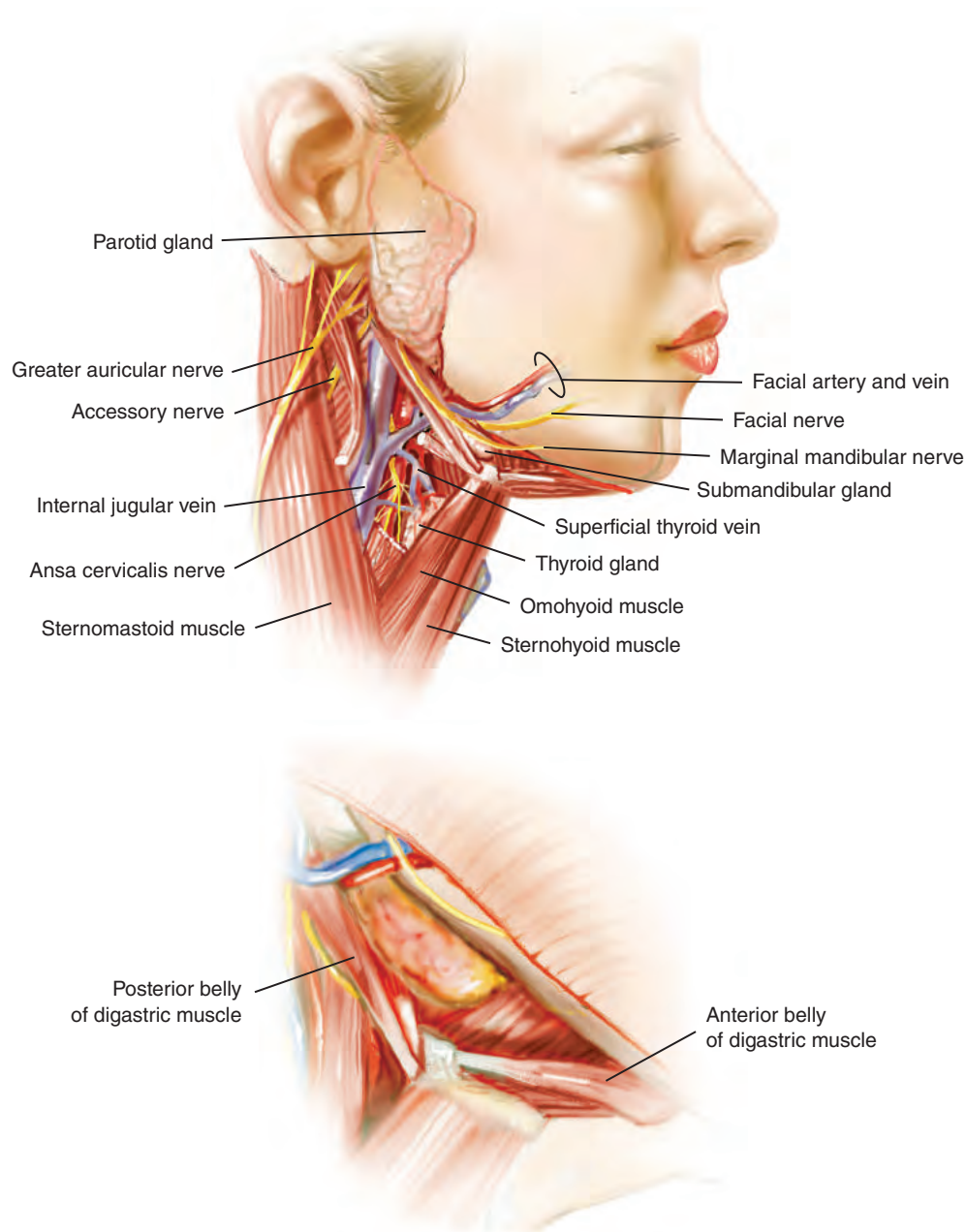
In selected cases removal of the buccal fat pad will reduce cheek fullness and enhance the malar eminence. It is essentially the central body and buccal portion or extension that is clinically removed, effecting contour changes of the cheek.

The buccal fat pad has a distinct yellow color and is easily distinguished from subcutaneous fat. Because of its intimate relationship with the facial vessels, parotid duct, and branches of the facial nerve, the fat should be gently teased and removed. Sharp dissection should be avoided. The buccal fat pad resembles an egg yolk in color as well as in size and consistency; removing this pad from the masticatory space is also reminiscent of separating egg yolk from egg white.

Stuzin et al described the intraoral approach, in which a longitudinal incision is made in the buccal sulcus at the level of the second upper molar, dissection continuing through the buccinator. The buccal fat is enveloped in a fascial layer. This fascial layer is opened and the buccal fat pad is as easily identified and delivered as an egg yolk. Alternatively, during open or endoscopic face lift the buccal fat pad is approached along the anterior border of the masseter muscle. Careful dissection and spreading are recommended to avoid injury to the facial nerve branches. Longitudinal spreading will provide easy access to the buccal fat pad.

The buccal fat pad does change with age. It is most prominent in infants and young children. As the surrounding tissues grow with age, this fat pad becomes less prominent during adulthood. With old age, the buccal fat pad undergoes involution, is far less prominent, and can descend, contributing to the heaviness of the jowls.

The Submental or Digastric Triangle

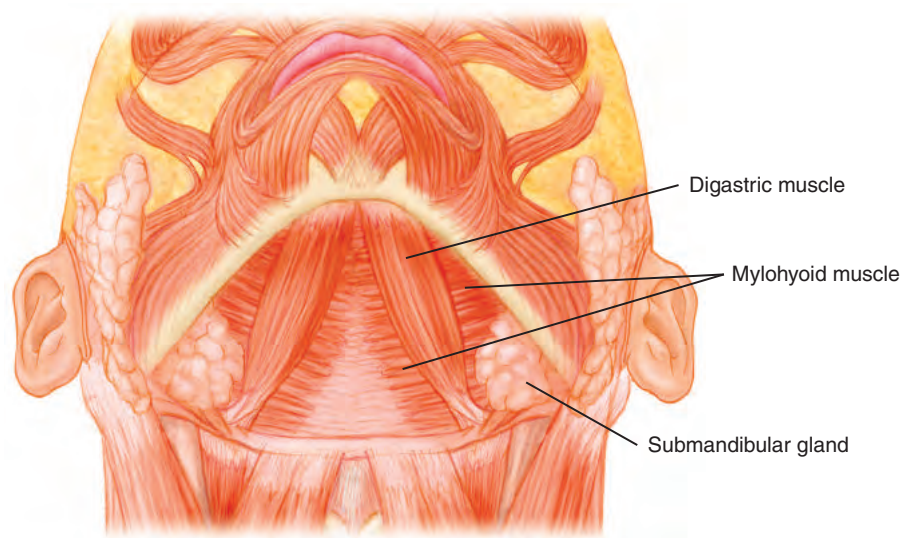


With greater interest in subplatysmal procedures to improve neck contouring, the anatomy of the submental triangle has gained importance. Two sides of the submental triangle are made up of the anterior belly and posterior belly of the digastric and ramus; the mandible makes up the third side. Within this triangle deep to the platysma lie the subplatysmal fat, the submandibular gland, the facial artery and vein, the lingual nerve, and the marginal mandibular branch of the facial nerve. There are also a number of lymph nodes within this triangle.

Mylohyoid Muscle

The mylohyoids are a pair of flat triangular sheets of muscle originating from the mylohyoid line of the mandible. The fibers run forward and downward toward the insertion, posteriorly into the hyoid and anteriorly into a fibrous raphe that extends from the mentum to the hyoid. These paired muscles compose the muscular support of the floor of the mouth and constitute the medial side of the submental or digastric triangle.

Submandibular Gland



The submandibular gland is a bilobed structure with a large superficial lobe and a much smaller deep lobe. The lobes are attached to each other along the posterior border of the mylohyoid muscle. The bulk of the gland lies under the body of the mandible and extends down to the tendinous junction between the two bellies of the digastric. The gland is encased in a connective tissue capsule. The relations of the superficial part of the gland are as follows:

- Anterior lies the anterior belly of the digastric muscle

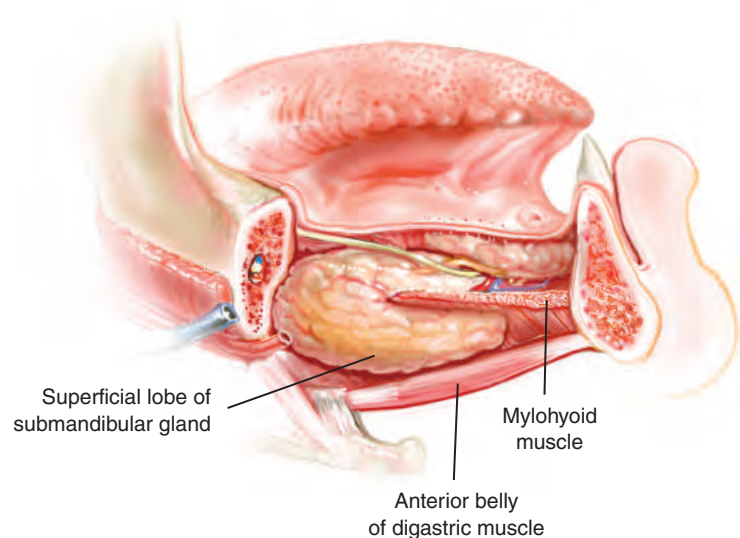
- Posterior lie the posterior belly of the digastric and the stylohyoid muscles

- Medial lie the mylohyoid, hyoglossus, and the lingual and hypoglossal nerves

- Lateral lie the body of the mandible, the platysma, and the cervical branch of the facial nerve

- The facial artery crosses the posterior and superior aspect of the gland

Functional Significance



The contents of the submental or digastric triangle all lie deep to the platysma and in neck contouring or rejuvenation constitute the deepest layer of the neck. Removal of subplatysmal fat, partial tangential or complete excision of the anterior belly of the digastric muscle, and partial excision of the superficial lobe of the submandibular gland all constitute deep plane neck procedures and contribute to neck recontouring.

Although fat and digastric muscle excision is relatively straightforward, the excision of the superficial lobe of the submandibular gland may cause concern because of the intimate relationship of the gland to the facial artery, cervical and marginal mandibular branches of the facial nerve, and the lingual nerve. However, since the gland is encased in a sheath or capsule, intracapsular dissection of the gland is relatively safe.

Concluding Thoughts

My fascination with anatomy first began in medical school, when I recognized the beauty and complexity of the body's anatomic structures. I well remember one of my professors telling me that I would learn anatomy three times and forget it four times. Little did I know how true that statement was. Over the span of my career, I have not only learned and relearned my anatomy, but also have grown to recognize that this is a topic that requires frequent revisiting if one is to gain familiarity with anatomic structures, their relationships, and the intricacies of their vasculature and innervation. Perhaps it was this fascination with anatomy that led me into a career as a surgeon. Regardless, it is knowledge of anatomy that is the foundation of all of the surgical procedures that I perform today.

A detailed knowledge of the anatomy of the face is essential to appreciate the aging process and the resulting changes in facial appearance. Armed with this understanding, we can successfully develop strategies for rejuvenation. Understanding of the planes of the face and the contents of each of these planes enables the surgeon to satisfactorily and confidently operate on facial tissues to restore a youthful appearance while minimizing morbidity.

Dissecting with confidence while ensuring the safety of important nerve and vascular structures is the hallmark of an experienced surgeon. With experience, the surgeon also recognizes the fact that variation in anatomy is the rule rather than the exception. Two sides of the same face will vary in symmetry and anatomy, just as the facial anatomy will vary from one individual to another. In addition to naturally occurring anatomic variations, the surgeon must also be prepared to address those resulting from trauma and from previous surgical interventions.

Although anatomy is seemingly static, we would be mistaken to assume that we know all there is to know about this topic. New anatomic insights and details are regularly being described as our understanding of facial anatomy continues to evolve.

Annotated Bibliography

Furnas DW. The retaining ligaments of the cheek. *Plast Reconstr Surg* 83:11-16, 1989.

This article discusses anatomic features and functions of the retaining ligaments of the cheek. With a thorough knowledge of this anatomy, surgical landmarks can be identified and anatomic disorientation during facial dissection can be avoided.

Knize DM. An anatomically based study of the mechanism of eyebrow ptosis. *Plast Reconstr Surg* 97:1321-1333, 1996.

The development of eyebrow ptosis with aging is commonly attributed to progressive laxity of scalp and forehead soft tissues. However, if change in eyebrow position resulted entirely from tissue stretching, uniform lowering of the medial and lateral eyebrow segments should occur. Clinical observations show that the lateral eyebrow segment usually becomes ptotic earlier than the medial segment, indicating that a more complex mechanism exists. To clarify the development of eyebrow ptosis, the author performed anatomic and histologic studies on 20 (40 half-head) fresh cadaver specimens. The studies confirmed that the mechanism producing eyebrow ptosis has a relatively greater effect on the lateral eyebrow segment. The interaction of structures and forces contributing to the mechanism producing eyebrow ptosis is also discussed. Derived concepts can be applied to the execution of the forehead lift procedure.

Knize DM. Reassessment of the coronal incision and subgaleal dissection for foreheadplasty. *Plast Reconstr Surg* 102:478-489; discussion 490-492, 1998.

The subgaleal plane is the most commonly used dissection plane for foreheadplasty to-day. However, some surgeons have begun to advocate using the subperiosteal plane, and controversy surrounds the question of which dissection plane is more surgically sound for raising a forehead flap. On the basis of 25 fresh cadaver dissections and more than 20 years of clinical experience with foreheadplasty, the author concludes that dissection done at the subperiosteal rather than the subgaleal plane provides greater benefit to the patient.

Mendelson BC, Freeman ME, Wu W, et al. Surgical anatomy of the lower face: the premaseter space, the jowl, and the labiomandibular fold. *Aesthetic Plast Surg* 32:185-195, 2008.

The authors describe the premaseter space, an avascular cleavage plane that contains vital structures through which sub-SMAS dissection can be performed safely and easily. They conclude that the premaseter space should be considered the preferred dissection plane for lower (cervicofacial) face lifts.

Mendelson BC, Muzaffar AR, Adams WP. Surgical anatomy of the midcheek and malar mounds. *Plast Reconstr Surg* 110:885-896; discussion 897-911, 2002.

The authors describe the anatomy of the midcheek to explain midcheek aging and malar mounds. Their cadaver study located a glide plane space overlying the body of the zygoma. The function of this space, together with the anatomic boundaries and anatomic features of this area, determine the characteristic aging changes that occur in this region and explain malar mounds. The authors also discuss the surgical implications of this anatomy.

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Mitz V, Peyronie M. The superficial musculo-aponeurotic system (SMAS) in the parotid and cheek area. *Plast Reconstr Surg* 58:80-88, 1976.

The authors investigated the SMAS in the parotid and cheek areas by anatomic dissections, radiographs, and histological sections. They conclude that the SMAS may be helpful in corrective surgery for facial palsy and during face-lift operations if a retrofascial approach is used. However, this procedure, safe in the parotid area, can become dangerous in the area anterior to the parotid gland.

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This study documents the anatomy of the deep attachments of the superficial fasciae within the temporal and periorbital regions. Knowledge of these relationships allows the surgeon to use the tissue planes and soft tissue ligaments as intraoperative landmarks for the vital neurovascular structures. This results in improved efficiency and safety for aesthetic procedures in these regions.

Rohrich RJ, Pessa JE. The fat compartments of the face: anatomy and clinical implications for cosmetic surgery. *Plast Reconstr Surg* 119:2219-2227; discussion 2228-2231, 2007. *The authors investigated the partitioning of subcutaneous fat of the face in multiple independent anatomic compartments by performing 30 hemifacial cadaver dissections. They found that the nasolabial fold is a discrete unit with distinct anatomic boundaries. What has been referred to as malar fat is composed of three separate compartments: medial, middle, and lateral temporal–cheek fat. The forehead is similarly composed of three anatomic units, including central, middle, and lateral temporal–cheek fat. They concluded that the concept of separate compartments of fat suggests that the face does not age as a confluent or composite mass. Shearing between adjacent compartments may be an additional factor in the causes of soft tissue malposition.*

Rohrich RJ, Pessa JE. The retaining system of the face: histologic evaluation of the septal boundaries of the subcutaneous fat compartments. *Plast Reconstr Surg* 121:1804-1809, 2008.

The authors studied the histology of the septal boundaries between several adjacent fat compartments. They found that fibrous condensation of connective tissue formed diffusion barriers. These septa originated from underlying fascia and inserted into the dermis of the skin. A septal barrier originated from the fascia of the frontalis muscle, so these septal barriers are not necessarily related to the superficial musculoaponeurotic system but can occur anywhere between superficial fascia and skin. Their findings support the concept that subcutaneous fat is compartmentalized, specifically by fascial condensations that travel from superficial fascia to dermis. These septa form an interconnecting framework that limits shearing forces on the face. This framework provides a “retaining system” for the human face. Implicit in this concept is the suggestion that the face ages three-dimensionally, with separate compartments changing relative to one another by both position and volume.

Rohrich RJ, Pessa JE, Ristow B. The youthful cheek and deep medial fat compartment. *Plast Reconstr Surg* 121:2107-2112, 2008.

This article explores the concept of pseudoptosis as a mechanism of midfacial aging: diminished volume of a specific deep fat compartment leads to an excess skin envelope and the illusion of a more prominent nasolabial fold. The anatomy of this deep fat compartment, and of two others, is described.

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The authors demonstrate that superficial fat in the face exists in distinct anatomic compartments. These fat compartments are separated by fascial septa that arise from the superficial fascia and insert into the dermis. Perforating vessels arising from deep arteries travel through these septa to supply the skin and define the overlying vascular territories or angiosomes.

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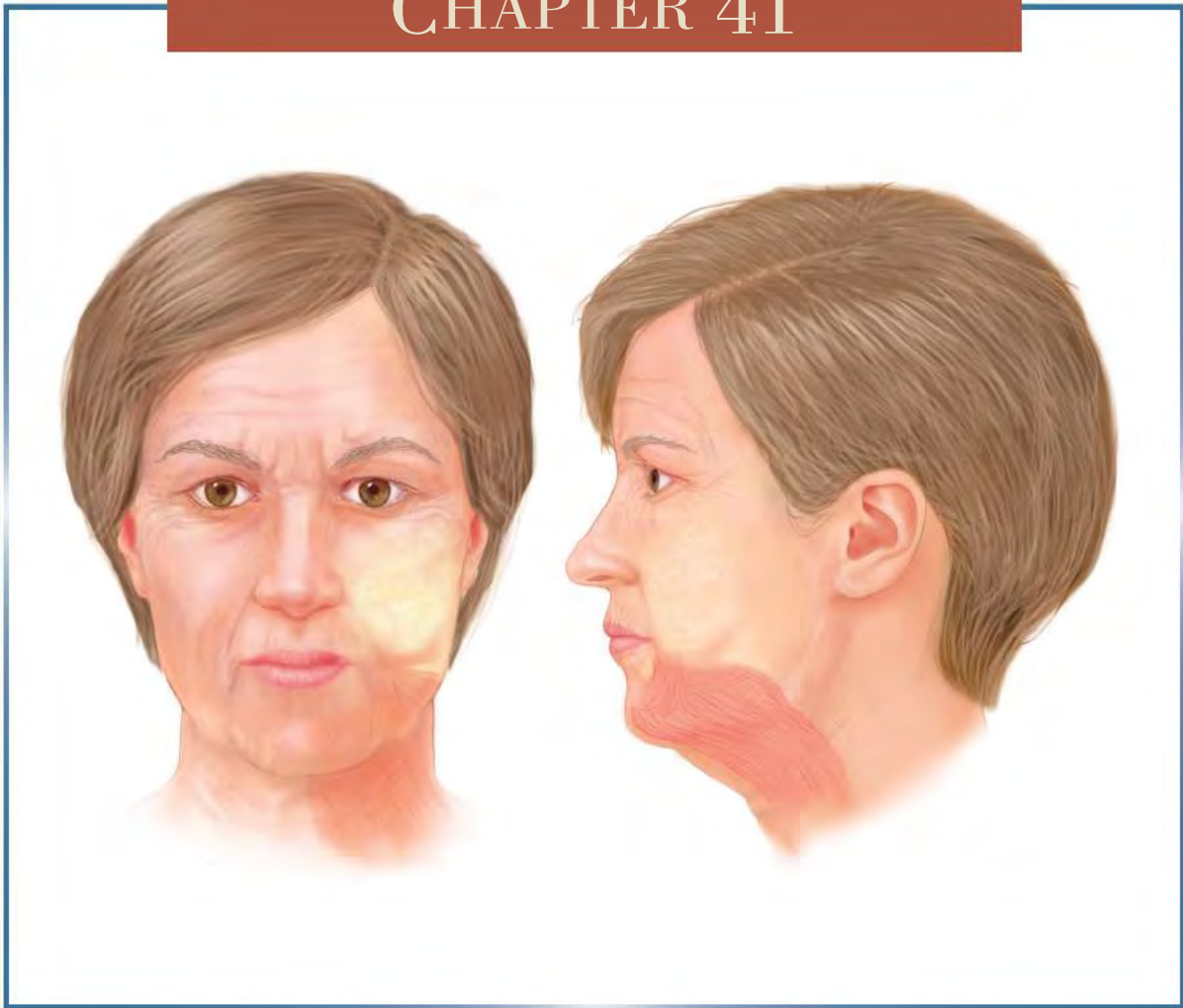
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CHAPTER 41

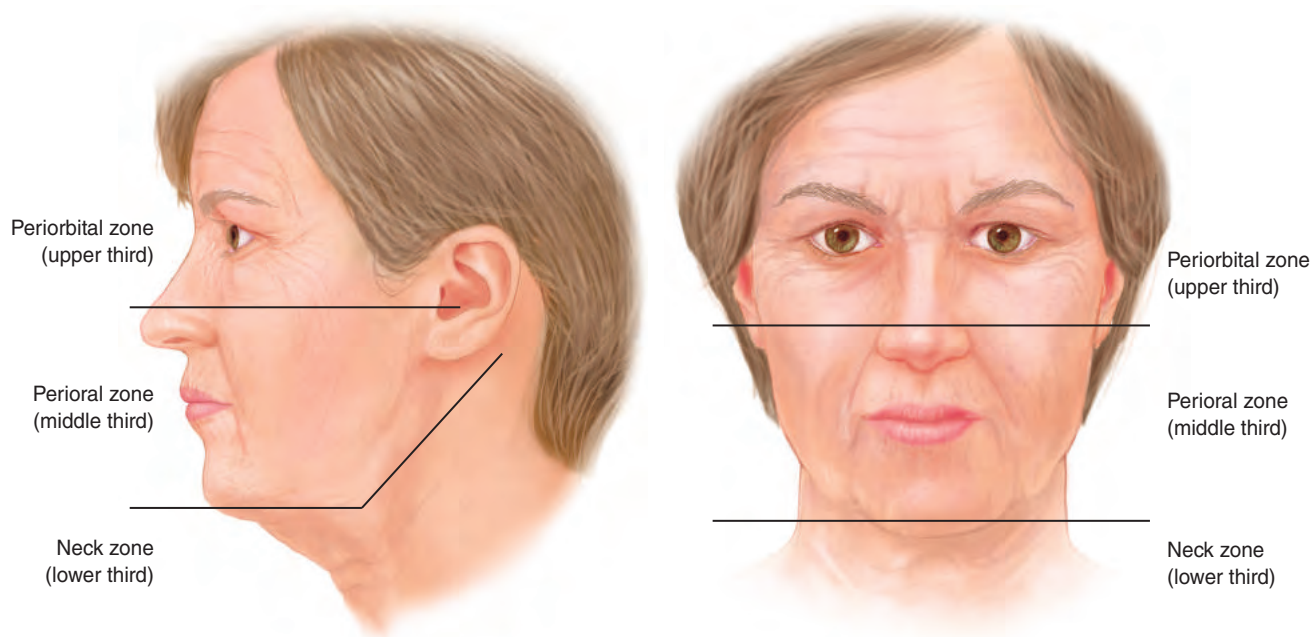


Clinical Decision-Making in Face Lift and Neck Lift

FOAD NAHAI

Evaluation

Not all faces age in the same way, nor do they require the same procedures for rejuvenation. The degree of volume loss, tissue descent, and skin changes will vary. Each face ages individually, with some areas remaining more youthful than others. I evaluate the entire face, assessing skin quality, volume, and descent. For descriptive purposes, I think of the face in terms of the three zones: periorbital, perioral, and neck.



The forehead, brow, and upper midface make up the *periorbital zone*; the lower part of the face—nasolabial folds, lips, jowls, and chin—is called the *perioral area*; and the jawline, submental area, and neck are referred to as the *neck zone*. I also think of these three zones as dividing the face and neck into upper, middle, and lower thirds.

Ideally, I prefer to rejuvenate all three zones simultaneously to restore a youthful appearance with a harmonious transition from zone to zone. Most of the time, however, patients request improvement in one zone or only one component of a given zone. Many patients who would be excellent candidates for full facial rejuvenation say, “I just want my eyes or my neck done.” Another typical request is, “I know I could use a face lift, but I just want to get rid of my baggy eyelids.” These patients require an explanation of the aging process so they will understand that it is best to

address an entire zone rather than individual components of a zone. It is even better to address all three face and neck zones rather than only one. Nevertheless, some patients truly need rejuvenation of only one zone rather than of the full face. In these patients, the aging process has advanced more rapidly in one zone than in the others.



In this 56-year-old patient, aging affected all three of the facial zones. She underwent an endoscopic brow lift, upper and lower blepharoplasty, and face and neck lift. Her postoperative result demonstrates harmonious rejuvenation of all three facial zones.



The signs of aging are not as far reaching in this 48-year-old patient. Her facial aging was confined mostly to the upper third, or periorbital zone. She underwent an endoscopic brow lift and upper lid blepharoplasty with transpalpebral midfacial rejuvenation. Her postoperative result also demonstrates harmonious facial rejuvenation, even though the surgical correction was far more limited.

When a patient expresses interest in a procedure involving only one zone, I advise her or him about how the overall result could be enhanced by adding procedures involving adjacent zones. Doing so avoids a patchwork effect in which a rejuvenated periorbital area leads into an aging lower face and neck. The patient's motivation for seeking less rather than more may be financial, or could be related to a fear of surgery and anesthesia, or the patient may have a genuine lack of concern about the rest of the face compared with the area in question. The surgeon should initiate an open discussion of the patient's wishes, concerns, and fears so the patient will be pleased rather than disappointed with the results. When examining a candidate for face-lift surgery, I first determine which zones require intervention and whether the aging process has affected the face equally. For example, is the most striking feature of this aging face the neck, the midface, or the brow? Or are they all equally involved?

Facial aging involves more than sagging, wrinkling skin with shifting soft tissue; most of these patients have also lost volume. An aging face in a thin patient looks much older than an equally aged full face in an overweight patient. This is obviously related to loss of volume. After my initial impression, I evaluate the skin, each zone, and the components of each zone according to my mental checklist.

Facial Skin

The evaluation includes an assessment of skin quality and skin excess, along with the presence of rhytids at rest and on animation. I look for signs of photoaging and sun-related dyschromia. I assess the skin's thickness and elasticity and make a mental note of where the excess skin is and whether the excess is real or apparent.

Checklist for Evaluating the Aging Face—Facial Skin

Quantity	Quality	Rhytids
<i>Visible skin excess</i>	<i>Thickness</i>	<i>At rest</i>
	<i>Elasticity</i>	<i>On animation</i>
	<i>Photoaging</i>	



This 50-year-old woman has facial aging in all three zones. Her skin quality is rather poor, showing real and apparent excess skin, significant photoaging, and deep rhytids at rest and on animation.



This 51-year-old patient also demonstrates facial aging in all three zones but has better skin quality. Her full, heavy face has more apparent than real excess skin, normal elasticity, and minimal photoaging. No rhytids are visible at rest.

Upper Third of the Face: The Periorbital Zone

Evaluation of the periorbital zone begins with an analysis of the medial and lateral brow position and the relationship of the brow to the upper eyelid. I look at the glabella for lines as well as active and passive rhytids. The temporal brow junction, with the upper cheek–zygomatic area, is evaluated for the presence of deep rhytids (crow’s-feet) and excess skin (see Chapters 27 and 35). I evaluate the upper and lower lids, assessing the skin, muscle, and fat in the lids. After noting the relationship of the upper lid to the brow, I move to the lower lid, noting the relationship of the lower lid to the cheek and the transition from the periorbital to the perioral zone. Lower lid tone is assessed. The volume of the cheek and midface area is also noted.

Checklist for Evaluating the Upper Third of the Face/Periorbital Zone

Brow position	Lower eyelid
<i>Lateral</i>	<i>Skin</i>
<i>Medial</i>	<i>Muscle</i>
Glabella	<i>Fat</i>
<i>Depth of rhytids</i>	<i>Lid-cheek junction</i>
<i>Muscle activity</i>	<i>Lid tone</i>
Upper eyelid	Nasolabial folds
<i>Skin</i>	Transition to perioral zone
<i>Muscle</i>	Soft tissue volume
<i>Fat</i>	
<i>Relationship to brow</i>	

Middle Third of the Face: The Perioral Zone

The perioral area, or middle third, is evaluated next. The nasolabial folds and marionette grooves are categorized by noting their depth at rest and when smiling (see Chapter 9). The angle of the mouth is noted. The lips are evaluated for volume and length of the upper lip. With aging, the lips lose a significant amount of volume and the distance from the nose to the upper lip vermilion lengthens, leading to a loss of definition of the philtral columns. Lip lines are noted. I specifically look at the depth of the chin crease for chin ptosis and evaluate the jowls. I also evaluate the role of the mandibular ligament in the aging appearance in this area. The nose, especially the tip, often becomes ptotic with aging.

Checklist for Evaluating the Middle Third of the Face/Perioral Zone

Nasolabial folds and marionette grooves	Lower lip
Angle of the mouth	<i>Volume</i>
<i>Downward</i>	<i>Lip lines</i>
<i>Neutral</i>	Chin
<i>Upward</i>	<i>Chin crease</i>
Upper lip	<i>Chin ptosis</i>
<i>Volume</i>	Jowls
<i>Length</i>	Nose
<i>Philtral columns</i>	<i>Tip ptosis</i>
<i>Lip lines</i>	

Lower Third of the Face: The Neck Zone

In assessing the quality and quantity of the neck skin, I look for excess skin below the thyroid cartilage and over the sternocleidomastoid muscle. A judgment is made as to whether the submental skin excess is real or apparent. I then look at the jawline, submental area, and neck-jaw angle and their relationship to each other. Assessment of the submental and neck fat includes the subcutaneous fat and the subplatysmal fat. I differentiate between subcutaneous and subplatysmal fat by pinching the submental area at rest and then after contraction of the platysma muscles.

Checklist for Evaluating the Lower Third of the Face/Neck Zone

Skin	Fat
<i>Quality</i>	<i>Subcutaneous/preplatysmal</i>
<i>Quantity</i>	<i>Subplatysmal</i>
– Real excess	<i>Platysma bands</i>
– Apparent excess	<i>Jawline</i>
	<i>Neck/jaw angle</i>
	<i>Digastric muscles</i>
	<i>Submandibular gland</i>



Evaluation of excess skin of the neck and platysma bands with the patient at rest



Evaluation of platysma bands on animation



Evaluation of the location of submental fat, pinching the submental area at rest

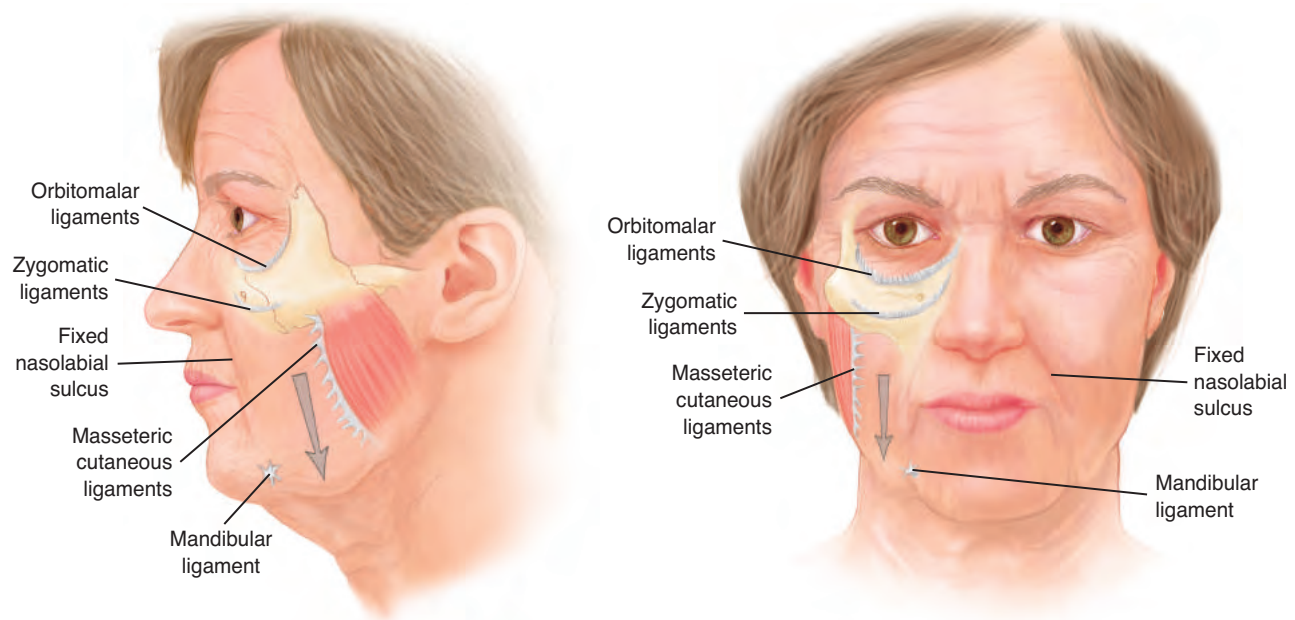
Subcutaneous versus platysma fat is assessed by pinching the submental area during contraction

The platysma bands are evaluated. The submandibular gland and digastric muscles are assessed by looking for a bulge below the mandibular rim within the submandibular triangle, especially on neck flexion.

Facial Adhesions and Retaining Ligaments

Determining whether the facial ligaments and adhesions should be released is an important step in planning surgical rejuvenation of the face.

Proper elevation and rejuvenation of the periorbital area depends on the appropriate release of a number of temporal adhesions and attachments, regardless of the degree of brow ptosis or facial aging. In contrast to the face, these temporal adhesions and attachments are not visible and cannot be assessed clinically.



Retaining ligaments of the midlateral face can be assessed clinically. These ligaments maintain the facial skin in its normal anatomic position. Stuzin et al described two types of retaining ligaments: a true osteocutaneous ligament running from a fixed bony origin to the dermis (such as zygomatic and mandibular), and a second system made up of a coalescence of superficial and deep facial fascia fixing the fascial layers to the underlying structures, such as the parotid and masseter, and then attaching superficially to the skin (the parotid cutaneous and masseteric cutaneous ligaments). These ligaments are essentially fixed structures so that facial tissue, especially fat pads, can pivot around them, producing creases such as the marionette lines of the lower face. With age, the ligaments attenuate and relax. This relaxation, along with loss of skin elasticity and soft tissue, causes some of the stigmata of aging. The zygomatic ligaments suspend the malar soft tissues and fat pad over the zygomatic

prominence. As this support weakens, the malar soft tissues gradually migrate downward, and redundant skin hangs over the fixed nasolabial sulcus. Rather than deepening with age, it is the downward migration of the soft tissues against the fixed nasolabial sulcus that accounts for the observed changes. Similarly, attenuation and weakness of the masseteric cutaneous ligaments allow a downward shift of the cheek tissues below the mandibular margin. Tethering by the mandibular ligament forms the jowls.

Clinical evaluation of the face should take note of these ligaments and the role they play in the aging face. Ligaments extending from bone to dermis must be released during a face lift to achieve the desired results. Leaving the masseteric ligaments intact limits lateral mobility. An evaluation of the relevance of these ligaments to the observed aging changes allows the surgeon to plan appropriately for ligament release. Although release of these ligaments is required in most older individuals, it is not always necessary to divide them in younger individuals and in those undergoing limited rejuvenation procedures.

TREATMENT OPTIONS

The Face

I do not believe that there is a face lift for all seasons. However, all described face-lift techniques have five things in common:

1. An incision
2. Flap elevation
3. Vectors
4. Fixation
5. Ancillary procedures

Evaluation of the face leads to selection of the procedure including length and location of the scars, level and extension of dissection or flap elevation, management of the superficial musculoaponeurotic system (SMAS), vectors, volume management, and ancillary procedures. These decisions are based on analysis of the patient's degree of aging, morphology, skin quality and quantity, and, most important, the patient's expectations and my understanding of the anticipated result.

The options include a variety of incisions, different levels of dissection, varying extent of skin undermining, different vectors, and repositioning of the subcutaneous tissues through a number of suspension or plication techniques.

Treatment Options for the Face

Incisions	Extent of skin undermining
<i>Length</i>	SMAS management
<i>Location</i>	<i>Plication</i>
Levels of dissection	<i>Resection and plication</i>
<i>Subcutaneous</i>	<i>Mobilize, resect, and plicate</i>
<i>Subfascial</i>	Vectors
<i>Subperiosteal</i>	<i>Vertical</i>
<i>Combination</i>	<i>Diagonal</i>
	Suspension sutures

Incisions

The length of the incisions varies from liposuction and endoscopic access incisions to the classic full-length face-lift incision. The purpose of skin incisions is to gain access to deeper tissues, resect excess skin, or both.

If the purpose of the skin incision is to allow access to the deeper tissues, and the deep tissue rearrangement renders the desired result without skin excision, these access incisions can be kept to a minimum, as in liposuction and endoscopic procedures. If the desired result cannot be attained through the rearrangement of the deeper tissue without skin excision, a longer skin incision is necessary, and the length of that skin incision will reflect the location of the excess skin to be removed. For example, endoscopic face lifting is achieved without removing any facial skin, whereas short-scar face-lift techniques eliminate the postauricular scar in patients who have no excess skin below the level of the cricoid and posterior to the sternomastoid. However, the success of endoscopic and short-scar procedures depends not only on the location of excess skin but also on the quality and elasticity of the skin. These procedures rely on redraping and redistribution of the skin, especially in the neck. Stretched, inelastic skin, regardless of location—face, breast, or abdomen—will not redrape, redistribute, or retract and must be excised.

The short-scar techniques have increased in popularity as patients demand minimally invasive procedures, with less down time and reduced morbidity. Patient selection is the key, because unless a less-invasive procedure with a shorter scar produces a result comparable to that of standard procedures, is not in the best interest of the patient and may result in loss of the surgeon's credibility. In selecting patients for the short-scar technique, I assess the quality of the neck skin and then evaluate the patient with what I call the "vertical simulation" test. I place my hand on the

side of the patient's face in front of the tragus and pull vertically upward, simulating the vertical vectors of the short-scar face lift. While my hand is elevating this tissue, I observe the junction of the earlobe and neck skin. If there are no folds of excess skin extending posteriorly beyond that area, the patient is an excellent candidate for a short-scar face lift. If there is excess skin or if a fold develops there, the patient is best suited for a full-scar procedure. Additionally, this test also enables me to evaluate the neck and submental area and determine whether I will make a submental incision or not by observing the neck during the vertical simulation test.



For example, these images depict an ideal candidate for a short-scar face lift. The vertical vector, as demonstrated by the examiner's hand, does not result in any folds of excess skin behind the earlobe, and the improvement seen in the submental area obviates the need for a submental incision.



In contrast, these images show an individual who would not be a candidate for a short-scar face lift, because the vertical vector demonstrated by the examining hand results in folding of excess skin beyond the earlobe, and the lack of improvement in the submental area and jawline indicates the need for a submental incision and a central approach to neck recontouring.

Location

The scar location depends on the patient's facial structure, including the hairline, sideburns, skin color, and ear topography.

Temple Incision

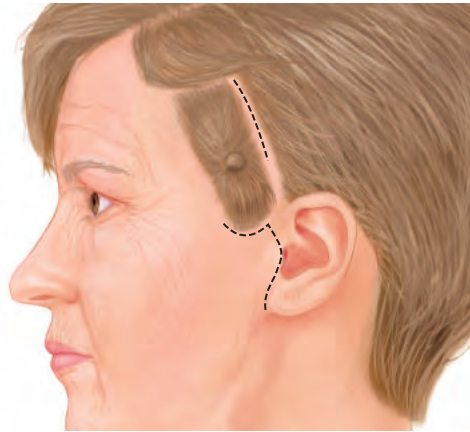


Incision behind the temporal hairline

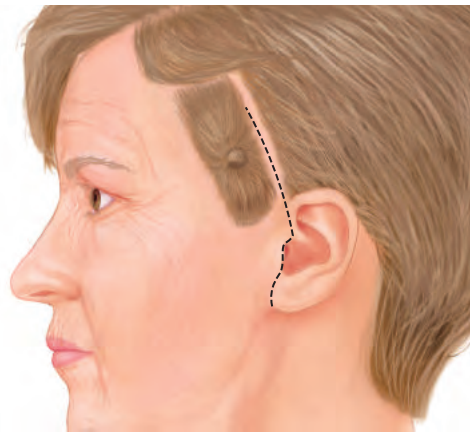


Prehairline incision

The options include placement of the incision 2 to 3 cm behind the temporal hairline or right at the temporal hairline. This decision is based on the distance between the lateral canthus and the anterior part of the temporal hairline, which ideally should be 3 to 5 cm. To maintain this ideal distance, the excess skin over the upper cheek is assessed. This excess skin will be recruited and rotated upward when the face-lift flap is elevated. If resection of excess cheek skin through the incision behind the temporal hairline would widen the distance between the hairline and lateral canthus, I prefer a prehairline incision to maintain a natural 3 to 5 cm distance. Widening beyond 5 cm results in an unnatural or “operated-on” appearance. When resection of the excess cheek skin would not shift the temporal hairline posteriorly or widen the distance between the hairline and lateral canthus, the incision can safely be placed behind the hairline. This placement is of more significance in men than in women.



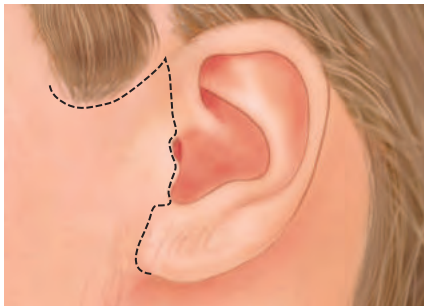
Incision behind the temporal hairline



Prehairline incision

In patients with short sideburns, I prefer the prehairline incision to avoid elevation or elimination of the sideburns through the vertical shift of facial skin. In secondary face lifts I make a prehairline incision, because most of these patients already have shortened sideburns.

Preauricular Incision

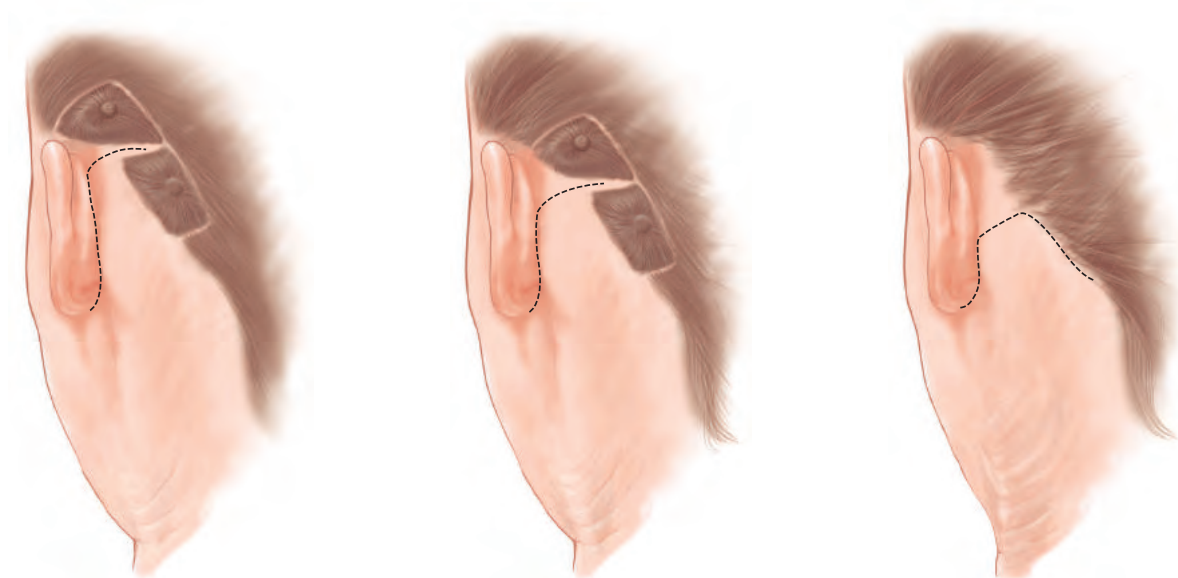


The incision in the preauricular area is made in the anatomic margin between the ear and the face rather than in front of it. Not only the color but also the texture and thickness of the ear skin vary from that of facial skin.

To mask this difference, a curved incision along the curve of the anterior border of the helix is made to the upper border of the tragus. At this juncture, the incision may be curved in front of the tragus or along the posterior border of the tragus; then it fol-

lows the sulcus between the earlobe and the cheek. My preference is for the intratragal incision along its posterior border but not behind the tragus. A well-executed intratragal incision is imperceptible compared with a pretragal incision. In the rare patient who has little color difference between the facial and tragal skin, the pretragal incision may serve as well. For a tragal incision to be imperceptible, the tragus has to have a beginning and an end and not blend into the cheek at the lower border. The inferior tragal border must be preserved. The prominence of the tragus plays a role in selecting the intertragal incision. The more prominent the tragus, the better the rest will be. A flat tragus may retract forward and lead to enlargement of the external auditory meatus. Special attention must be paid in men, whose facial skin may be ruddier than the ear skin. In these patients a pretragal incision is preferred.

Retroauricular Incision



A high retroauricular incision crossing to the hairline—best suited to individuals with modest redundancy of neck skin with normal skin elasticity

A lower retroauricular incision crossing to the hairline—best suited to individuals with modest to excessive redundancy of neck skin with some loss of skin elasticity

An occipital hairline incision—best suited to individuals with excessive or massive skin redundancy, especially in the lower neck with stretched, inelastic skin

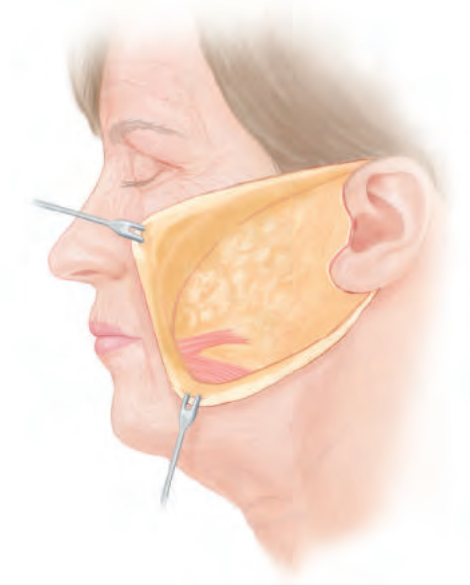
I used to make retroauricular incisions only in patients with inelastic or stretched neck skin with excess skin below the cricoid and posterior to the sternomastoid, but now I rely on the vertical simulation test to determine the need for a retroauricular incision. This incision is best placed within the retroauricular sulcus. The upward length is not only a matter of personal preference but of practical importance. I vary it according to my estimate of the amount of skin to be removed. The less skin that is being removed, the longer I make this retroauricular incision before taking it transversely across into the occipital hairline. In patients with an excessive amount of redundant skin, I take this incision across to the occipital hairline and then follow it downward. I discuss these options with patients so they understand the incisions are being altered to achieve a better result.

Choosing the Best Option

Features	Face Lift: Incision Options		
	Prehairline	Prehairline With Discontinuous Temporal Incision	Temporal Continuous With Preauricular Incision
Sideburns			
High or short			
Low or long			
Hairline			
Anterior: Lateral canthus to hairline distance 3 to 5 cm			
Posterior: Lateral canthus to hairline distance >5 cm			
Secondary Face Lift			

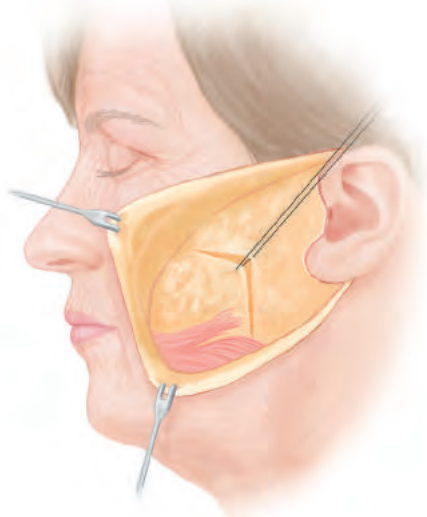
Levels of Dissection

Subcutaneous



I personally do not perform a subcutaneous face lift and believe that few surgeons do. The subcutaneous dissection serves two purposes: access to deeper tissues (SMAS) and skin resection. All modern face-lift techniques include various degrees of skin undermining. Extensive skin undermining to release the nasolabial fold and mandibular retaining ligaments, although effective, can increase the risk of vascular compromise and hematoma.

Subfascial

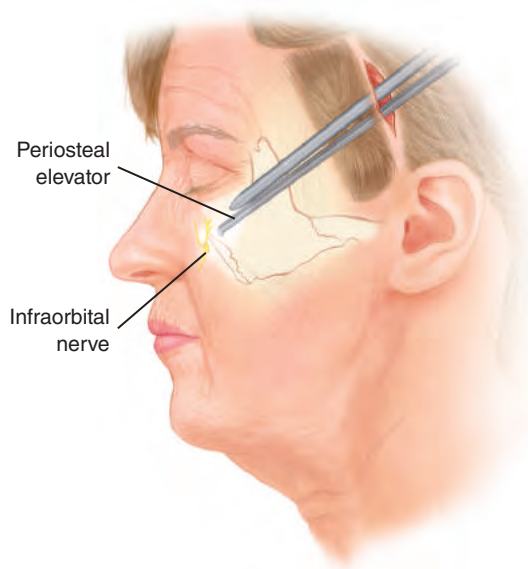


Most modern face lifts include some form of subfascial or sub-SMAS dissection. The extent of this dissection varies from technique to technique. The vectors and methods of plication also vary from surgeon to surgeon. I rely heavily on SMAS mobilization and a vertical vector for improvement of the perioral area, jowls, and jawline.

Low dissections of the SMAS have a limited effect on the upper midface and periorbital area. High SMAS dissections dramatically improve the upper midface and periorbital area.

In thin faces, I try to preserve the SMAS; in heavy faces, I resect it. I plicate the SMAS or undermine and plicate as necessary. My preference is to incise the SMAS not immediately preauricular, as in some described techniques, but at the junction of the mobile and fixed SMAS. This avoids dissecting the very thin SMAS in the preauricular area. My decision to plicate or to mobilize and plicate the SMAS depends on its mobility. I pick the SMAS up at the junction of the fixed and mobile SMAS and pull it superiorly while observing the effect on the jawline and perioral area. If the pull provides the desired effect, I simply plicate (in thin faces), or resect and plicate (in heavy faces). However, if pulling without mobilization does not produce the desired effect, I incise and mobilize the SMAS until the desired effect is observed.

Subperiosteal

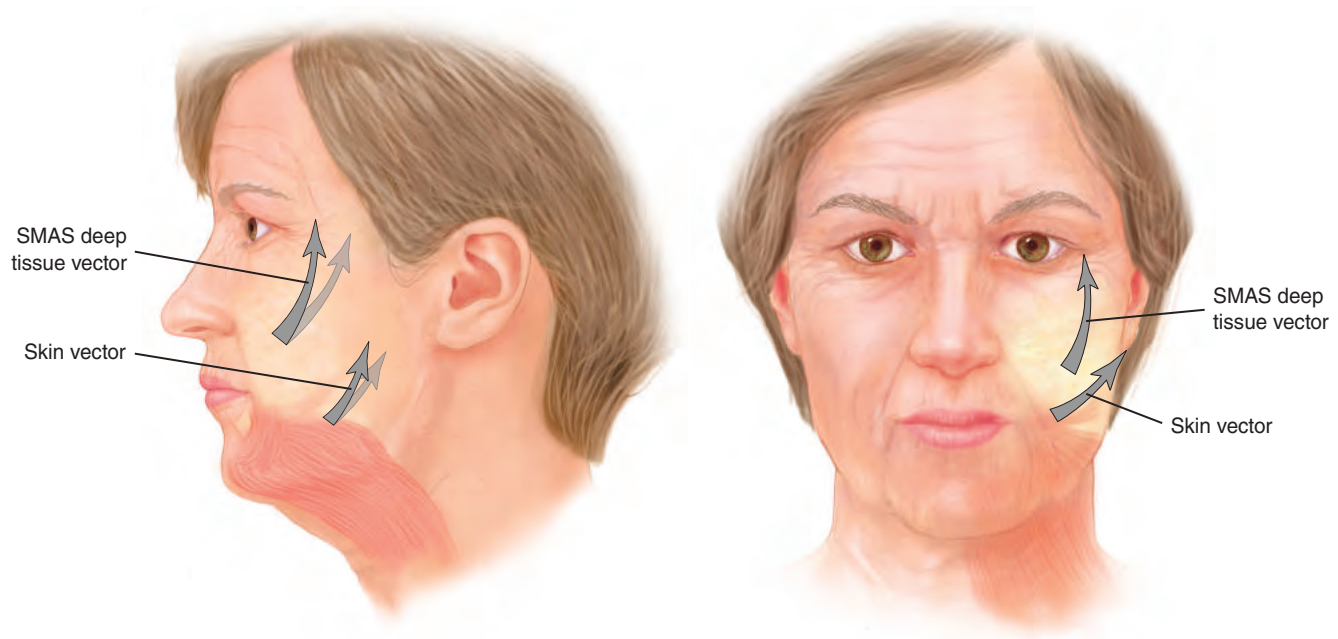


The advantage of the subperiosteal approach to the midface is its relative ease, speed, and safety. The facial nerve branches are less at risk with this approach; however, it is limited in its effects on the lower face, jawline, and jowls. The subperiosteal approach depends on suspension sutures to maintain the result.

Combinations

The subperiosteal and subfascial or subperiosteal and subcutaneous levels of dissection can be combined in a variety of ways. Examples include a subperiosteal approach to the periorbital area and midface and a sub-SMAS approach to the perioral area and jawline.

Vectors



Most modern face lifts include a separate vector for the skin and deeper tissues. The deeper tissues are elevated in a more vertical or diagonally vertical vector and the skin in a more posterior and vertical direction. The vertical vector on the SMAS improves the jawline, the perioral area, and, with the high SMAS technique, the midface. The more diagonal vector on the platysma improves on the neck and submental area. With a short-scar face lift, the skin vector is vertical, but the vector on the SMAS and platysma can be varied.

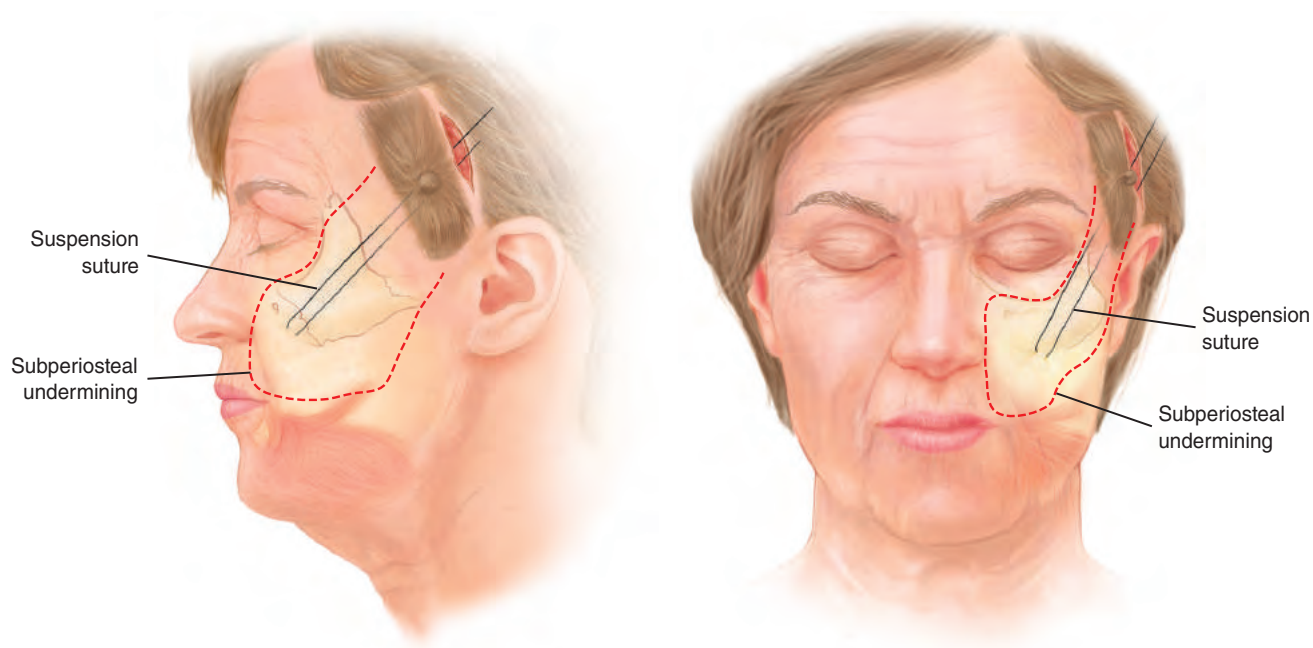
Choosing the Best Option

Regional Effects	Face Lift: Levels of Dissection						Suspension Sutures and Devices
	Subcutaneous	Subfascial				Subperiosteal	
		Standard SMAS	High SMAS	Extended SMAS	SMASectomy		
Periorbital	+	+	++++	++	++	++++	++++
Cheek and nasolabial folds	++	++	++++	++++	++++	++++	++++
Jowls and jawline	++	++++	++++	++++	++++	+	+
Neck		++	+++	+++	+++	+++	
Vectors	Diagonal	Vertical	Vertical Diagonal	Vertical Diagonal	Vertical Diagonal	Vertical Diagonal	Diagonal Diagonal
Risks							
Skin flap viability	++++	++	+	+	+		
Facial nerve	+	++	++++	++++	++		

Degree of effectiveness indicated by the number of pluses.

Sutures

Suspension



Most endoscopic and subperiosteal midface techniques require suspension sutures or other devices to elevate and hold the soft tissues in the desired position. Although usually effective, these sutures are not risk free; a disadvantage is that the fixation point is far removed from the tissue being fixed.

Ancillary Procedures

Ancillary procedures include volume management and resurfacing. These are performed almost routinely in all of my facial rejuvenation procedures to enhance the overall result. Although in the past the actual face lift was the end result, today many of us feel that the face lift lays the foundation, and the ancillary procedures that are performed concomitantly represent the finishing touches that result in true rejuvenation rather than simply the rearrangement of soft tissues.

Volume Management

Although volume management usually includes augmentation of tissues, in selected patients I also remove excess volume, especially in the neck and jowls. Alloplastic implants, autologous fat, and fillers are available for volume enhancement. By far the most popular material of choice for volume enhancement is autologous fat. In some patients, volume enhancement with fat transfer has become routine. Alloplastic materials such as chin and cheek implants may be preferable to fillers or autologous fat in selected patients. Fillers are also an acceptable alternative to autologous fat for volume enhancement.

The buccal fat pad is very prominent in some heavy faces and must be addressed to recontour the perioral area and jawline. The buccal fat pad can be approached either through the face-lift incision deep to the platysma or through an intraoral incision. I have resected the buccal fat pad as an isolated procedure in heavy, youthful faces (those that present a cherubic appearance) and in primary as well as secondary face lifts for recontouring. Despite the intimate relationship of the superficial portions of the buccal fat pad with the facial nerve, I have found this procedure to be both safe and effective. Although I rarely resect the buccal fat pad, in the right patient it has a dramatic effect in recontouring the lower face and managing volume.

It is rare and only in a heavy face that I resect fatty tissue. When I do so, it is limited to the jowls. However, in all but the thinnest of necks I resect some fat below the skin, between the platysma or deep to the platysma, depending on the volume of the neck and distribution of the fat in these three layers.

Resurfacing

Rearranging the deep tissues and resecting excess skin does not always result in improvement of the quality of the skin. Sun-damaged, inelastic, wrinkled skin is usually dealt with through resurfacing, concomitant with the face lift. This includes dermabrasion, peels (croton oil or TCA), and lasers. These procedures, when combined with a face lift, are not only effective but also safe if limited to the areas where there has been no skin undermining. The undermined skin may also be treated with dermabrasion, peel, or laser, but cautiously and very superficially. Judgment must be exercised on an individual basis when resurfacing over face-lift flaps.

The Neck

Treatment Options for the Neck

Incisions	Extent of skin undermining
<i>Length</i>	Vectors
<i>Location</i>	<i>Vertical</i>
Levels of dissection	<i>Diagonal</i>
<i>Subcutaneous</i>	Suspension sutures
<i>Subplatysmal</i>	Plication sutures

Incisions

Length

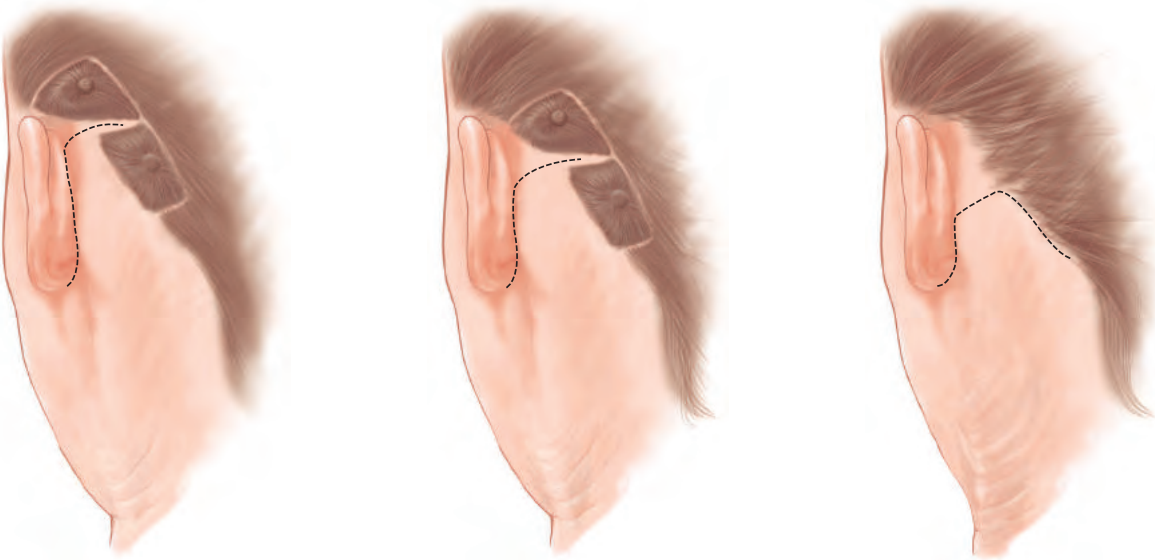
Incisions for rejuvenation and recontouring of the neck range from liposuction access incisions to submental incisions and preauricular and retroauricular incisions. Incision length is dictated by the anatomic and morphologic findings as well as the planned procedure. The submental incision allows access to the medial platysma and subplatysmal structures. The retroauricular incision allows access to the lateral platysma and affords the opportunity for skin resection.

Location



SUBMENTAL My preference for the submental incision, varying in length from 3 to 5 cm, is to place it just posterior to the submental crease. Others prefer to place the incision within the crease. I believe placement within the crease further deepens the

crease and attracts attention to the scar. Posterior placement affords better access to the submental area and allows dissection anteriorly to eliminate or render the submental crease less shallow. This incision also allows access to the chin for correction of the ptotic or “witch’s” chin.



RETROAURICULAR In the isolated neck lift without a face lift, it is sometimes necessary to begin the incision at or below the level of the tragus, continuing around the earlobe and into the retroauricular area to prevent earlobe distortions and improve access to the jawline and neck. In the past I typically reserved retroauricular incisions for patients with inelastic or stretched neck skin with excess skin below the cricoid and posterior to the sternomastoid, but now I rely much more on the vertical simulation test. The best placement is within or just above the retroauricular sulcus. Upward length should be varied according to the amount of skin removal required. The less skin to be removed, the longer I make this vertical component before crossing to the hairline. If neck skin is excessive, I place the incision along the occipital hairline in a downward and backward direction rather than extending it into the hair. These incisions are all planned preoperatively, and their location and alternatives are fully discussed with the patient. I emphasize the benefits of a lower incision in terms of tightening the lower neck skin.

Choosing the Best Option						
Features	Neck Lift: Incision Options					
	Preauricular	Submental	Short in Retroauricular Sulcus Only	Longer Above Level of Tragus Crossing Into Hair	Long to Level of Tragus Crossing Into Hair	Long to Just Below Level of Tragus Then Crossing Down Along Occipital Hairline
Skin Quality						
Normal elasticity						
Inelastic, stretched, sun damaged						
Skin Quantity						
No skin excess						
Apparent skin excess						
Real skin excess						
Planes of Intervention						
Superficial						
Deep to platysma						

Levels of Dissection

Planes of the Neck
Superficial plane
Intermediate plane
Deep plane

I think of the neck as having three planes: superficial (skin and subcutaneous fat), intermediate (platysma and interplatysmal fat), and deep (subplatysmal structures).

Superficial Plane

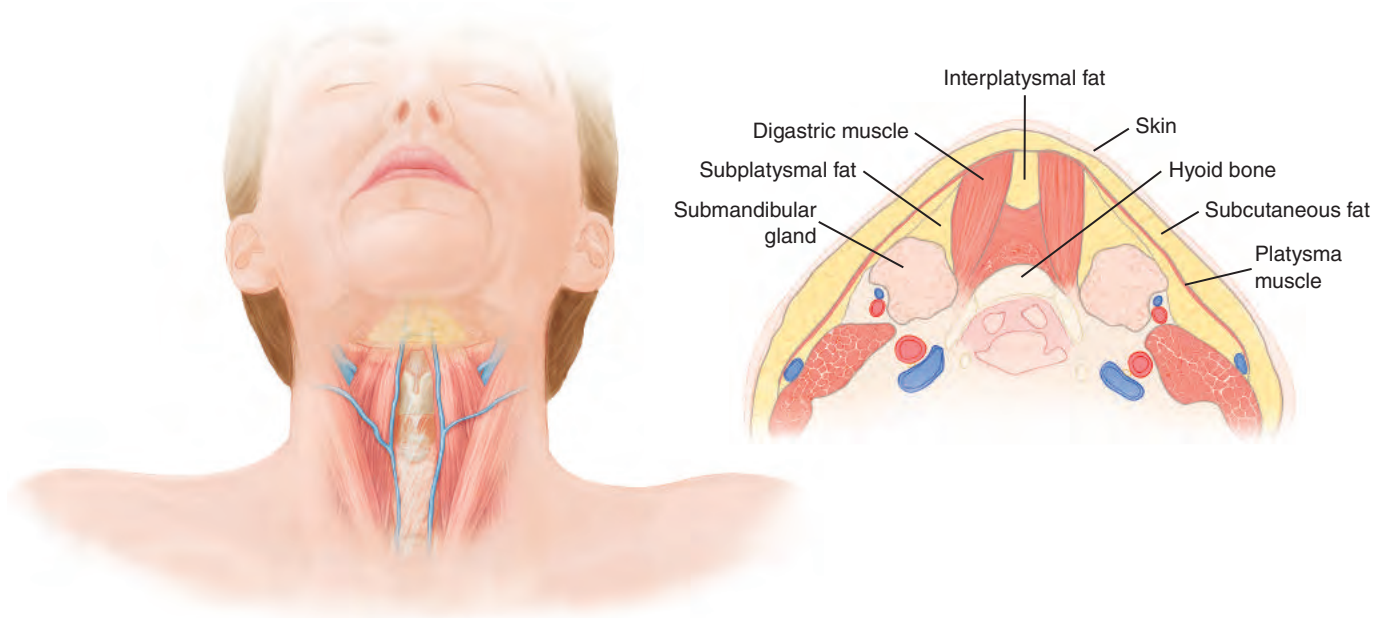


The superficial plane includes the skin and subcutaneous fat; each neck and submental lift includes varying degrees of dissection and undermining in this plane. It is important to leave at least a 3 to 5 mm thickness of fat on the deep surface of the skin, whether the defatting is performed directly or through liposuction. Leaving this layer of fat with a suitable thickness renders a smooth contour to the neck and eliminates the skin irregularities that are seen with aggressive removal of subcutaneous fat. Aggressive removal of fat leads to adherence of the skin onto the platysma. Intervention in this plane is usually combined with interventions in the other two planes, except in individuals who are candidates for liposuction only.

Intermediate Plane

The platysma and the small amount of fat between the medial border of each platysma muscle make up this plane. Plication of the platysma in the midline is the most common procedure at this level. In a patient with a heavy submental area, the intervening fat between these medial borders is resected as necessary. If fat is resected from between the platysma muscles and deep to the platysma, it is important that sufficient fat be left deep to the skin. Removing fat aggressively below the skin, between the platysma muscles and deep to it, leads to an unnatural hollowing of the submental area. Very rarely do I remove fat from all three layers. The more deep fat I remove, the more superficial fat I leave behind.

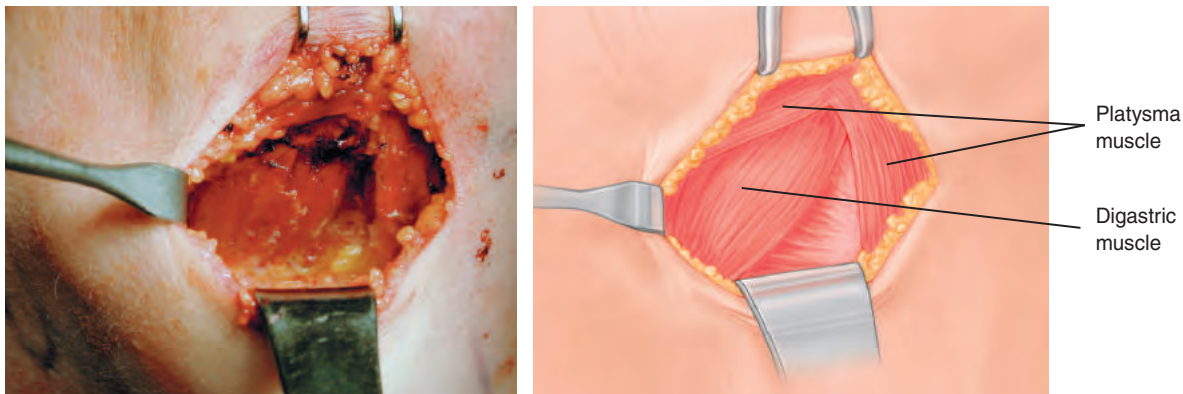
Deep Plane



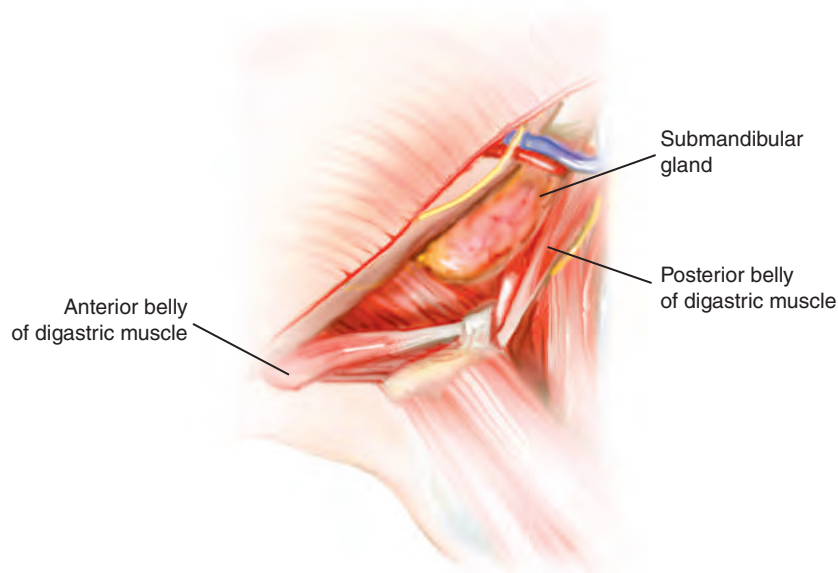
The subplatysmal fat, digastric muscles, and the submandibular gland make up the structures of the deep plane. Resection of the subplatysmal fat, the anterior belly of the digastric muscle, and the superficial lobe of the submandibular gland are the procedures performed in this plane. If needed, a suprahyoid fascial release is also performed in the deep plane.



To distinguish between excessive preplatysmal (subcutaneous) fat and subplatysmal fat, a useful maneuver is to grasp the submental fold between the thumb and index finger and then ask the patient to grimace, thus contracting the platysma muscles. If the fold between the examiner's thumb and index finger is unchanged, the bulk of the fat is subcutaneous; if it diminishes, then the bulk of the fat is deep to the platysma and must be removed in that plane to recontour the submental area.



Once the subplatysmal fat has been dissected, the anterior belly of the digastric muscle is easily viewed. If it appears as a bulge when the patient's neck is flexed, a tangential excision of the anterior belly would further improve the submental contour.



A large submandibular gland is often visible preoperatively. Once the digastric muscle has been identified, the superficial lobe of an enlarged submandibular gland is readily visible. If it bulges further on neck flexion, the superficial lobe can be resected to further enhance neck contour and improve on the visible bulge.

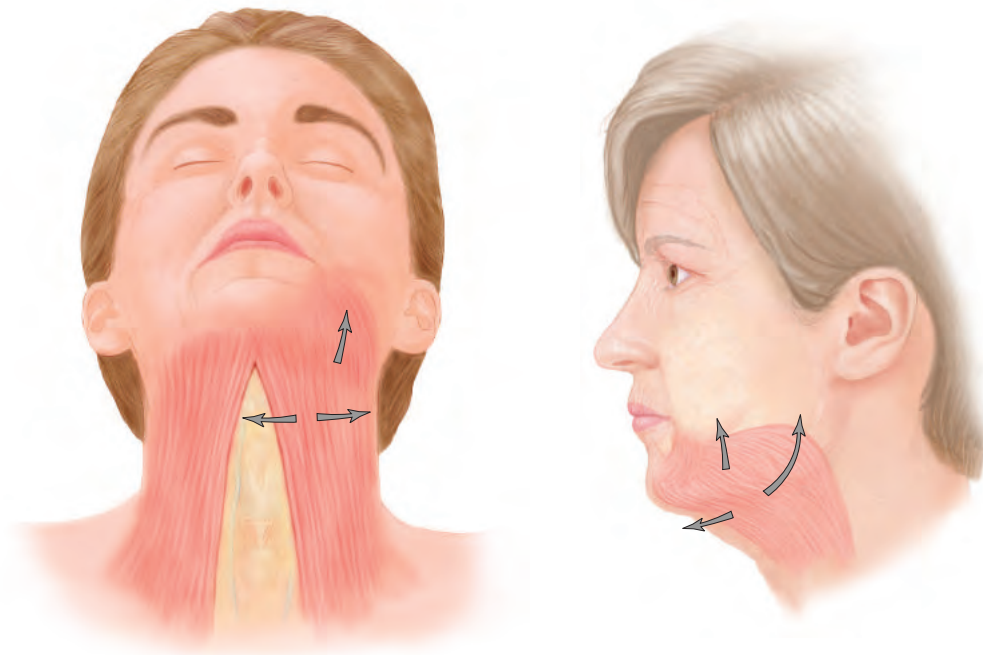
Extent of Skin Undermining

With the exception of liposuction only, extensive neck undermining is the rule to facilitate the redraping of the apparent excess skin of the neck, especially in the submental area. The undermining usually extends from the sternomastoid muscle on each side, across the midline, and down to the level of the thyroid cartilage. More extensive lateral and inferior dissection and undermining may be necessary in some individuals who have an excessive amount of neck skin or inelastic skin.

Choosing the Best Option

Planes or Layers of the Neck	Neck Lift: Incisions and Anatomic Features								
	Incisions		Fat Distribution			Structures			
	Liposuction Access	Submental	Subcutaneous	Interplatysmal	Deep or	Platysma	Digastric Muscles	Sub- mandibular Gland	Hyoid Fascia
					Subplatysmal				
Superficial									
Intermediate									
Deep									

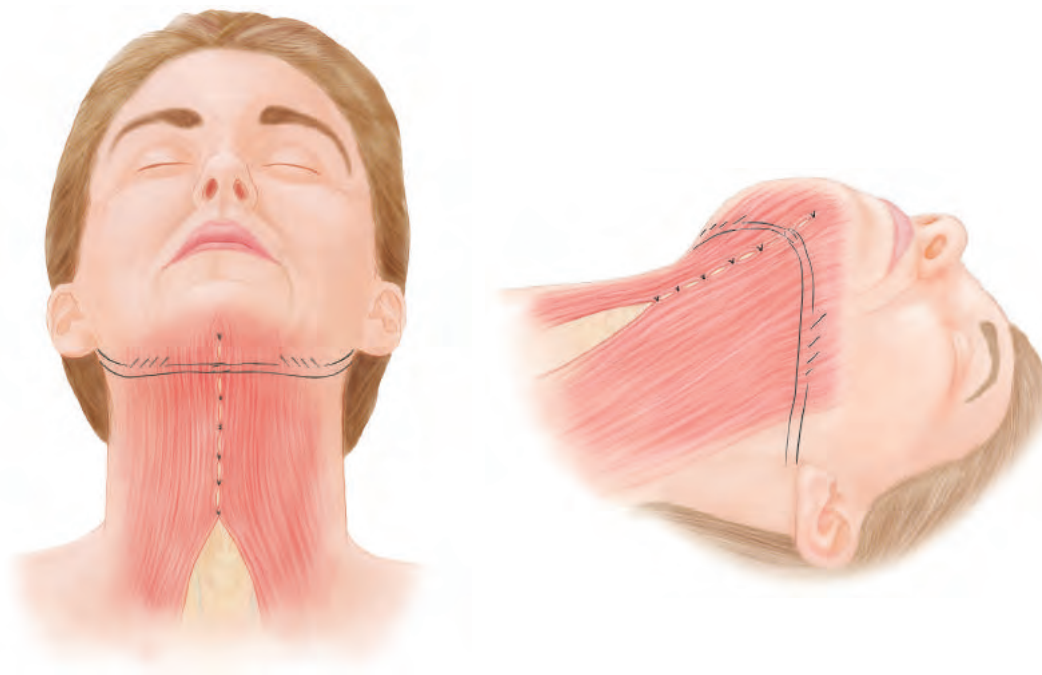
Vectors



The vectors that influence the appearance of the neck and jawline include the vertical vector applied to the jawline through the platysma plication of a face lift. A more diagonal and posterior vector involving the lateral border of the platysma combined with a medial plication of the two platysma muscles defines the submental area and the neck-jaw angle.

Sutures

Suspension Sutures



Suspension sutures running over the platysma and below the mandibular border, designed to define the neck-jaw angle, were described by Guerrerosantos and later popularized by Giampapa. In carefully selected patients, suspension sutures can be effective, but I have found them to be of limited value in individuals with large submandibular glands. In my experience, a more direct approach in the deep plane produces longer-lasting results.

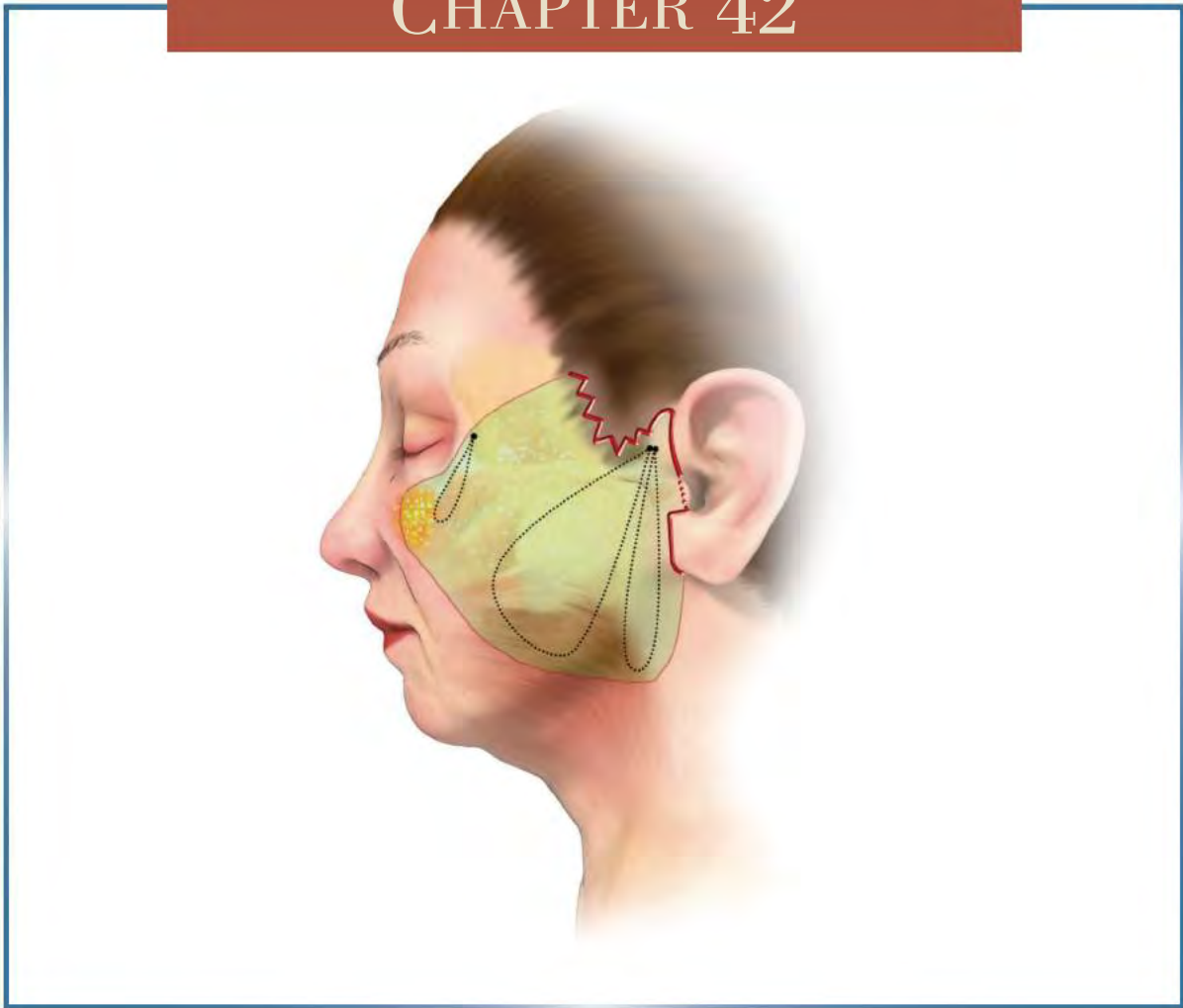
Plication Sutures

Plication of the platysma in the midline, as advocated by Feldman (the corset platysmaplasty), is highly effective in recontouring the submental area. When combined with a lateral plication, platysmal plication defines the jawline and neck-jaw angle. This step is an integral part of almost all the neck lifts I perform.

Ancillary Procedures

Although volume management in the neck almost always means removal of fat or partial resection of the digastric or submandibular gland, volume addition in the form of autologous fat or acellular dermal matrix has been advocated for correction of the contour irregularities associated with aggressive oversuction superficial to the platysma. Resurfacing either with laser or my preference, TCA peels, is an acceptable adjunct to neck lift. The energy levels on the laser are set below that for a face lift. I apply 20%, 30%, or even 50% TCA to the face, but I limit neck peeling to 20% TCA, and even then the endpoint is a mottled frosting rather than the uniform frosting that I look for on the face.

CHAPTER 42



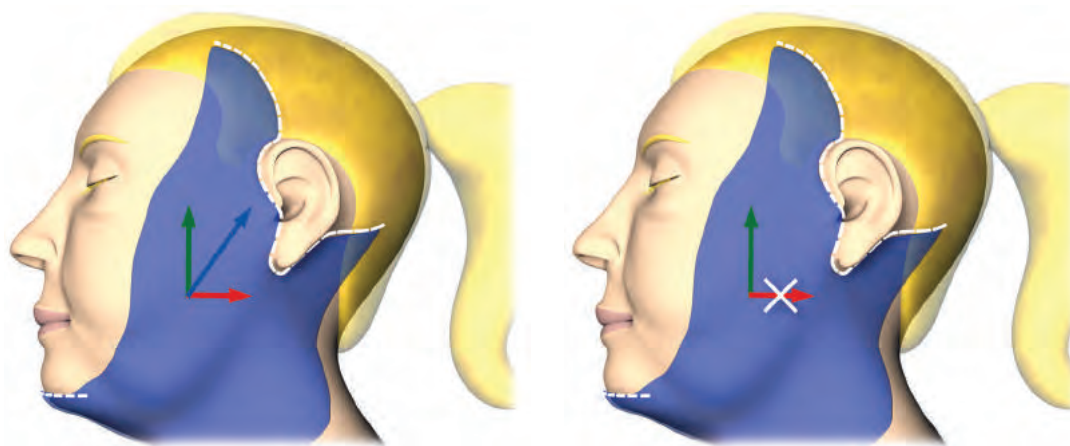
The MACS-Lift Short-Scar Rhytidectomy With Fat Grafting

PATRICK L. TONNARD, ALEXIS M. VERPAELE

When different surgical techniques in facial rejuvenation are compared, one is tempted to focus on the result without considering the global risk-benefit ratio associated with any surgical intervention. Some techniques can produce superb results, but the trade-off may be a high complication rate or a prolonged postoperative recovery. Today, many patients prefer a simpler route to rejuvenation. Bearing in mind that the ultimate goal of aesthetic surgery is a happy patient, it is not always the most aggressive and extensive surgery that delivers the greatest patient satisfaction. Ultimately, it is the delicate subjective balance between the final result and the morbidity of the procedure that will determine the level of patient happiness. The appeal of the *minimal access cranial suspension lift* (MACS-lift) lies primarily in the fact that it strikes the right balance, offering a stable, natural facial rejuvenation through a simple and safe procedure. The operation takes only 2 to 2½ hours to perform and can be done with a local anesthetic in an outpatient setting. In comparison with a classic face lift, the MACS-lift has a quicker recovery time and a lower morbidity rate, with a final scar that is significantly shorter.

The MACS-lift provides a powerful correction of submental and upper neck laxity, correction of a blunted submental angle, restoration of a well-defined jawline by correction of the jowls, restoration of the midfacial volume, and correction of the nasolabial folds. Patients who are seeking improvement of one or more of these features are good candidates for a simple or extended MACS-lift procedure. Adjunctive procedures to enhance the results may include upper and lower blepharoplasty, micro-fat grafting, short-scar temporal lifting, and anterior and posterior cervicoplasty.

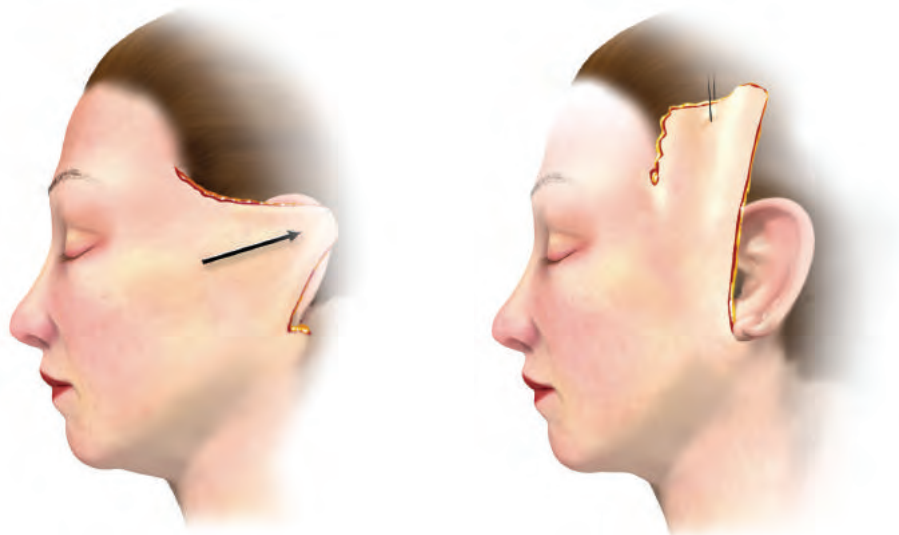
Basic Concepts



Traditional face-lift designs all have an oblique vector of traction on the superficial musculoaponeurotic system (SMAS), which can be divided into a horizontal and a vertical component. In recent years, more emphasis has been put on reorienting this vector in a more vertical direction.

In classic face-lifting, the direction of skin redraping still follows an oblique vector. The horizontal component of the vector of traction on the SMAS and on the skin does not rejuvenate the face; rather, it tends to flatten the face and put it under tension.

With the MACS-lift, the vertical rejuvenating vector is the only vector applied on the deep tissues as well as on the overlying skin. The MACS-lift eliminates the horizontal vector of traction; it can therefore be considered a pure vertical vector face-lift technique.



When lateral skin redraping is performed, as in classic face lifts, a dog-ear is created at the earlobe, necessitating redraping with a retroauricular flap dissection. No dog-ear is produced under the earlobe with vertical skin redraping, thus obviating the need for retroauricular dissection. Therefore the MACS-lift can also be considered a purely antigravitational procedure.

The MACS-lift is aimed at obtaining an antigravitational volume redistribution in the upper neck and face by suspending the soft tissues of the face, working in the superficial subcutaneous plane without any deeper undermining. The skin excess is redraped in a vertical direction and resected in the temporal region and lower eyelid.

In recent years the concept of volumetric rejuvenation has gained worldwide acceptance. We now know that the restoration of facial volumes is more important than the amount of skin resected and the tension on the skin and SMAS. There are many methods to obtain this volumetric restoration; the question remains: In what plane should the surgery be done to obtain a good result while minimizing morbidity? The MACS-lift technique provides a safe and effective method for accomplishing these goals. This technique acts directly on the sagging soft tissues, with suspension sutures in the superficial subcutaneous level and limited skin undermining, to provide an efficient, safe, and durable correction with significantly lower morbidity and faster recovery.

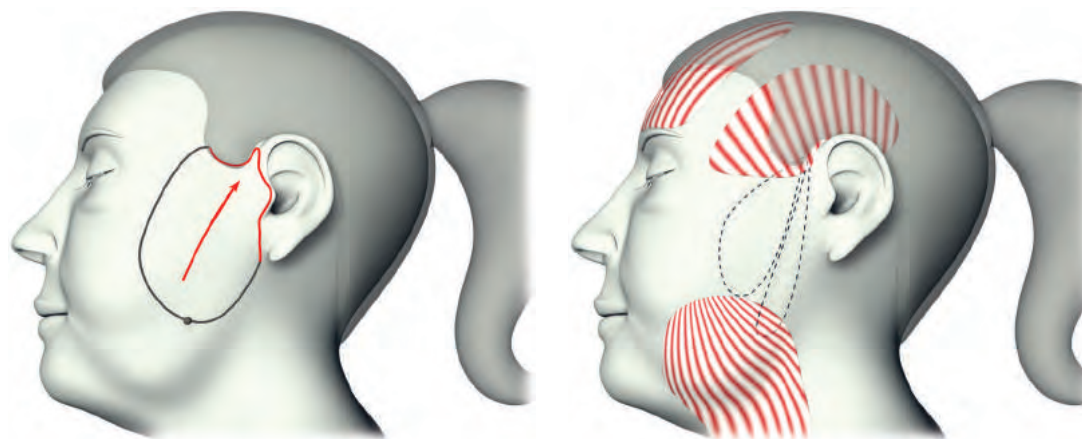
Overview of Technique: Simple and Extended MACS-Lift

The key concept underlying the MACS-lift procedure is the vertical suspension of sagging facial soft tissues with slowly resorbable monofilament purse-string sutures. These are strongly anchored to deep temporal fascia through a preauricular and temporal prehairline incision. Excess skin is excised in the temporal region after pure vertical redraping of the skin flap. Submental suction lipectomy always precedes the lifting procedure. The extent of the skin undermining is just sufficient for placing the purse-string sutures. There are two variations of the procedure:

The *simple MACS-lift* (S-MACS), in which two purse-string sutures are placed for correction of the neck and the lower third of the face (cervicomental angle, jowls, and marionette grooves)

The *extended MACS-lift* (X-MACS), in which a supplementary third purse-string suture is placed to suspend the malar fat pad; this suture will have an added impact on the nasolabial groove, midface, and lower eyelid

Simple MACS-Lift

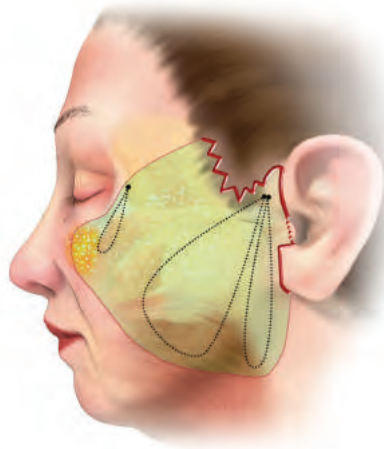


With the simple MACS-lift approach, the incision begins at the lower limit of the earlobe, extends preauricularly to the temporal hairline, and traces the temporal hairline along the sideburn up to the level of the lateral canthus. The skin is undermined at a subcutaneous level over 5 to 6 cm in an anterior direction. The inferior limit of undermining goes as caudal as necessary to visualize the lateral border of the platysma muscle. Usually the undermining is marked 2 to 3 cm below the mandibular angle.

The first purse-string suture is anchored to the deep temporal fascia 1 cm in front of the helical rim and 1 cm above the zygomatic arch. It runs downward toward the mandibular angle as care is taken to incorporate a firm bite in the craniolateral border of the platysma muscle, and then it turns upward as a narrow U-shaped loop toward the original anchor point. The suture is firmly woven into the SMAS tissue, which is not undermined. When this purse-string suture is tightened, the lateral portion of the platysma is pulled upward. This suture, when combined with a closed-suction lipectomy, produces a dramatic correction of the cervicomental angle and contour of the upper neck.

The second purse-string suture starts at the same anchor point on the deep temporal fascia, extends more obliquely toward the jowls (± 30 degrees from the first suture), and follows the borders of the undermining as a more open, O-shaped, purse-string loop. It ends at the original anchor point. When this suture is tightened, the SMAS is placed under concentric tension, producing a lift to the jowl, the marionette groove, and the corner of the mouth.

Extended MACS-Lift



The incision for the extended MACS-lift follows the same course as in the simple MACS-lift but is extended in a cranial direction for 1 to 2 cm along the anterior temporal hairline, up to the level of the tail of the eyebrow. The skin is undermined as in the simple MACS-lift, but a supplementary area over the malar fat pad is included.

The third purse-string suture has a narrow U-shape, like the first one. Its anchor point is located in the most anterior part of the deep temporal fascia, just lateral to the lateral orbital rim. This suture runs first downward toward the malar fat pad, then turns back toward the anchor point. Tightening this suture serves to suspend the malar fat pad, thereby correcting the nasolabial groove and midface ptosis and shortening the height of the lower eyelid.

In both the S-MACS and X-MACS procedures, after placement of the sutures, the skin is redraped in a purely vertical direction and the excess skin above the temporal hairline incision is resected without any traction. Because there is no lateral traction on the skin, there will be no dog-ear at the level of the earlobe, eliminating the need for retroauricular dissection. This is contrary to the classic face-lifting concept in which skin is redraped in a more oblique direction, generating a skin excess below the earlobe that needs to be redraped further backward through a retroauricular flap dissection.

As a consequence of lifting the malar fat pad toward the lateral orbital rim, the skin “bunches up” in the region of the lateral part of the lower eyelid and the paracanthal zone. This necessitates a skin excision in the subciliary and paracanthal region. Because of the good structural support of the lower eyelid provided by the third purse-string suspension suture, this pure skin resection is easy and safe. The excess skin is evaluated by pinching the skin between the teeth of a forceps and is excised through a lower eyelid blepharoplasty incision with paracanthal extension (the pinch blepharoplasty). The surgeon can easily resect 4 to 8 mm of skin, especially in the paracanthal region, without risk of causing ectropion or scleral show.

The MACS-lift will adequately treat 90% of our patient population. When the limits of the MACS-lift procedure are reached, ancillary procedures will supplement this procedure. Care is taken not to overtreat any patient.

Ancillary Procedures

Anterior Neck

Preoperatively, the patient's facial and cervical flaccidity is assessed by the surgeon by digitally lifting the facial skin upward at the mandibular angle region. If this maneuver produces correction of visible platysma bands, one can be confident that the MACS-lift will adequately tackle this problem. If the platysmal bands are not corrected with this preoperative maneuver, an anterior cervicoplasty is added at the end of the MACS-lift procedure. Because suturing together platysmal bands on the midline counteracts the lifting effect on the cheeks, the neck work is delayed until the face-lift procedure is completed. At the end of a MACS-lift procedure, the lateral parts of the platysma are so tightly pulled upward by the vertical purse-string sutures that it is virtually impossible to bring the medial borders of the platysma together to the midline. Therefore we prefer an open resection of the medial bands of the platysma at the end of the procedure. A resection of about 1 cm of medial muscle border is carried out, with or without a horizontal relaxation incision at the level of the hyoid. Conservative open resection of subplatysmal fat is done when indicated.

Posterior Neck

The limits of MACS-lifting depend on the amount of skin excess in the neck as well as the quality of the skin. Problems can arise when dealing with thin, sun-damaged neck skin with a significant amount of wrinkles down to the clavicular region. In these cases, after vertical skin redraping, vertical skin folds will begin to appear in the infralobular neck region. These folds are aesthetically unacceptable and need to be corrected at the end of the procedure with a posterior cervicoplasty (see p. 1407). This maneuver consists of tension-free redraping of the skin in an occipital direction from a prehairline posterior neck incision.

Forehead

Indications for brow lifting are very surgeon dependent. Some surgeons believe that everyone needs one; others—and we fall into this category—are more conservative in their approach and do not routinely elevate every patient's eyebrows.

Many procedures are available for forehead correction, ranging from open foreheadplasty to endoscopic brow lift or limited incision temporal lifting techniques. With the introduction of *botulinum* A toxin into our practice, our indications for surgical brow-lifting have diminished impressively. Almost every patient is offered *botulinum* toxin treatment after surgery. It completes the treatment, optimizes the result, and leads to improved patient satisfaction.

Indications and Contraindications

The MACS-lift short-scar technique is particularly appropriate for younger patients who usually are not willing to undergo aggressive and potentially risky procedures to achieve their goals. It is also suitable for older patients who do not want to change too much, but only want to obtain correction of their obvious signs of aging. For these patient populations, less aggressive but still effective surgical rejuvenation techniques are welcome.

The ideal patient for a surgeon's initial MACS-lift case is a 45- to 50-year-old woman whose main complaint is a moderate submental laxity with a blunted cervicomental angle, but without visible platysmal bands. Jowls, marionette grooves, and nasolabial folds are developing but are mainly disturbing to the patient when she bends forward. This is a frequent complaint in middle-aged women who discover these signs of aging in the lower third of the face. This type of patient is ideally suited for treatment with the two-suture simple MACS-lift technique.



This patient's mild jowling and central anterior neck laxity make her an ideal candidate for correction by a simple MACS-lift.

The extended MACS-lift, with the addition of a third suture, is particularly appropriate for a patient who needs correction of the upper half of the nasolabial folds and the midface. The third suture suspending the malar fat pad gives a powerful correction of these features and also enhances the volumetric restoration of the midface, providing very strong support to the lower eyelid skin. Therefore the indication for the third suture can be extended to patients of all ages who have a flattened malar mound and laxity of the lower eyelids. The need for the third suture is not only determined by age, but also by the bony anatomy of the face. A person with a poorly developed malar eminence will be subject to earlier midfacial aging than one with a strong malar relief. This is also often related to poor lower lid support.

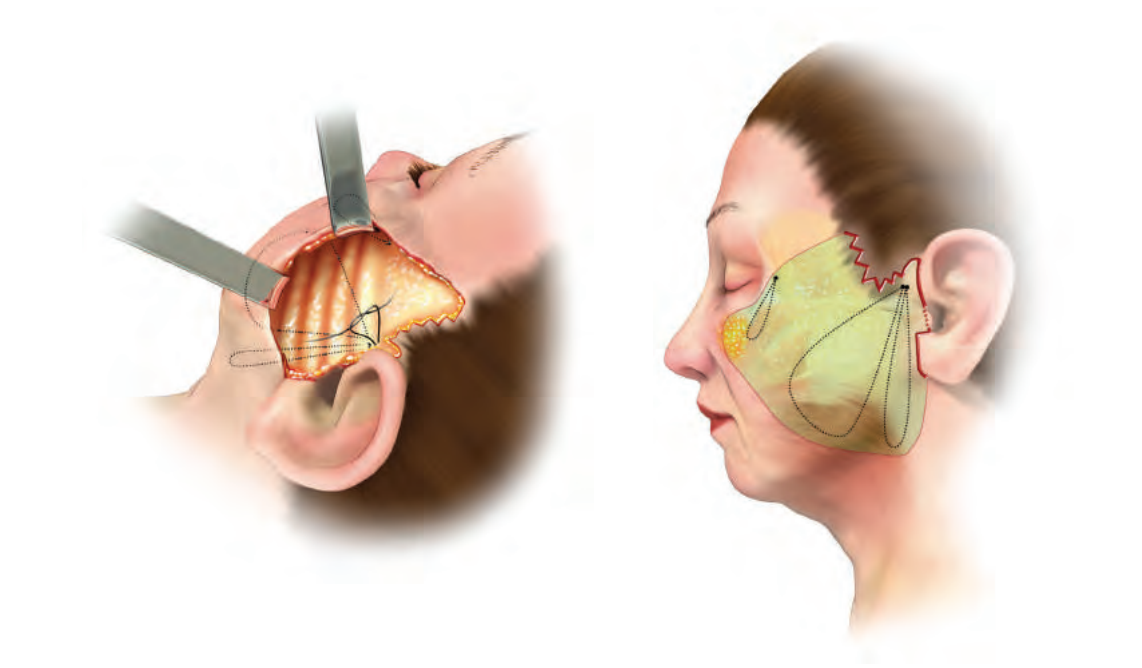


Both of these women would benefit from an extended MACS-lift. For a younger patient, it will correct the malar insufficiency and flattening of the lateral cheek. In an older patient, it will also correct the nasolabial folds and midfacial hollowing.

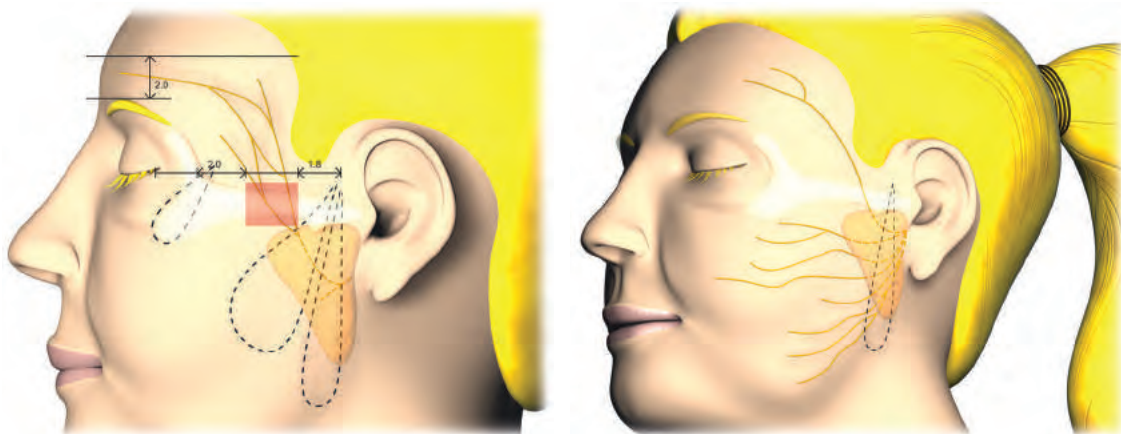
In classic teaching, smoking is considered an absolute contraindication for face-lift surgery. Because of the limited subcutaneous dissection and the absence of multiplanar dissection, we consider smoking to be a relative contraindication. For the same reason, combining the MACS-lift with skin resurfacing techniques is safe and well tolerated.

As a general rule, only patients with no major medical history of disease or cardiovascular risk factors are selected for outpatient, office-based surgery. The decision whether to perform the MACS-lift with a local or general anesthetic depends on the surgeon's and patient's preferences.

Pertinent Anatomy



Three permanent purse-string sutures are woven into the deep subcutaneous tissues, which consist of parotid fascia and SMAS in the preauricular area, and the malar fat. The sutures are anchored into the deep temporalis muscle fascia to ensure a strong hold.



The main danger zone in the placement of sutures is located on the zygomatic arch, halfway between the ear and the lateral orbital rim. This zone is completely avoided, because no suture crosses the zygomatic arch. The anchor point of the first two sutures is located posterior to the frontal branch of the facial nerve. The first loop is directed vertically downward and reaches the lateral edge of the platysma muscle in the region of the mandibular angle. The marginal mandibular branch of the facial nerve is out of danger for entrapment by the purse-string suture, since it runs more anteriorly.

The second purse-string suture loop runs at an angle of 25 to 30 degrees and reaches to 1 to 2 cm above the mandibular border. The third loop takes its origin in the temporalis muscle fascia just lateral to the lateral orbital rim and is also directed downward. It lies well anterior to the course of the frontalis branch of the facial nerve.

Preoperative Assessment

Generally, it is very important to listen carefully to the patient's wishes in the first clinical consultation. We start by inquiring what bothers the patient and has prompted this visit.



When asked what they are seeking, most patients consulting for facial rejuvenation demonstrate a maneuver that they have repeatedly executed before their mirrors: they push the skin of the mandibular angle upward. This maneuver has a beneficial effect on the neck and on the jowling. Some patients also include the zygomatic region into this maneuver and push it upward. This will have an additional effect on the nasolabial fold, the midface, and the lower eyelid.

The main consideration when assessing a potential candidate for MACS-lift surgery is determining whether a simple or an extended MACS-lift is indicated. A simple MACS-lift acts primarily on the lower half of the face—the upper neck and submental area, jowls, marionette grooves, and lower cheeks.



This 52-year-old woman exhibits moderate fatty deposits in the submental area with jowling and marionette grooves. There is a slight downward slant of the corners of the mouth. She has a somewhat heavy neck, which will require maximal power-assisted liposculpture (PAL) for contouring. Her malar area has well-preserved defi-

nition, and there is no obvious skeletonizing of the lower eyelid. Treatment will consist of submental liposculpture combined with a simple MACS-lift to correct the neck laxity, jowl deformity, and marionette grooves. (Her results can be seen on p. 1418.)



This 56-year-old woman had general sagging of the lower part of the face with a lax, fatty, infiltrated neck with obvious platysmal bands, marked jowling, deep nasolabial folds and marionette grooves, and pronounced nasojugal grooves with demarcation of the inferior orbital rim. A simple MACS-lift would improve her neck, jowls, and marionette grooves, but to adequately address her midface, an extended MACS-lift with a third purse-string suture to the malar area is needed. This would restore a youthful ogee curve to the cheek, correct the upper nasolabial folds, refill the lower orbital rim, and correct the nasojugal grooves. Her planned treatment consists of a submental liposculpture, an extended MACS-lift, and a lower pinch blepharoplasty. (Her postoperative result is shown on pp. 1426-1427.)

It is important to explain the concept of the MACS-lift intervention to the patient. To do this, it is helpful to simulate the feasible correction on the facial features with the patient looking in the mirror and the physician standing behind. This will give the patient an idea of the possibilities and limitations of the technique. The patient will learn that the MACS-lift is a lifting procedure that addresses the neck and lower two thirds of the face, without having an influence on the forehead. The patient will also understand that the main goal is to restore the facial volume and to get rid of most of the facial laxity.

It is rare for a patient to demand an extreme correction at the risk of a completely flattened, expressionless face. *Patients want to look younger, not different.* Many patients are afraid of changing too much and losing facial expression. In the majority of patients, it is perfectly feasible to reproduce the desired result with the MACS-lift procedure. In some cases, ancillary procedures can be proposed, but the patients must be informed of the cumulative morbidity to be expected. Once the surgeon understands the patient's expectations, a treatment plan can be designed to meet patient goals. The patient's input is essential to this process.

All patients are fully informed of the details of the proposed procedure, including the benefits, limitations, risks, time of surgery, expected morbidity and recovery, and the potential for problems and complications. This informed consent is provided both verbally and in written documents given to the patient.

Preoperative Planning

Photography

A standardized series of nine pictures is taken of the patient.



The frontal view shows the face from the top of the head down to the sternal notch.



A perfect perpendicular side view should show only one eyebrow, with the patient gazing straight forward.



The oblique view has the tip of the nose just within the contour of the opposite cheek to demonstrate the distribution of the facial volumes.



An extra side view picture is taken with the patient looking down at the knees, producing a double chin. We refer to this as the “Bruce Connell view,” because he has pointed out its importance.



A close-up view of the lower face is taken to focus on the contour of the jaw line, marionette grooves, and nasolabial folds and to demonstrate any perioral rhytids (the “bar code”). A close-up view of the upper half of the face reveals detailed information about the upper and lower eyelids, tear troughs and periorbital fold, grooves and wrinkles.

Patient Instructions

The patient is instructed to take the following medications:

Oral ampicillin 500 mg every 6 hours, beginning the morning of surgery and continuing for 4 days

Acyclovir 800 mg once daily for 10 days, beginning 2 days preoperatively, if erbium-YAG laser resurfacing is performed

Arnica montana 30K for prevention of ecchymoses and edema, of which five doses are taken:

- 1 week preoperatively
- 1 day preoperatively
- Immediately before surgery
- Immediately after surgery
- 1 day postoperatively

Continue any home medication

The patient is instructed to respect the following guidelines:

Stay in the company of a friend or relative for the first 24 hours.

Relax in a quiet environment.

Avoid stressful activities.

Avoid bending forward and Valsalva maneuvers.

Sleep with the head slightly elevated.

A soft diet is recommended, since mouth-opening is painful the first 5 days because of traction on the temporalis muscles.

Dressing instructions after resurfacing include the following:

Avoid allowing the resurfaced area to dry out by regularly applying copious amounts of Vaseline/paraffin ointment at least every 2 hours.

Gently remove the ointment every 4 hours, then apply a gauze soaked in a solution of tepid tap water and vinegar (1 coffee spoon of vinegar to 1 coffee cup of tepid water).

Do not remove the yellowish, fibrous exudate that covers the wound for 4 to 5 days.

It will disappear spontaneously as the skin heals.

The patient is also informed about normal postoperative discomfort, swelling, and ecchymosis, especially in the eyelids. He or she is instructed to contact the surgeon if any of the following conditions develop:

Rapidly increasing swelling and/or pain in the cheek area, which could indicate a postoperative hematoma

Pain or increasing discomfort in the resurfaced area

A temperature greater than 38° C (100.4° F)

Any visual impairment

Operative Technique

Preoperative Markings

Any makeup is removed by the nurse and a new set of nine pictures is taken. The patient sits upright in front of the surgeon for the initial markings. Submental liposuction is planned for almost every patient. Fat tends to accumulate in this area, so even in slim patients, liposuction in this region helps to enhance the cervicomental angle.



The patient is asked to make a double chin, and the area where excess fat is palpated is marked with a pencil (*left*). Care is taken to include the lateral “wings” of the submental fat, which go as far as the infralobular area, and the lower pole of the jowls.

When the nasolabial folds, midface, and/or lower eyelids require correction, an extended MACS-lift is planned. This necessitates extra preoperative marking to guide the placement of the third suture.

A point is marked 2 cm caudal to the lateral canthus (*right*). In most people this point coincides with the bulk of the malar fat pad. During surgery this point will be suspended by the third suture to the most anterior part of the deep temporal fascia, just lateral to the lateral orbital rim. An arrow is marked between the two points and is repeated on the contralateral side.

Anesthesia and Surgical Setting

We prefer to perform the MACS-lift using a local anesthetic with sedation. If the surgeon prefers, heavier sedation can be used, but patient cooperation will diminish and oxygen must be administered. This procedure can also be performed with the patient under general anesthesia, depending on the surgeon's preference.

The MACS-lift is designed to be performed, ideally, in a private surgical office by one surgeon and one nurse. If the instrument table is well prepared in advance, no circulating nurse is necessary. A headlight or a lighted retractor is required for placement of the purse-string suture beneath the cheek flap. The height of the operating table must be controllable by foot switch, and the surgeon's seat must also be adjustable in height by nonsterile foot manipulation.

Submental Infiltration

The sequence of infiltration follows the sequence of the procedure:

1. Upper eyelids
2. Submental area
3. Cheek infiltration



For a submental suction lipectomy, an average of 30 to 40 ml is infiltrated in the preplatysmal fat until a moderate degree of tumescence is achieved.

Markings and Incisions



With the patient supine on the operating table, marking resumes at the lower limit of the lobule, extending up in the preauricular crease. The incision is usually carried out on top of the tragus. At the level of the incisura intertragica, the marking makes a 90-degree turn backward to preserve the integrity of this anatomic landmark. Markings then follow the posterior edge of the tragus, ascending toward the helical root. Because there is a distinct color difference between the cheek skin and the auricular skin, it is essential that the markings precisely follow this line of demarcation. At the superior limit of the ear, the marking traces the small hairless recess between the sideburn and the auricle and then turns downward to follow the inferior implantation of the sideburn.



In men, the marking descends approximately 1.5 cm before turning anteriorly to cross the sideburn.



The horizontal marking then continues forward in a zigzag pattern 2 mm within the lower and anterior implantation of the sideburn. This zigzag pattern increases the length of the temporal incision for better congruence with the length of the cheek flap. In a simple MACS-lift the incision will extend to the level of the lateral canthus. In an extended MACS-lift the incision goes up to the level of the tail of the eyebrow (*note dotted line*). The total length of the incision will not exceed 7 to 9 cm, depending on the dimensions of the auricle (vertical branch of the incision) and the width of the sideburn (horizontal branch of the incision).



The surgeon palpates the mandibular angle with an index finger and marks it as the lowest point of the undermining. The extent of the undermining is marked starting from the lowest point of the incision at the lobule, directed toward the marking of the mandibular angle, then curving anteriorly to 5 to 6 cm in front of the ear. Next, the marking is directed toward the upper end of the incision. For an extended MACS-lift, the preoperative marking of the malar eminence should be incorporated. If a simple MACS-lift is planned, the malar eminence is not included in the demarcation.

When adjunctive procedures are planned (such as an upper/lower blepharoplasty, fat grafting, short-scar temporal lifting, anterior/posterior cervicoplasty), they are marked together with the MACS-lift markings. (For detailed descriptions, see the individual adjunctive procedures later in this chapter.)



The subcutaneous plane is infiltrated with the preferred solution of local anesthetic. Normally 30 to 40 ml of solution is injected in the cheek, which gives a moderate degree of tumescence. At the end of the cheek infiltration, a distinct blanching is visible in the previously infiltrated eyelid and submental areas.

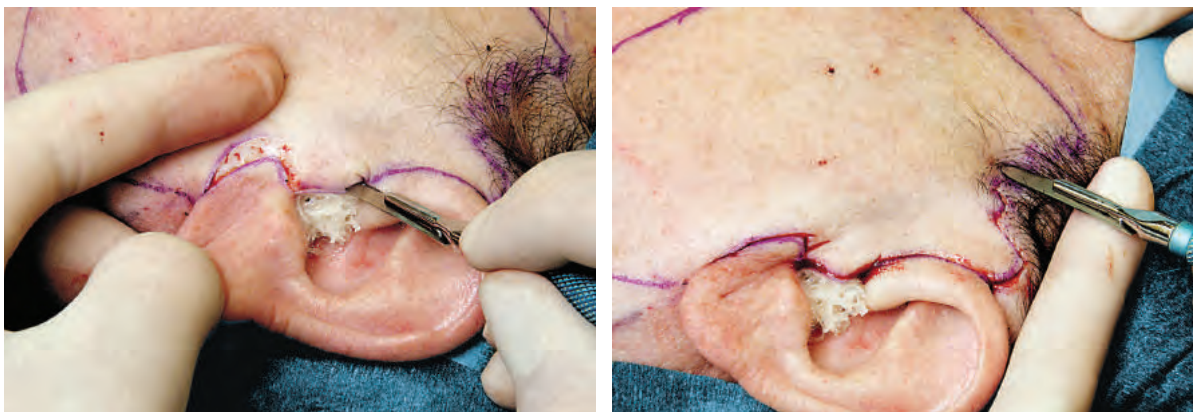
Suction Lipectomy



We prefer to use a 3 mm spatula cannula with one opening. The opening is always directed downward, not toward the skin, to avoid dermal damage. Two or three incisions are used to crisscross the marked area optimally. The lipectomy is performed in a preplatysmal plane under tactile guidance of the nondominant hand. A maximal lipectomy is performed so that in the end the cannula is visible just beneath the skin. For patients with heavy necks, power-assisted liposuction (PAL) is used. It enhances patient comfort, since the cannula movements are less vigorous, especially when the patient is under local anesthesia. It also diminishes the physical effort for the surgeon.

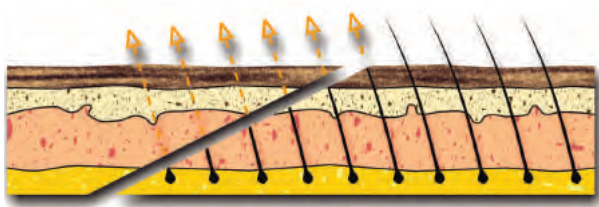
Incision

The incision starts at the lobule and continues along the previously described markings. The surgeon carefully respects the incisura intertragica by making a distinct 90-degree step at the beginning of the tragus.



The tragal incision is made exactly on the edge of the tragus. An incision placed too anterior to the tragus will leave a visible color difference between the pale tragus skin and the slightly darker cheek skin.

The blade is then inclined to an angle of 30 degrees to the skin so the incision goes obliquely through the dermis, perpendicular to the hair shafts. The incision follows the marked zigzag pattern 2 mm within the hairline.



An oblique incision within the hairline will allow hair to grow through the scar. After hair regrowth, the final scar will be hidden a few millimeters within the hairline and become virtually invisible.

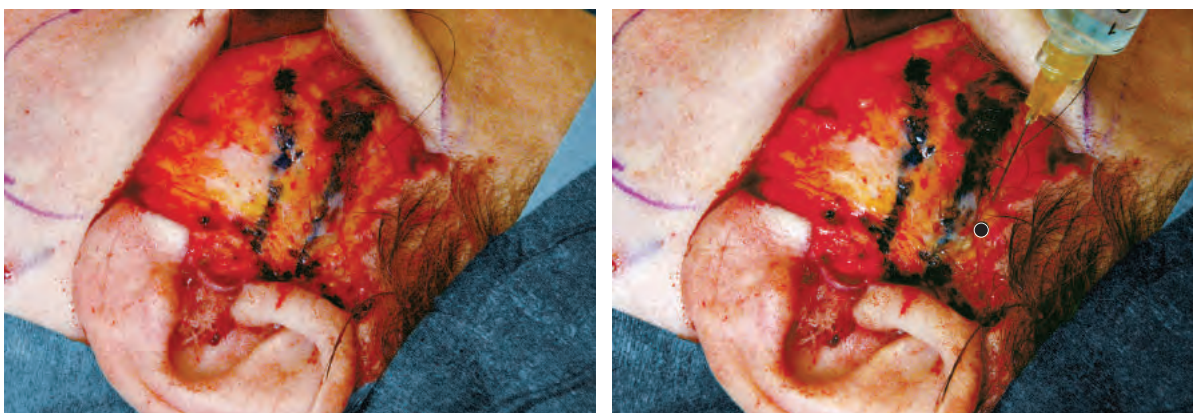
Flap Creation



Blind undermining of the skin is performed with Rees face-lift scissors, and the dissection proceeds in a subcutaneous plane. The scissors points are directed toward the skin to ensure that the surgeon has visual and palpable control over the thickness of the cheek flap. Most of the dissection is accomplished by spreading maneuvers with the scissors. Care is taken to create a flap sufficiently thick to mask small irregularities of the underlying layer.

After the flap is created, hemostasis is achieved by direct coagulation with microneedle cautery under direct illumination by a lighted retractor or a headlight.

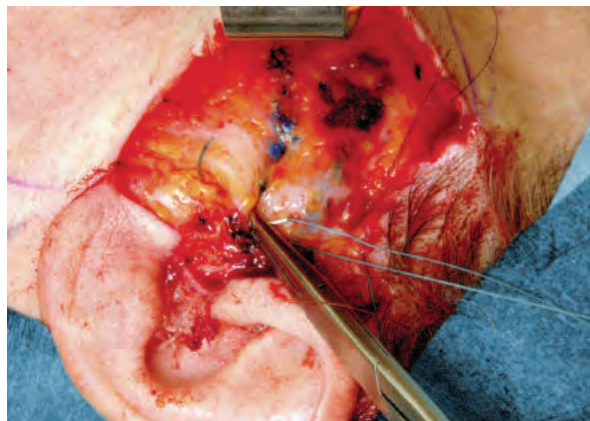
First Purse-String Suture: The Vertical Loop



The initial purse-string suture will be fixed to the deep temporalis fascia at a point 1 cm above the zygomatic arch and 1 cm in front of the helical rim. (The zygomatic arch is marked for demonstration purposes.) An extra dose of local anesthetic is injected at the anchor point (*note dot*) down to the temporal bone, then the needle is withdrawn and all layers of tissues are infiltrated.

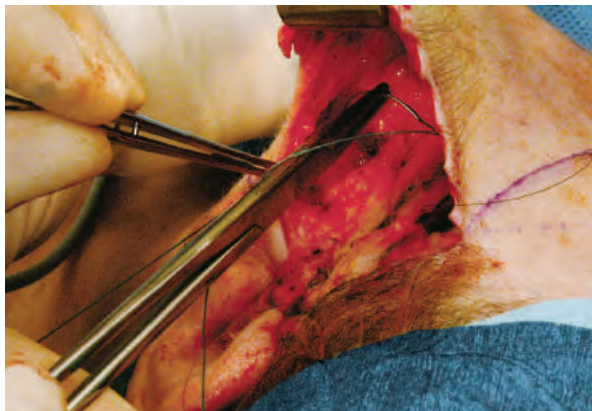


With the iris scissors in the spreading mode, a 0.5 cm diameter window is made in the subcutaneous tissue to visualize the deep temporal fascia. It should be identified as a distinct, white, shiny layer. A 2-0 permanent suture on a big V-7 needle is used to perform the suspension of the sagging facial and neck soft tissues. A Prolene, Gore-Tex PTFE, or Mersilene suture can be used.

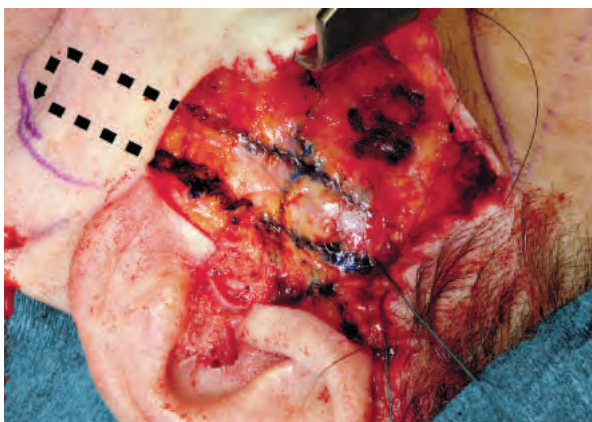


The first bite starts in the window where we visualize the deep temporal fascia and goes down to the temporal bone. The needle is oriented toward the tragus, so there is no danger of damaging any facial nerve branch. The frontal branch of the facial nerve runs deep in this region and becomes superficial several centimeters more anteriorly. Firm bites approximately 1 to 1.5 cm long and 0.5 cm deep are taken in the SMAS tissue—parotid fascia in the upper two thirds and platysma in the lower third. With every bite it is essential to confirm that the needle enters a substantial part of the SMAS tissue so the suture will not pull through.

The suturing goes down toward the region of the mandibular angle to the lower limit of the undermining. In this region direct visualization by means of a headlight or a lighted retractor is helpful.



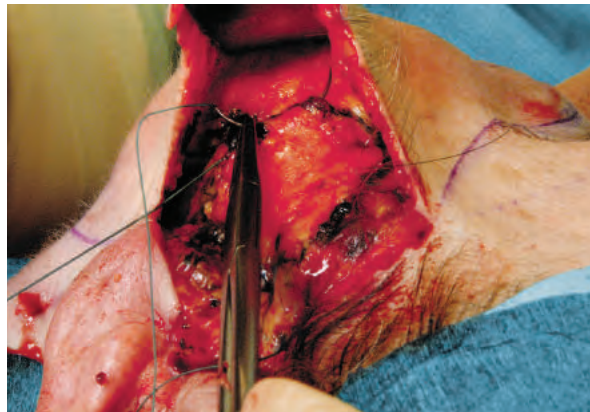
When the region of the mandibular angle is reached, the suturing is turned upward and continued toward the starting point.



This creates a narrow U-shaped purse-string loop about 1 cm wide. (The course of this loop is marked on the patient for demonstration purposes.) After the first purse-string suture is tied, some obvious skin dimples might occur at the mandibular angle. Most of these will disappear with the vertical redraping of the skin, but some will have to be freed with scissors.

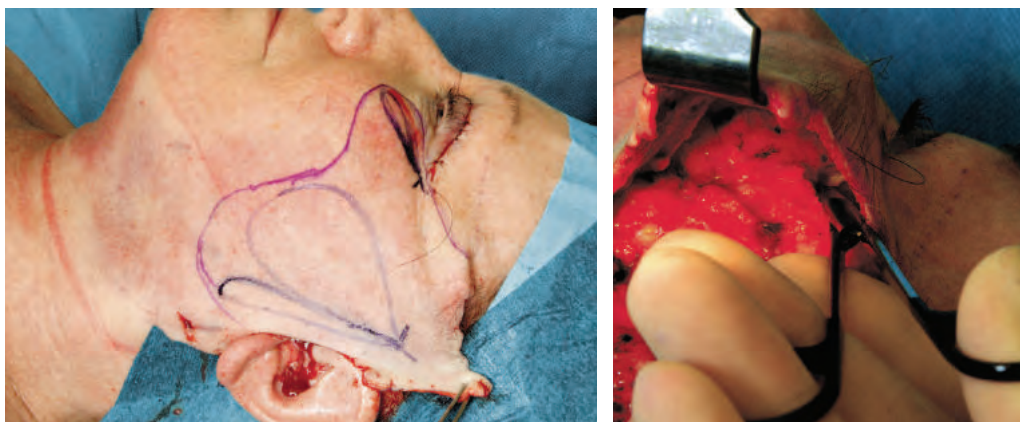
Second Purse-String Suture: The Oblique Loop

The second suture originates from the same location on the deep temporal fascia. This purse-string suture forms a wider loop, directed toward the jowls, at an angle of ± 30 degrees with the vertical. This loop is more O-shaped than the U-shaped vertical loop to prevent linear traction on the subcutaneous tissue, which could be visible through the skin.



The loop follows the borders of the anterior undermining in the lower part of the cheek. Short bites of 1 cm maximum are taken in the parotid fascia and the SMAS tissue.

Third Purse-String Suture: The Malar Loop



The first and second sutures start from a common anchor point 1 cm above the zygomatic arch and 1 cm anterior to the helical rim. (The projection of the three purse-string sutures has been marked on the patient's skin for orientation and demonstration purposes.) The third suture has a separate anchor point on the deep temporal fascia, just lateral to the lateral orbital rim. Here a window is made in the orbicu-

laris muscle by spreading the iris scissors. This suture forms a narrow U-shaped loop to prevent bulging of subcutaneous tissue in the highlighted zygomatic area. It runs to the malar fat pad, which has been preoperatively located by a point marked 2 cm below the lateral canthus.



With the same suture (2-0 Prolene, Gore-Tex, or Mersilene), a deep bite is taken to anchor the suture to the deep temporal fascia. The purse-string suture is oriented obliquely downward and medially. The malar fat pad is recognizable by a more fibrous consistency than the surrounding subcutaneous fat. At the preoperatively marked point—the malar fat pad—the direction of the suturing is reversed, now in upward and lateral direction. The loop has a narrow U-shape, grabbing firm parts of tissue with every bite of the suture. The suture ends at its starting point in the window made in the orbicularis muscle.

The knot is tied under maximal tension. The window in the orbicularis muscle is closed with 4-0 Vicryl to prevent knot palpability in the lateral orbital region. Again, some skin dimples may have to be freed with the scissors at the borders of the malar undermining.

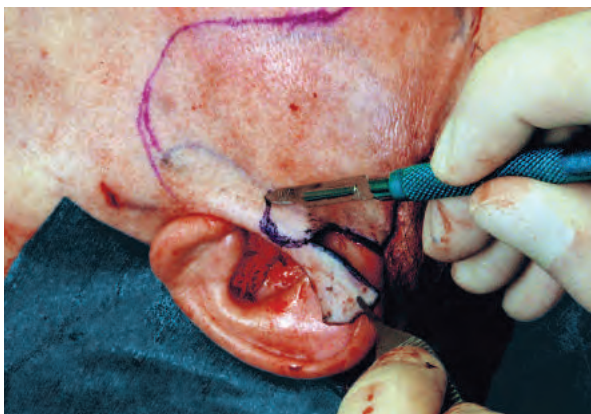
Skin Redraping and Resection

One of the most important features in the short-scar face lift is the vertical redraping of the skin. This provides a “lock” to the subcutaneous sculpturing work in the cheek. Because the vector of the subcutaneous lifting is almost purely vertical, the redraping and resection of the skin in the same direction will seal the underlying suspension effect. Vertical redraping also prevents formation of dog-ears at the lobule. The earlobe is pulled upward by the suspension sutures and will have to be set back in the cheek flap, taking the place of any dog-ears.

When vertical redraping of the skin is performed, the need for retroauricular skin redraping will be avoided or limited to the few cases with extreme neck skin laxity.

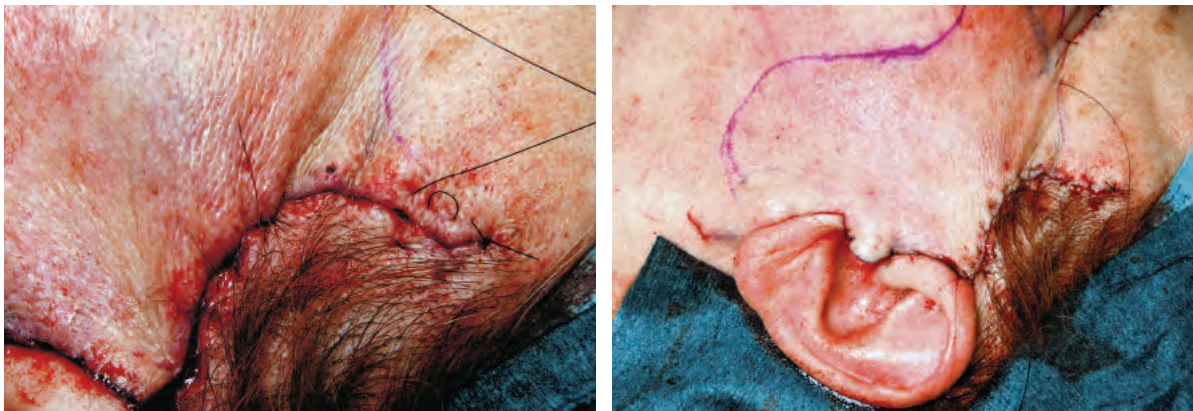


The skin flap is put under moderate vertical tension, and the skin excess is determined with the help of the Pitanguy-d'Asumpção forceps. The skin marking is incised with the knife, and the excess is excised with the scissors. The skin resection on the cheek flap is carried out in linear fashion and will be sutured to the zigzag border of the temporal hairline incision. The zigzag incision will now open up when coapting with the linear cheek flap, thereby compensating for the incongruence in length of both borders and reducing possible dog-ears. Closure with interrupted 4-0 Vicryl buried sutures is started from the superior end of the incision backward to avoid dog-ears in this section.



The lateral part of the cheek flap is trimmed only minimally just to coapt with the preauricular incision. Absolutely no traction is exerted on this part of the incision. The skin is incised with the knife, and the flap is resected with the scissors. The earlobe is pulled upward by the action of the suspension sutures and the redraping of

the skin in the vertical direction. To put the earlobe back into its natural position, a small segment of skin has to be excised anterior to the earlobe. It is preferable to underresect rather than to overresect in this area to avoid postoperative position changes of the earlobe.



The horizontal limb of the incision is sutured with a running 5-0 nylon horizontal mattress suture, taking bigger bites on the cheek flap side than on the temporal side to compensate for the final incongruence in length between both sides.



A small, hollow, silicone tube is inserted for drainage at the lowest point of the incision. This tube will drain into the loose retroauricular dressing during the first 24 hours postoperatively, after which it is removed, together with all dressings. The rest of the suturing is done with running and separated 6-0 nylon sutures.

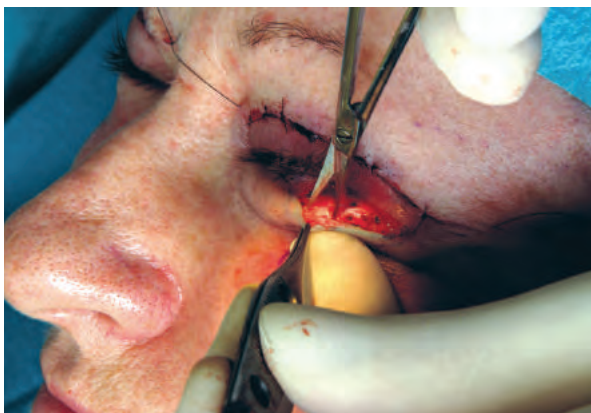
Adjunctive Procedures

Pinch Lower Blepharoplasty

A pinch lower blepharoplasty is routinely added after performing an extended MACS-lift, because the lifting of the malar mound creates skin excess in the lower eyelid region. The concept of the pinch blepharoplasty of the lower eyelid is to safely remove excess skin in the paracanthal and lateral subciliary region after providing strong structural support of the lower eyelid through suspension of the malar fat pad with the third purse-string suture of the MACS-lift procedure.



The skin excess is estimated by a pinching maneuver with a nontoothed forceps and marked with methylene blue. The pinch blepharoplasty is performed through a classic lower blepharoplasty incision.



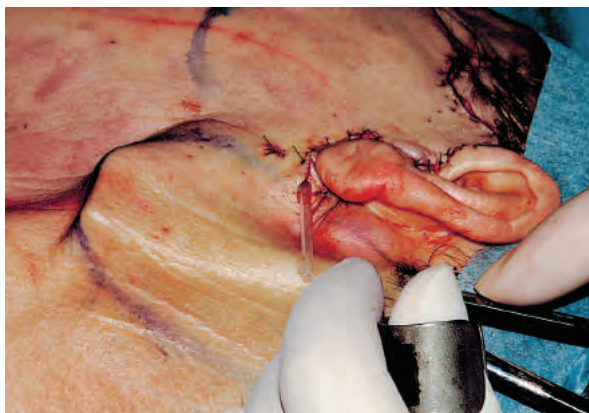
The skin is freed from the orbicularis, vertically redraped without any tension, and resected.



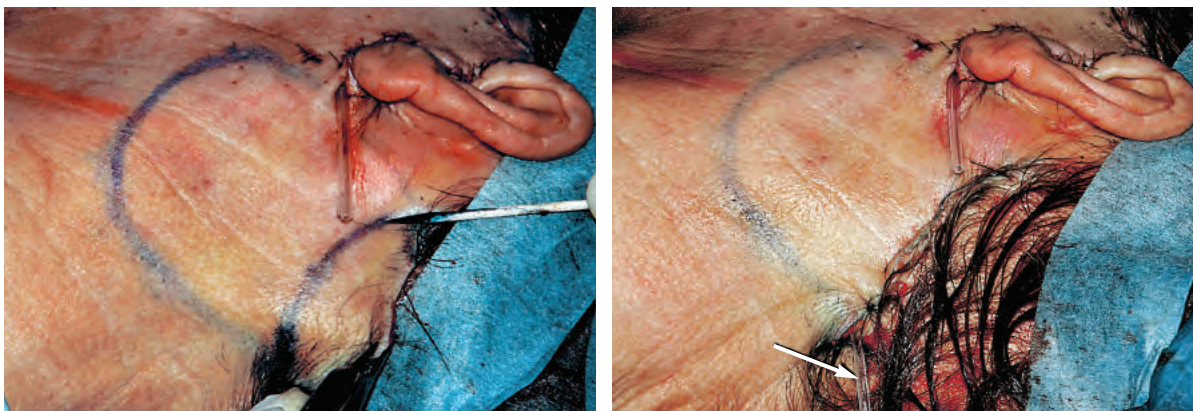
One or two inverted 5-0 Vicryl buried subcutaneous sutures are placed in the canthal and paracanthal part of the incision. The skin is closed with a running 5-0 nylon intradermal suture.

Posterior Cervicoplasty

One of the consequences of vertical redraping of the skin is that in some patients, aesthetically unacceptable vertical folds appear in the infralobular region. This occurs primarily in patients with extreme neck laxity and thin, elastotic, wrinkled neck skin, which is typically associated with severe sun damage. In our series this represented 2% of cases. (This procedure was not performed on the patient whose case presentation began on p. 1389 and whose postoperative care is detailed on pp. 1426-1427, but was performed on the patient described on pp. 1430-1431.)



A 5 cm incision is designed in a zigzag pattern at the occipital hairline. The area of skin undermining is designed to reach 1 cm beyond the anteriormost infralobular skin fold. The skin flap is created by blind scissors dissection in a superficial subcutaneous level.



The skin is redraped in an occipital direction, and the skin excess is resected. The skin is approximated with buried 4-0 Vicryl sutures and finished with a running 4-0 nylon horizontal mattress suture over a hollow silicone drainage tube (*arrow*).

Short-Scar Temporal Lift

The goal of face-lift surgery is to turn back the hands of time, rejuvenating the patient's appearance, delaying the process of aging, and restoring a look more like the individual appeared at a younger age.



When analyzing a patient's photographs in her twenties and thirties, the vast majority of photos show full upper eyelids, with only a minimal show of the eyelid above the cilia. The medial part of the eyebrow usually is relatively low, and the lateral third is at the same level or even higher than the medial third.

With aging, the tail of the eyebrow descends to a variable degree, depending on the underlying anatomy of the frontalis muscle. The part of the population that has a frontalis muscle insertion extending to the tail of the eyebrow will have less descent of this part of the eyebrow and often will respond very well to a chemodenervation with *botulinum* toxin of the temporal portion of the orbicularis oculi muscle.

However, most people do not have good support of the lateral third of the eyebrow and develop a degree of temporal hooding with time. It is this deformity that we aim to correct with the short-scar temporal lift. Additionally, when a vertical face lift of any kind is performed, the problem of temporal hooding is aggravated by a gathering of skin in the paracanthal region. This can be anticipated in the preoperative consultation with the patient in front of the mirror. If too much skin redundancy appears in the paracanthal area when simulating the vertical lift, the patient is counseled about the necessity of a temporal lift.

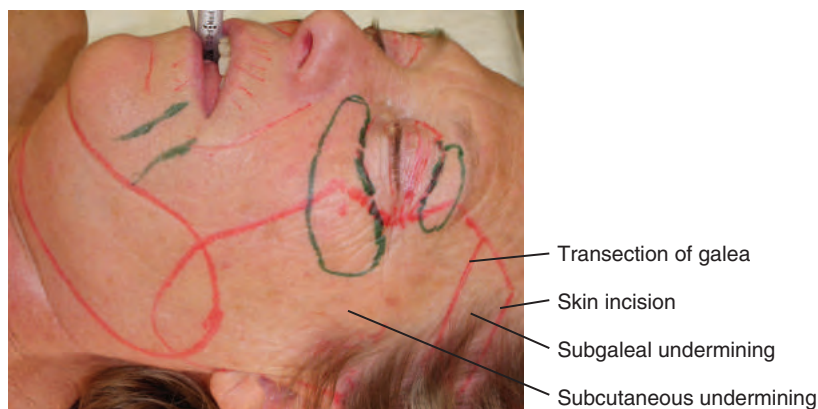
To address these problems, a modified Fogli's temporal lift by fasciapexy is performed. The principle of this operation is basically the same as for a subcutaneous forehead lift, limited to the lateral third of the forehead, in which the galea is used as a vehicle to suspend the ptotic temporal tissue and provide a tension-free skin closure in the temporal hair-bearing skin.

Technique

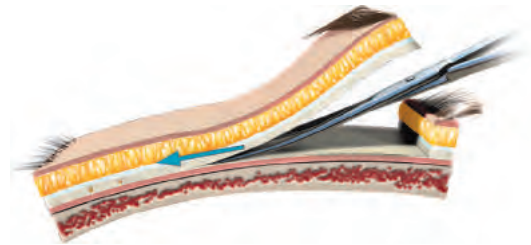
The subcutaneous part of the temporal undermining is performed from the MACS-lift incision in continuity with the subcutaneous cheek skin undermining. It stops at a level at least 2 cm above the tail of the eyebrow.

The temporal lift is done after the loop sutures are placed, but before the final re-draping and resection of the cheek and lower eyelid skin to reduce the dog-ear formation in the temporal and paracanthal region.

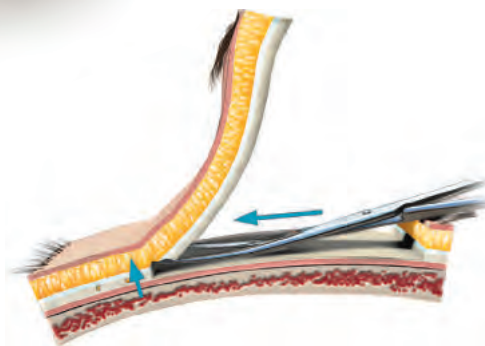
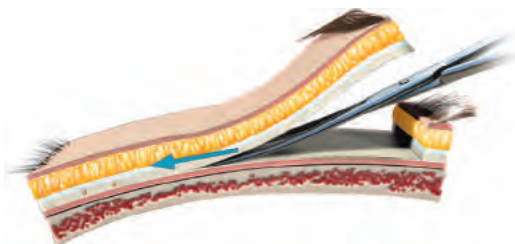
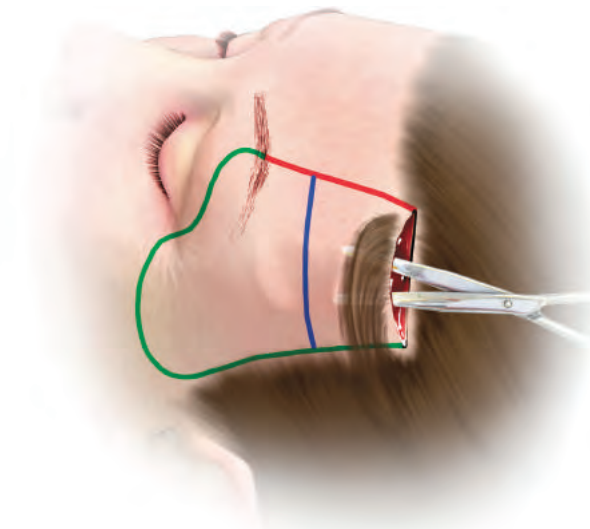
Markings



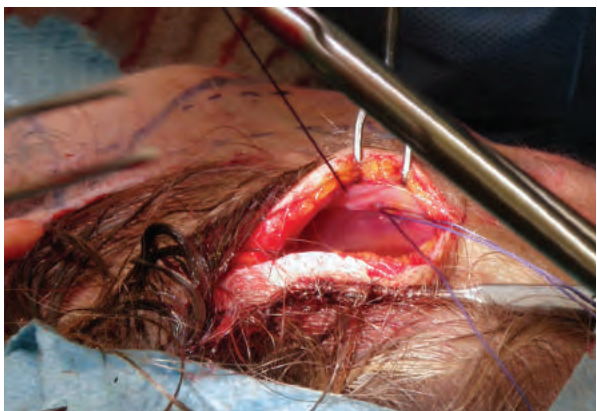
When a temporal lift is planned in combination with a MACS-lift, the markings are adapted, so that the subcutaneous dissection of the cheek is extended over the temporal region to a level at least 2 cm above the tail of the eyebrow. The skin incision is marked horizontally in the temporal hair-bearing skin.



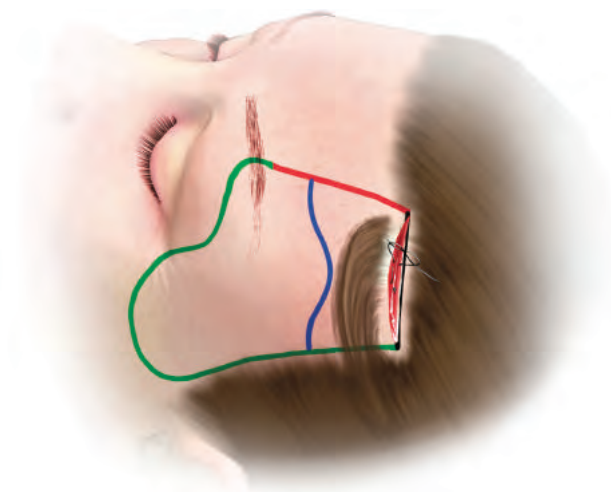
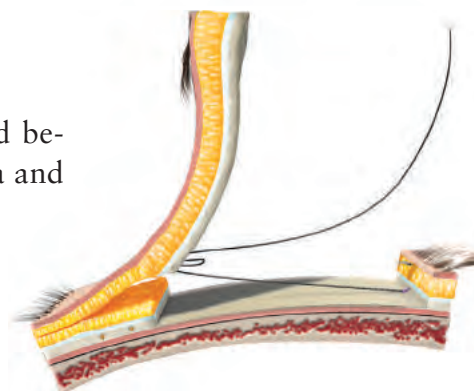
From here a subgaleal undermining is performed downward to a level about 2 cm above the tail of the eyebrow.



Here the galea is transected with the tip of the scissors from deep to superficial, to fall into the subcutaneous undermining already performed earlier. This maneuver protects against possible damage to the frontal branch of the facial nerve, which runs at the undersurface of the temporoparietal fascia, about 2 cm cranial to the tail of the eyebrow.



Two U-shaped Vicryl 2-0 sutures are placed between the cranial edge of the transected galea and the galea at the site of the skin incision.



Tying these knots will produce a bulging of skin that will disappear after 6 to 8 weeks when the Vicryl sutures lose their strength. After the knots are firmly tied, a few millimeters of skin are resected to minimize skin bulges and the incision is closed with 3-0 running nylon suture.

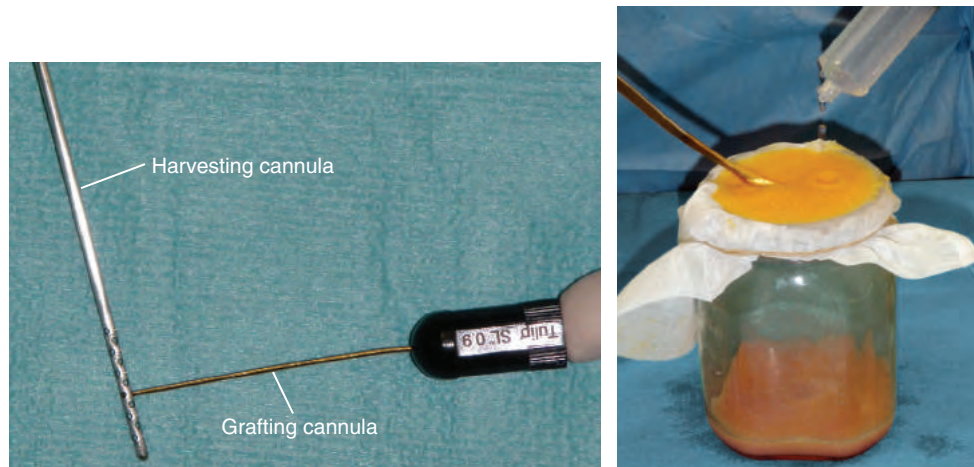
For the medial part of the forehead, *botulinum* toxin therapy is recommended, because it is an effective way of treating glabellar and frontal grooves without the need for further surgical procedures.

Microfat Grafting

Deflation through loss of subcutaneous fat is a recognized causative factor in facial aging. Guided by early patient photographs (age 20 to 30), we decide which areas need volumetric restoration by additional fat grafting. Experience has taught us that almost every patient loses volume in the nasojugal and nasolabial folds and marionette grooves. About 50% of these individuals will benefit from adding volume to the malar area and the medial upper eyelid.

Technique

Fat grafting is performed before the MACS-lift. This minimizes the cold ischemia time of the prepared fat grafts. At this stage there is also no distortion of the face by edema resulting from the surgery.

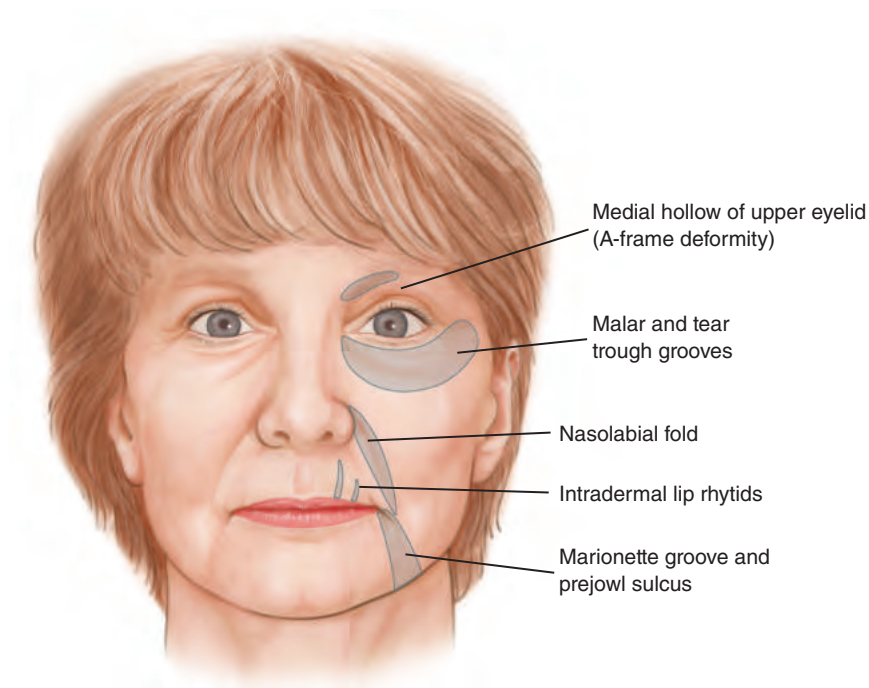


The fat is usually harvested by the assistant at the time of infiltration of local anesthetic to the face. The abdomen is the preferred donor site because of its ease of access. A multiholed grater cannula (Tulip; Wells Johnson, Tucson, AZ) with 1 mm sharp holes is used for fat harvesting. The fat parcels harvested this way are small enough to be placed with a 0.9 mm or 0.7 mm grafting cannula.

The fat is then strained through a sterile nylon cloth and rinsed with normal saline solution. Then the fat is collected in 10 cc syringes for final transfer to 1 cc Luer-Lok syringes.

The fat is injected using 0.9 to 0.7 mm diameter blunt cannulas with one small hole on the side. No incision is needed to insert the cannula. A puncture with an 18-gauge needle works well. The puncture hole need not be closed.

Areas for Fat Grafting



The medial part of the upper eyelid is grafted deep to the orbicularis oculi muscle in contact with the interior aspect of the superior orbital rim.



The malar area is grafted very deep, in contact with the malar bone, so that no grafted fat is encountered when the skin is being undermined over the lateral part of the malar area in an extended MACS-lift.

The nasolabial fold is filled in a deep plane, after which a subcision is performed with an 18-gauge needle. Additionally, a small quantity of fat (approximately 0.5 cc) is injected in the cavity created by the subcision to prevent reattachment of the skin to the deeper plane. Intradermal injections are made into vertical perioral, nasolabial and glabellar rhytids and sometimes in the corners of the mouth. This is only possible with the use of the ultrafine microfat parcels harvested with the method described.

Injection Guidelines

Grafted Area	Level of Injection	Volume (cc)
Upper eyelid	Deep	0.8-2.0
Malar	Deep	3.0-25.0
Nasolabial fold	Deep and superficial and intradermal	1.0-3.0
Perioral	Superficial and intradermal	1.0-4.0
Marionette grooves	Deep and superficial	1.5-3.0

Lip Lift Combined With Laser Resurfacing of the Perioral Region



In many persons the vertical height of the upper lip increases with age, hiding the upper incisors and sometimes even covering a part of the lower teeth. Lifting the upper lip has a very rejuvenative effect, especially when combined with microfat grafting.

The excision is planned as a subnasal gull-wing or bullhorn pattern down to the level of the orbicularis oris muscle. No skin undermining is performed. Meticulous closure with 5-0 subcutaneous polylactic or polydioxanone sutures and 6-0 horizontal mattress nylon sutures is performed.

In combination with perioral micrografting, the results of skin resurfacing with an erbium-YAG laser can be significantly enhanced. For the patient on p. 1414, we combined subcutaneous and intradermal microfat grafting with laser resurfacing and lip lift. The depth of the ablation can be reduced when appropriate filling of the rhytids is done by intradermal microfat injection.

Postoperative Care

The area of the neck where liposuction was performed is supported with an adhesive elastic tape. The preauricular incision is covered with a transparent adhesive foil dressing (OpSite, Tegaderm).

Cooling of the skin with ice has been abandoned because of the rebound postoperative vasodilation that occurred. Instead we now use a temperature-controlled cooling device (Hilotherm) that has closed-circuit cooled water circulation through a snug facial mask. The water temperature is set on 15° to 17° C (59° to 63° F). This is sufficient to diminish the facial edema without causing discomfort, while avoiding postcooling rebound swelling. Our clinical experience has shown significantly reduced postoperative swelling and bruising. There is usually some swelling in the superior sternocleidomastoid region; the patient is reassured that this temporary deformity will resolve over the next 2 weeks.

Suction drains and submental adhesive tape are removed on the first postoperative day; the patient is allowed to shower and shampoo. Sutures are removed on postoperative day 6, and any remaining ecchymoses can be concealed with camouflage makeup.



This patient, who is the subject of the operative series on pp. 1393 through 1405, is seen here 24 hours after surgery. At that time the submental adhesive tape, all dressings, and the silicone drainage tube were removed. The undermined area was gently milked out in the direction of the lobule to remove any residual serosanguineous fluid. Usually some swelling in the superior sternocleidomastoid region is apparent; this is often described by the patient as a “bull neck.” The patient is reassured that this temporary deformity will resolve over the next 2 weeks. From this point on the patient is allowed to shower and shampoo daily.



The patient returned 1 week postoperatively for suture removal. Postoperative edema has resolved significantly. Some ecchymoses are still visible, which can be concealed with camouflage makeup.



Preoperative

2 weeks postoperatively

6 weeks postoperatively

Two weeks postoperatively, edema and ecchymoses have almost completely subsided, which allows the patient to return to normal professional and social activities. The sternocleidomastoid swelling has also disappeared, but the patient will still note some mild tension in the temporal region. The patient is informed that this may take 2 months to disappear completely.

Six weeks postoperatively, correction of jowling, marionette grooves, and nasolabial folds is obvious. On frontal view, note the general volume shift in a cranial direction, resulting in a triangularization of her face. On lateral view, note the volume reduction in the submental area, with correction of the cervicomental angle. No folds or dog-ears are visible near the lobulus, confirming the futility of a retroauricular incision in this case. The axis and position of the auricle are unchanged in the vertical as well as in the horizontal direction.

Results

Simple MACS-Lift



This 52-year-old woman was discussed earlier in Preoperative assessment (p. 1387). Her correction was performed under local anesthesia with intramuscular sedation.

Surgical Plan

A simple MACS-lift
Submental liposculpture

The results are seen 1 year after surgery. Note the correction of the cervicomental angle and jowling, as well as the triangularization of her face and better definition of the jawline, which is best seen on the oblique view.



This 50-year-old woman presented with mild corrugator frown lines, correctly positioned eyebrows, and a discrete upper blepharochalasis. She complained of deep nasolabial folds, the downward slant of the corners of her mouth, and beginning laxity of the upper neck.

Surgical Plan

A simple MACS-lift

Botulinum toxin injections to the corrugator, procerus frontalis, and orbicularis oculi muscles

Upper blepharoplasty with resection of skin and muscle and removal of fat from the medial compartment

Submental liposculpture

Seen 1 year postoperatively, the patient shows a softening of the nasolabial folds, correction of the marionette grooves and the downward slant of the corners of the mouth, better definition of her jawline, and a tighter upper neck.

Extended MACS-Lift

This 63-year-old woman presented with facial aging, including facial deflation, sagging, and perioral rhytids. The general shape of her face was rectangular; her eyebrows were in the correct position. She had an apparent skin excess in the upper eyelids, caused by a combination of deflation of the medial part of the eyelid and descent of the tail of the eyebrow. She had baggy lower eyelids, with a moderate skin excess and a marked nasojugal groove. The midface was mildly deflated, especially in the suborbital area. There was a degree of midface ptosis marking the upper third of the nasolabial fold. In the lower third of the face, there were fine rhytids on the upper and lower lip, a downward slanting of the oral commissures, and marked marionette groove and jowling. The laxity in the neck was discrete.

Analysis of the photograph in her early twenties reveals a youthful oval shape to her face. The eyebrows are in a low horizontal position. The upper eyelids are full, with little marginal show. The lower eyelid is taut, with a smooth transition between eyelid and cheek skin and therefore there is no nasojugal groove. She has no nasolabial folds and smooth perioral skin. The jawline is clear, with no jowls or marionette grooves.

Surgical Plan

Extended MACS-lift
Short-scar temporal lift
Discrete upper skin blepharoplasty
Lower blepharoplasty with arcus marginalis release and fat redraping, with discrete skin excision at the end of the procedure
Microfat grafting in the medial part of the upper eyelid (2 cc), malar area (7 cc), nasolabial fold with subcision, including intradermal injection (2 cc), upper lip, including intradermal injection (2.6 cc), and lower lip, including intradermal injection (2.6 cc)

Her results 1 year postoperatively show a restoration of the youthful oval shape of her face. The tail of the eyebrow is slightly elevated, and the upper and lower eyelids have regained their youthful fullness. The sharp shadows of the nasojugal and nasolabial folds and marionette grooves are effaced. The perioral rhytids have disappeared without the use of any resurfacing technique. The jawline is again straight and well defined, and the neck contour is improved.





This 46-year-old woman presented with combined deflated and ptotic facial features. There was a discrete ptosis of the eyebrow tail, with significant hollowing of the upper eyelid. The lower eyelid was empty, without significant laxity. The midface was deflated and ptotic, resulting in a heavy nasolabial fold. The corners of the mouth continued into an incipient marionette groove. The definition of the jawline was disturbed by marked jowling. She also requested a reduction rhinoplasty.

Analysis of her photograph in her late twenties reveals a general oval shape of her face. The youthful fullness of the upper eyelids and midface is striking compared with the empty look in her forties. Note the absence of nasojugal and nasolabial folds and marionette grooves in her earlier photo.

Surgical Plan

Extended MACS-lift
Short-scar temporal lift
Microfat grafting of the medial upper eyelid hollow (1.5 cc), the malar and infraorbital area (10 cc), the nasolabial fold with subcision (3 cc), the marionette groove (2.5 cc); in total, 34 cc of fat grafted
Pinch lower blepharoplasty
Open rhinoplasty

The results after 1 year show a replenishment of her eyelids and midface, with a general triangularization of her face as a result of the cranial shift of soft tissue volumes. The nasolabial folds, marionette grooves, and jowls have corrected. Note the resemblance to her youthful photo.





This 49-year-old man requested facial rejuvenation. He had thick, heavy skin and generalized facial sagging. He has some fatty infiltration of the submental area and ptotic jowls, with deep nasolabial folds and heavy overlying grooves. The midface had descended, and there was a distinct crease between the cheek and lower eyelid, which bulged from the eyelashes to the infraorbital rim. His upper eyelids were hollow, and the eyebrows were heavy and low set. The tail of the eyebrow had dropped, causing lateral crowding, with two to three deep horizontal creases in the paracanthal area. The patient also had deep frontal wrinkles.

Surgical Plan

Submental liposuction

An extended MACS-lift

Pinch lower blepharoplasty with transconjunctival resection of fat

Short-scar temporal lift with galeopexy (this procedure was done under local anesthesia with intramuscular midazolam 4.5 mg and took 2 hours 40 minutes)

The patient, shown 9 months and 3 years later, demonstrates correction of the cervicomental angle, definition of the mandibular border, and improvement of the jowls, with suspension of the submandibular glands by vertical tightening of the platysma muscles. The nasolabial groove has been reduced, and the midface shows almost complete rejuvenation of the lid-cheek junction. The malar volume is enhanced; this effect can be best appreciated on the oblique view, where the effect of the temporal lift can also be seen. The tail of the eyebrow has been raised about 1 cm. The beard and sideburn remain in an anatomic position.

Today we would add microfat grafting in the midface and nasolabial folds to enhance the long-term stability of this patient's result.



Preoperative

9 months postoperatively

3 years postoperatively



This 56-year-old patient, described earlier (p. 1388), presented with general sagging of the lower part of the face with a marked nasojugal groove and demarcation of the inferior orbital rim, pronounced nasolabial folds, marionette grooves, jowling, and a fatty, infiltrated neck. Correction was performed under local anesthesia with intramuscular midazolam sedation.

Surgical Plan

Extended MACS-lift
Submental liposculpture
Lower pinch blepharoplasty

Her results, seen 18 months postoperatively, reveal a nice redistribution of facial volumes with augmentation of the zygomatic region, shortening of the vertical height of the lower eyelid, reduction of the skeletonized aspect of the orbital region, and a better transition between the lower eyelid skin and the cheek skin. There is visible softening of the nasolabial fold and the marionette grooves, better definition of the jawline, and correction of cervical skin laxity. The patient's general facial shape now appears less square and is more triangular and youthful looking.





This 60-year-old man presented with the stigmata of facial aging in the submental area and a total absence of cervicomental angularity and jawline definition. His jowling, marionette grooves, and nasolabial folds were pronounced. There was general sagging of the midface, with skeletonization of the lower orbital region. Correction was performed with the patient under general anesthesia (his preference), with a 1-day hospital stay.

Surgical Plan

Extended MACS-lift
Submental liposculpture

Transconjunctival fat removal
Pinch lower blepharoplasty

His results, seen 1 year postoperatively, reveal a stable correction of the aging facial features. The cervicomental angle has been reconstructed without opening the neck. Correction of the jowling is evident, with better definition of the jawline. The downward slant of the corners of the mouth was also corrected, and a general triangularization of his square face can be seen on frontal view. Four millimeters of lower eyelid skin was removed in the paracanthal region. This, together with the removal of transconjunctival fat, resulted in a natural, rejuvenated lower eyelid without changing the shape of the palpebral fissure.

In oblique and profile views, the inconspicuous preauricular and temporal hairline scar can be noted as well as the unaltered position of the sideburns because of the purely vertical redraping of the skin. This also resulted in a hair-free tragus, a natural male sideburn, and normal position of beard growth. A short haircut, as usually worn by men, is perfectly possible with the MACS-lift technique.





This 58-year-old patient presented with obvious signs of facial aging after a 60 kg (132-pound) weight loss as a result of a Scopinaro bowel reduction procedure. She showed significant general sagging of the total facial skin envelope, with marked jowling, obvious platysmal bands, and very noticeable perioral rhytids. Surgery was performed with a local anesthetic with intramuscular midazolam sedation.

Surgical Plan

An extended MACS-lift
Submental liposuction

Perioral erbium:YAG laser resurfacing
Posterior cervicoplasty

The 1-year postoperative view shows a very natural correction of the sagging facial features in a cranial direction. Correction of the submental area, with restoration of the cervicomental angle, was accomplished without opening the neck. A posterior cervicoplasty was necessary, not for the effect on the submental area, but for removal of unaesthetic skin folds at the end of the procedure. Jowls and marionette grooves were corrected, as were perioral rhytids. The skeletonized aspect of the orbital region was corrected by upward movement of the malar soft tissues and a subsequent lower pinch blepharoplasty.



Clinical Caveats

A short-scar face lift is not a classic face lift with a short scar.

The only rejuvenating vector is the vertical one. The horizontal vector does not rejuvenate the face, but puts the face under tension and causes flattening of the face.

The vertical vector should work on the deep tissues and on the skin.

Purse-string sutures strongly anchored to the deep temporal fascia are not the same as cable sutures from one point to another. A cable suture gives traction between two points. Purse-string sutures, as used in the MACS-lift, are a facial sculpturing technique that causes multiple microimbrications in the subcutaneous tissue.

After vertical redraping of the skin flap, the skin is resected in the temporal region. This skin resection will act as a lock of the microimbrication result on the subcutaneous facial tissues.

Skin suturing starts from superior to inferior to prevent and treat dog-ear formation in the temporal area.

Only when residual skin folds are visible in the infraauricular region at the end of the skin suturing is a posterior cervicoplasty carried out. This is done only for redraping of unacceptable skin folds and will have no effect on the submental region.

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The minimal access cranial suspension (MACS)-lift exists in a simple and extended version. The simple MACS-lift achieves a vertical lifting of neck and lower half of the face with two purse-string sutures. The action of a third, malar suture gives additional correction of the middle third of the face, and results in the extended MACS-lift. It produces a natural midface lifting through a short scar, with adequate softening of the nasolabial fold and good support of the lower eyelid.

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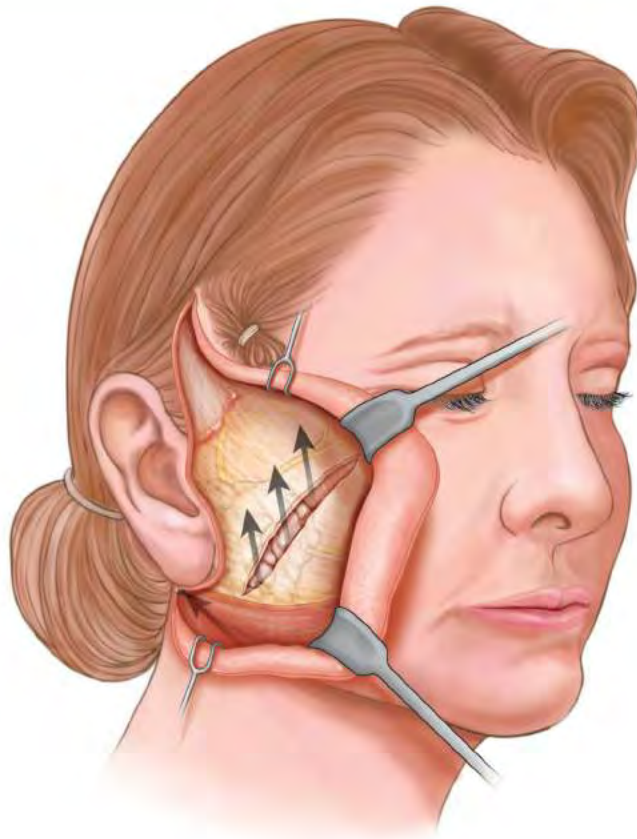
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CHAPTER 43



Short-Scar Rhytidectomy

DANIEL C. BAKER

Rhytidectomy is a procedure that continues to evolve as surgeons seek to offer patients natural rejuvenation with reduced morbidity. Over the years I have witnessed an evolution of techniques ranging from basic skin lifts to superficial musculoaponeurotic system (SMAS) procedures to even more complex, deep plane operations in search of an operation that reliably restores facial form with minimal morbidity. More recently, the need for extensive incisions for rhytidectomy has also been questioned. It has become increasingly clear that not all patients require the full classic temporal preauricular and retroauricular incisions. The incisions, as well as the planes or levels of facial dissection, should be individualized for each patient, in keeping with the physical changes related to aging and the desired result. As more patients seek facial rejuvenation at an earlier age, the need for surgical solutions that are less invasive and that involve less downtime is becoming increasingly important.

My approach to rhytidectomy has evolved over time. During my plastic surgery residency in the late 1970s, the rhytidectomy that I was taught was a combination of extensive defatting of the neck with complete platysma muscle transection, plicating the medial borders and pulling laterally. This was presented as the only way to achieve the “best results.” However, after many years of patient complaints, complications, and overoperated necks, I decided to abandon most of these techniques in favor of my current approach—a short-scar rhytidectomy with lateral SMASectomy or SMAS plication in selected cases.

Today there are a variety of rhytidectomy techniques that produce excellent results. Each surgeon must adopt a technique that serves his or her patients well and ideally is safe, consistent, and applicable to a variety of anatomic problems. For me, the short-scar rhytidectomy is a versatile technique that provides the solution I have been seeking for a wide range of problems for patients of various ages, without the downside of more traditional procedures. With this approach I am confident of obtaining consistently good results with shorter scars, minimal risk of complications, reduced morbidity, and speedy postoperative recovery. It is a quick, safe, and reproducible operation that combines the versatility of traditional SMAS flap undermining with the safety and rapidity of SMAS plication or lateral SMASectomy.

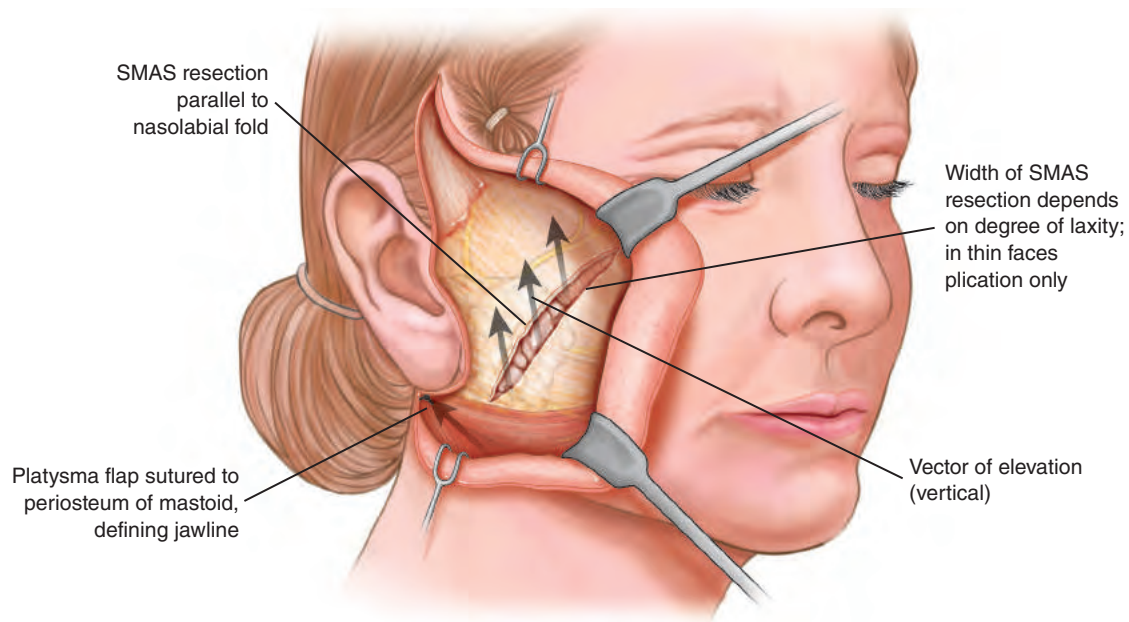
Evolution of Technique

SMAS

In 1976 the work of Mitz and Peyronie helped to popularize the SMAS. With this approach, the lateral SMAS was dissected directly overlying the parotid gland. I performed this type of SMAS dissection in the late 1970s and continued to do so into the mid-1980s. Generally I was disappointed with the effects of a simple elevation and tightening of the lateral superficial fascia, because I saw little appreciable difference in overall facial contour, regardless of whether a lateral SMAS dissection had been performed.

Increasing experience with SMAS dissection convinced me that the mobile SMAS anterior to the parotid gland would have to be elevated if the superficial fascia were to effect a change in facial contour. However, this more extensive SMAS dissection places the facial nerve branches in greater jeopardy. Additionally, the superficial fascia tends to thin out as it is dissected more anteriorly, making the SMAS more prone to tears. Because thinning and tearing after SMAS flap elevation was a common occurrence, compounded when significant tension placed on the SMAS flap during suturing resulted in additional tears, I concluded that extensive SMAS dissection was not warranted in most patients and offered little long-term benefit in comparison with SMAS plication.

Lateral SMASectomy



In 1992 I discovered the benefits of the lateral SMASectomy as an alternative to formally elevating the superficial fascia. With this approach, a portion of the SMAS is removed in the region directly overlying the anterior edge of the parotid gland at the interface of fixed and mobile SMAS. Excision of the superficial fascia in this region secures the mobile anterior SMAS to the fixed portion of the superficial fascia overlying the parotid gland. The SMASectomy is performed in a direction parallel to the nasolabial fold to ensure that the vectors of elevation after SMAS closure will lie perpendicular or more vertical to the nasolabial fold, thereby producing improvement in this fold as well as in the jowl and jawline.

Thus lateral SMASectomy became the foundation for my evolving face-lift technique. This was then combined with a short-scar approach, which addressed patient concerns about scarring and morbidity. The lateral SMASectomy also served as a debulking in full faced patients, but in thin faces I continued to perform SMAS plication.

Short-Scar Rhytidectomy



Although most classic face-lift incisions heal well and patients are happy, hairline disruptions like these are deforming and difficult to correct.

The short-scar rhytidectomy with lateral SMASectomy or plication developed out of the demands of younger female patients (mostly in their forties) who sought facial rejuvenation but were adamantly opposed to any scarring behind the ears. These patients objected to the posterior hairline distortion, hypertrophic scars, and hypopigmentation that they often observed in their friends or mothers who had undergone face lifts. They were embarrassed to wear their hair up or in a ponytail with such scars visible.

The concept of mini-lifts or reduced-incision face lifts is not new. Mini-lifts have been performed for almost a century; the first description of such a procedure was by Pas-sot in 1919. These early operations were usually preauricular skin excisions with minimal undermining, resulting in minimal, short-lived improvement. More recently, the S-lift concept and the MACS-lift techniques with suspension sutures have gained popularity.

My first experience with short-scar rhytidectomy was in 1990, when I operated on a young woman who had submental and submandibular fat and early jowling but good cervical skin elasticity. I performed lipoplasty of the neck and jowls with wide subcutaneous undermining in the face, detaching the malar and masseterocutaneous ligaments. A pure skin lift was done, with no retroauricular scars. The result was excellent, and this experience prompted me to adopt this procedure for all of my younger patients with similar anatomic features.

In 1992 I began to incorporate the lateral SMASectomy technique into the face-lift operation for women in their forties. I noticed that vertical elevation of the face had a beneficial effect on the cervical skin. Lax cervical skin was tightened because the soft tissues of the face and neck are linked anatomically. Between 1990 and 1998 I performed this operation, which had no retroauricular scars, on a total of 204 young female patients. The results were “ponytail friendly” for these young, active women.

As I gained experience with this operation and its potential benefits, I extended its application to older patients who demonstrated greater degrees of jowling and cervical laxity. With these patients, more extensive undermining was required in the neck and over the sternomastoid and submandibular regions and usually required a short retroauricular incision. This undermining exposed the platysma muscle in the neck, thereby facilitating elevation at the posterior muscle, continuous with the SMASectomy.

Between 1990 and 2009 I performed more than 2400 short-scar rhytidectomies with lateral SMASectomy or SMAS plication in patients ranging in age from 40 to 74. These patients exhibited a variety of facial aging changes and neck deformities. Today I can safely say that this procedure is as reliable and safe as other face-lift procedures. It is also reproducible by most plastic surgeons with generally consistent results in properly selected patients. However, it is *not applicable to all patients*, particularly those with excessive cervical laxity and poor skin elasticity. As I have gained more experience, my criteria for the best candidates have become more stringent. Today I rarely compromise the result for a shorter scar.

Advantages and Disadvantages

Lateral SMASectomy

Lateral SMASectomy has several advantages over traditional SMAS elevation. Because the procedure does not require traditional SMAS flap elevation, there is less concern about tearing of the superficial fascia. The potential for facial nerve injury is reduced because most of the deep dissection is over the parotid gland. If the SMASectomy is performed anterior to the parotid gland, the deep fascia will similarly provide protection for the facial nerve branches as long as resection of the superficial fascia is done precisely and the deep facial fascia is not violated. Because SMAS flaps have not been elevated, they tend to hold suture fixation more strongly, and thus the potential for postoperative dehiscence and relapse of contour is decreased.



SMAS resection begins over parotid, extends to lateral canthus



Resection at interface of fixed and mobile SMAS



Width of SMAS resection depends on laxity

A lateral SMASectomy or SMAS plication is performed at the interface of the superficial fascia fixed by the retaining ligaments and the more mobile anterior superficial facial fascia.



On closure, this brings the mobile SMAS up to the junction of the fixed SMAS, producing a durable elevation of both superficial fascia and facial fat. In thin-faced individuals, no SMAS or fat is removed; instead, the lax SMAS is imbricated and plicated to recontour atrophic areas in the face and to correct the midface and nasolabial folds.

Short-Scar Face Lift

The primary advantage of a short-scar rhytidectomy is that it allows patients who wear their hair pulled up or back to do so. Any retroauricular scarring or disruption of the posterior hairline makes such patients unhappy. In addition, the operation involves less dissection and is less invasive; presumably this causes less pain and results in a shorter healing time. In patients who develop hematomas, evacuation is easier with less morbidity.

Advantages and Disadvantages of Minimal-Incision Rhytidectomy	
Advantages	Disadvantages
Less dissection	Requires more vertical skin lift
Less invasive	Difficult to fit in “dog-ears” in temporal and earlobe areas
Less scarring	Requires time for temporal hairline scar to smooth
Avoids posterior hairline distortion	Requires time for retroauricular sulcus/earlobe scar to smooth
Allows easier hematoma evacuation	Occasionally causes skin fold at base of earlobe
Neck exposure	Is not applicable to patients with severe cervical laxity and poor skin elasticity
Ponytail friendly	

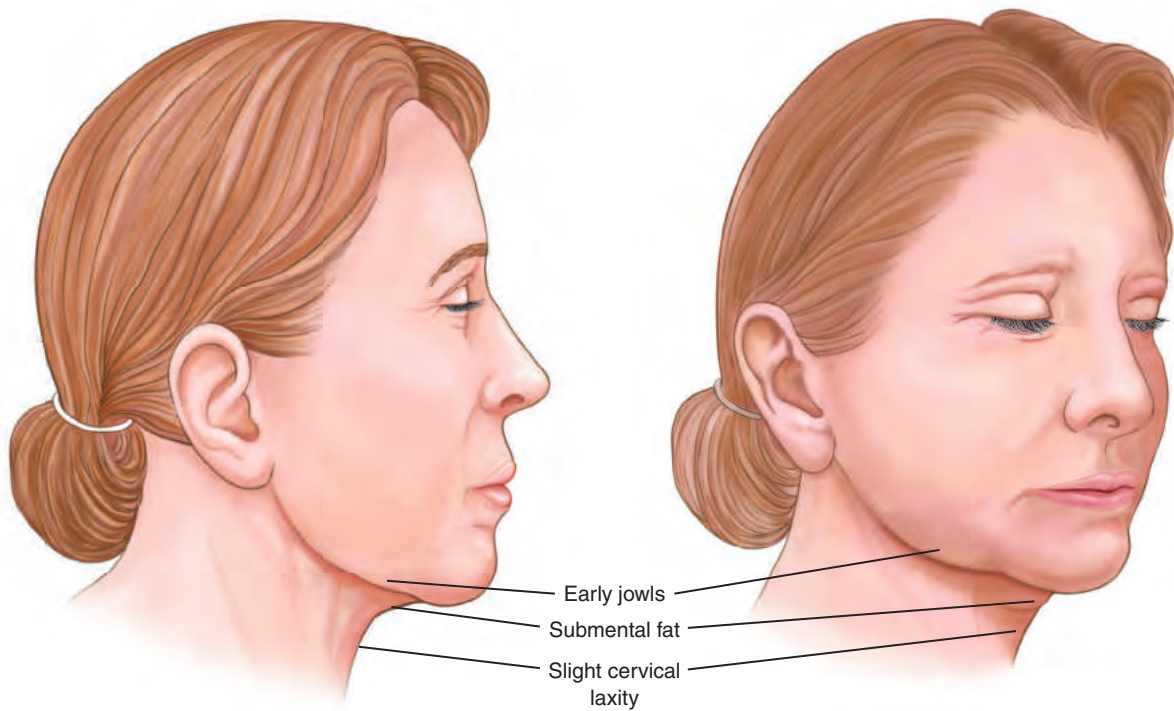
There are disadvantages as well. This technique is not suitable for all patients, especially those with severe cervical skin laxity. Because the technique requires a significant vertical lift, strict attention must be paid to minimizing temporal hairline shifts. In certain patients an anterior hairline incision must be used. Fitting dog-ears into the temporal and earlobe areas can be a challenge, and these areas take more time to soften and flatten. Exposure of the neck with the short-scar technique is limited, sometimes making the operation technically more difficult.

However, I do not use this technique in every patient, and there is still the occasional patient (usually with a very thin face) who has an excellent result with only a skin undermining and redraping procedure. There are other patients with severe cervico-facial laxity and loss of elasticity who benefit from a classic rhytidectomy operation with retroauricular scars. Most classic rhytidectomy incisions, if well placed and closed without tension, will heal well with minimal scarring.

Preoperative Assessment

Patient Profiles

Based on my surgical experience with this procedure, I have classified candidates for this procedure into four types as follows.

Type I: The Ideal Candidate

Characteristics	Surgical Plan
Age early to late forties	Suction-assisted lipoplasty (neck)
Aging primarily facial	SMASectomy or plication
Early jowling	Plication only in a thin face
Slight cervical skin laxity	Chin implant if indicated
May have submental fat	
May have microgenia	
Good skin elasticity	

Ideal candidates for a short-scar rhytidectomy are usually in their early to late forties, with signs of aging primarily in the face. Although they may have slight cervical laxity, skin elasticity is still good. They have early jowling, often with submental and submandibular fat. Microgenia may also be present.

These patients can be effectively treated with closed lipoplasty of the neck and jowls, wide subcutaneous skin undermining, and lateral SMASectomy or plication. No retroauricular incision is necessary to improve the neck and face. If indicated, a chin implant will enhance the result.

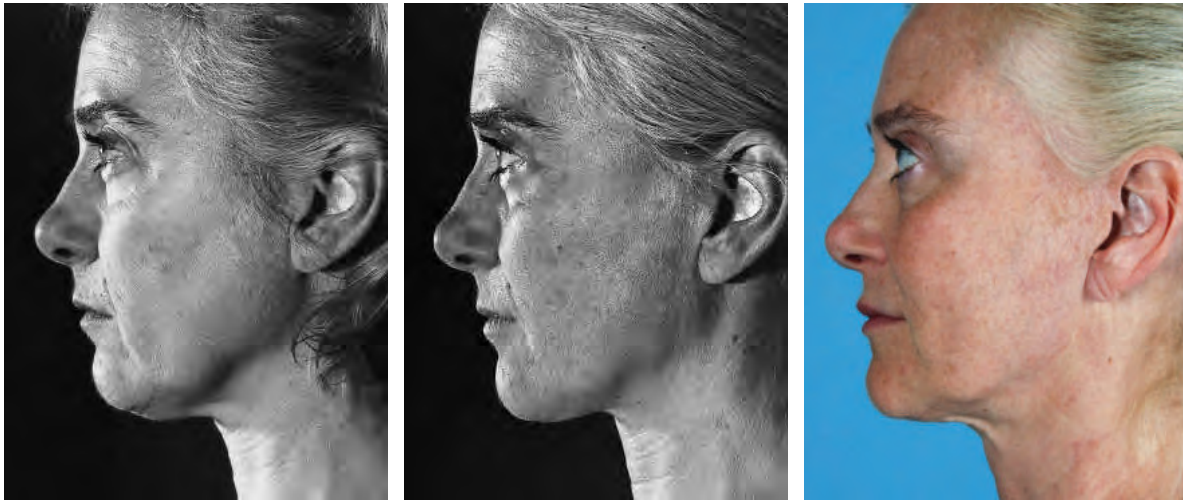


Preoperative: 47 years old

8 months postoperatively

10 years postoperatively: 57 years old

This woman is an example of a type I patient. She underwent a short-scar rhytidectomy and is shown 8 months postoperatively as well as 10 years postoperatively, when she returned for a secondary rhytidectomy.



Preoperative: 47 years old

8 months postoperatively

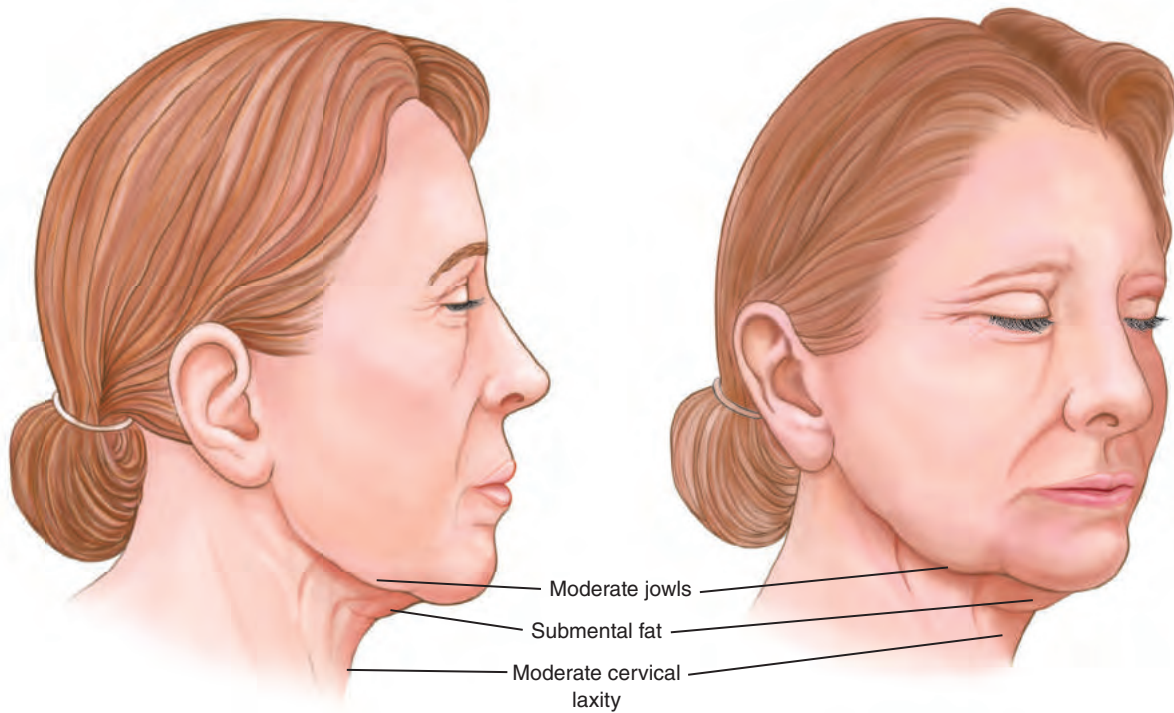
10 years postoperatively: 57 years old



Scars 10 years postoperatively



This 48-year-old woman had early jowling and cervicofacial laxity. Her face was thin and her body fat was low. At work she always wore her hair in a ponytail and was greatly concerned about retroauricular scars and posterior hairline disruption. Her presentation made her a type I (“ideal”) candidate for short-scar rhytidectomy. Her thin face and hollow cheeks were best treated with plication and imbrication to augment and recontour her face. Her 1-year postoperative results demonstrate an overall change in her facial shape to oval, with correction of the jowls and midface and enhancement of her cheekbones. The lateral view shows correction of the neck, with preservation of the hairline and imperceptible scars.

Type II: The Good Candidate**Characteristics**

Age late forties to late fifties
 Moderate jowls
 Moderate cervical skin laxity
 Submental/submandibular fat
 May have microgenia
 No active platysma bands

Surgical Plan

Suction-assisted lipoplasty (neck)
 SMASectomy/platysma resection
 Plication only in a thin face
 Chin implant if indicated

These patients are usually in their late forties to late fifties with moderate jowling and cervical skin laxity. Submandibular and submental fat is usually present, and they may have microgenia. Medial platysma bands are not present on normal animation. (I do not evaluate the platysma on forced animation or on the basis of static photographs; often what may appear to be significant platysma bands represents laxity only, which can be corrected with a lateral pull.)

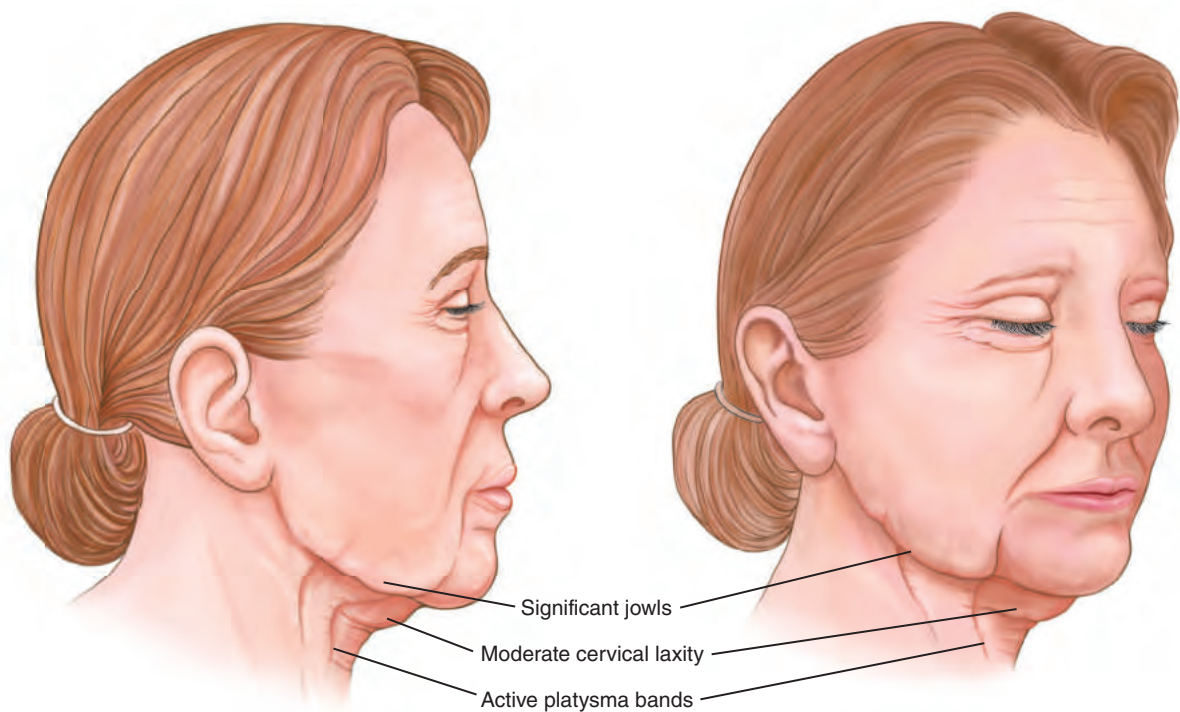


Closed lipoplasty of the neck and jowls along with lateral SMASectomy or plication produces a good result in these patients. If indicated, a chin implant will enhance the result. Usually a retroauricular incision is not required. However, if a dog-ear is present at the earlobe, it can be corrected with a short retroauricular incision.



This 55-year-old woman had moderate jowling and cervicofacial laxity with minimal submental fat. Excess skin and fat of the upper and lower eyelids was present. She represented a type II (“good”) candidate for short-scar rhytidectomy. To maintain facial fat and restore facial fullness, plication of the SMAS and platysma was performed. Her 1-year postoperative result demonstrates reestablishment of a youthful, oval facial shape, enhancement of the submalar region and cheekbones, and correction of the oral commissures. The lateral view demonstrates correction of the cervical laxity and jawline, with preservation of the hairline.

Type III: The Fair Candidate



Characteristics	Surgical Plan
Age late fifties, sixties, early seventies	Open submental suction-assisted lipoplasty
Significant jowls	Platysma approximation at hyoid with wedge excision
Moderate cervical skin laxity	SMASectomy or plication
Submental/submandibular fat	Usually extension of incision into retroauricular sulcus
Platysma bands on animation	Chin implant if indicated
May have microgenia	
Some secondary rhytidectomy	

Fair candidates are usually in their late fifties, sixties, or early seventies. They exhibit significant jowling, moderate cervical laxity, and submental and submandibular fat. Significant medial platysma bands, active on natural animation, may also be present.

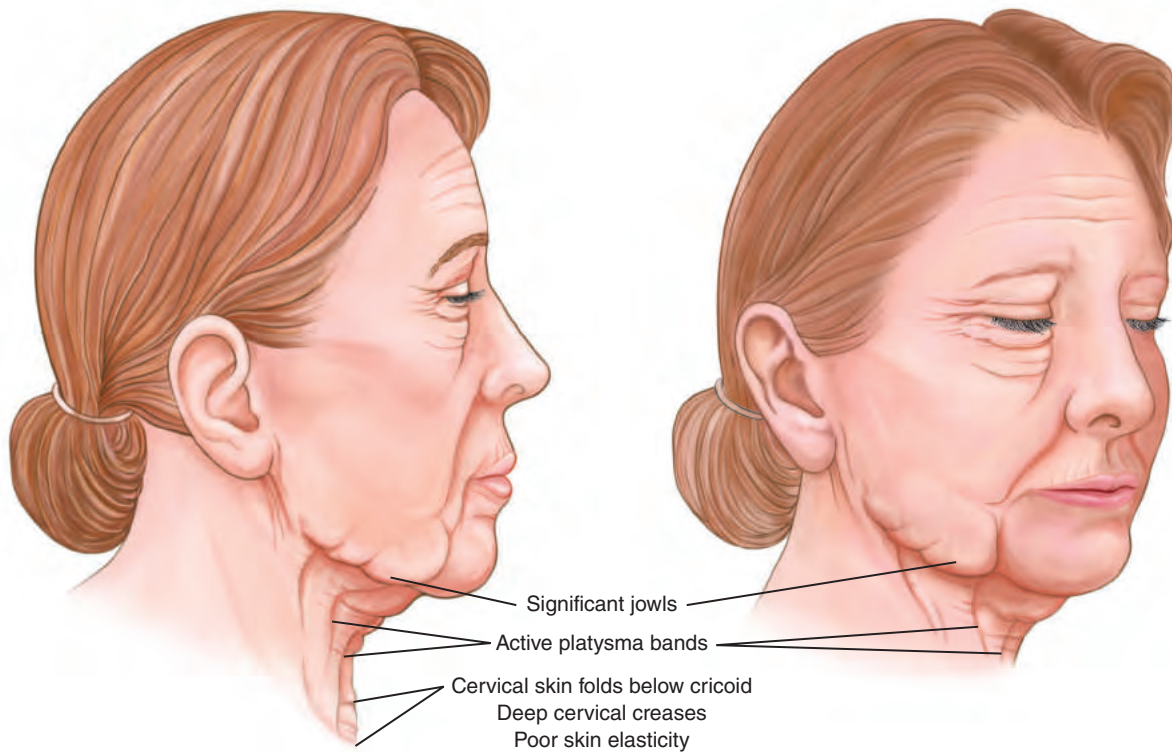
The approach to type III patients is via an open submental incision connecting subcutaneous undermining with the face and lateral neck. Open lipoplasty of submental and submandibular fat is performed to expose the platysma muscle. A 4 to 5 cm wedge of platysma is removed at the level of the hyoid. The medial borders of the platysma muscle are approximated to define the cervicomental angle. Lateral suturing of the platysma to the mastoid periosteum enhances the jawline. If redundant skin is present at the earlobe after redraping, it can be removed with a short retroauricular incision. It must be emphasized that in a type III patient the neck improvement and its longevity are usually not as successful as when a classic rhytidectomy with retroauricular scars is performed.



This 59-year-old woman had significant jowling and cervicofacial laxity with microgenia. She had excess skin and fat of her upper eyelids and represented a type III (“fair”) candidate for short-scar rhytidectomy. A lateral SMASectomy was performed to reduce jowl and cheek fullness. An upper blepharoplasty was also performed, and a chin implant placed. Her 1-year postoperative results demonstrate improvement in the facial shape and midface, with enhancement of the cheekbones. Neck improvement resulted from midline platysma approximation and a chin implant. No subplatysmal work was done. A rhytidectomy cannot eliminate deep rhytids from the commissures and jowl area.



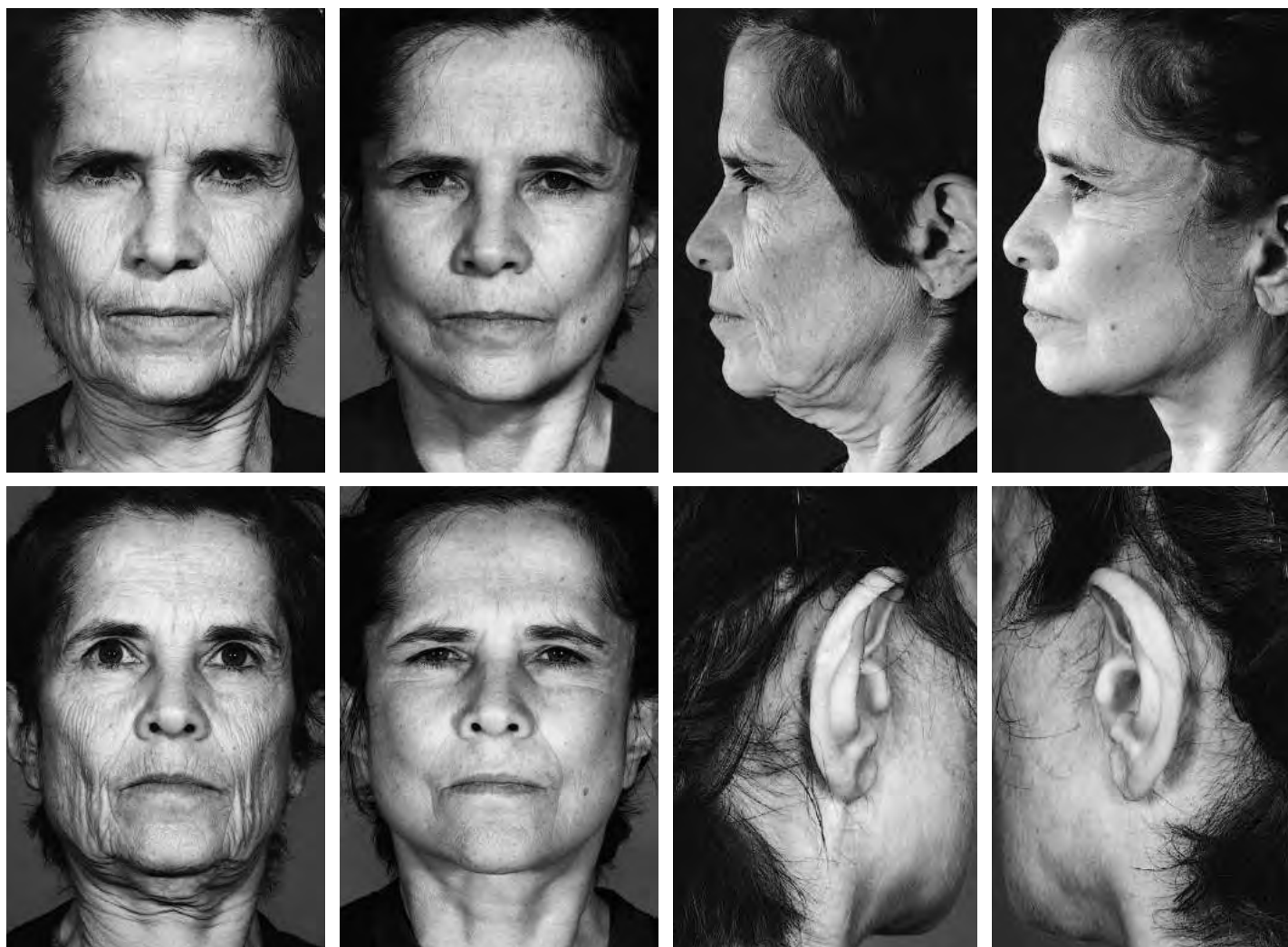
This 53-year-old woman had always had submental fullness and lacked cervico-mental definition. She represented a type III (“fair”) candidate for short-scar rhytidectomy. Her 1-year postoperative results demonstrate improvement in the neck and jowls and reshaping of the face. Despite the fact that no subplatysmal work was done, the lateral view demonstrates overresection of subcutaneous fat, leaving a slight submental hollow and a prominent, ptotic chin.

Type IV: The Poor Candidate**Characteristics****Surgical Plan**

Age late sixties and seventies	A significant compromise
Significant jowls	Open submental suction-assisted lipoplasty
Poor cervical skin laxity	Platysma approximation at hyoid with wedge excision
Skin folds below cricoid	SMASectomy/platysma resection
Submental/submandibular fat	Removal of dog-ear in retroauricular sulcus
Platysma bands on animation	Chin implant if indicated
Deep cervical creases	Requires more extensive undermining for skin redraping
Poor skin elasticity	Retroauricular incision can always be extended

Poor candidates are usually in their sixties and seventies, with significant jowling and active, lax platysma bands. Skin folds and deep creases below the cricoid cartilage are often present, and cervical skin elasticity is poor. Although these patients are not good candidates for a short-scar rhytidectomy, this operation can be offered to them as a compromise solution that keeps open the option of extending the retroauricular incision if necessary. Laterally and posteriorly, it is usually necessary to undermine over the mastoid and sternocleidomastoid muscles to obtain proper skin redraping. Excess cervical skin must be tailored into the retroauricular sulcus.

The short-scar technique is a compromise in these patients, and the improvement in the neck is rarely as good as would be obtained with a classic rhytidectomy with wide anterior and posterior cervical undermining and redraping.



This 60-year-old woman is an example of a type IV patient. She underwent a short-scar rhytidectomy with a temporal hairline incision. She is shown 1 year postoperatively with no posterior hairline incision.



This 60-year-old woman demonstrated cervical laxity below the cricoid, extending to the sternal notch. She was a poor candidate for a short-scar face lift, which would have compromised the improvement of her cervical laxity. Although the patient has a nice improvement after undergoing a short-scar rhytidectomy, the postoperative result demonstrates persistent cervical laxity extending to the sternal notch. The patient was not happy and required neck revision with a classic retroauricular incision. This much cervical laxity can only be corrected with wide through-and-through undermining and removal of excess skin through the retroauricular occipital incision.

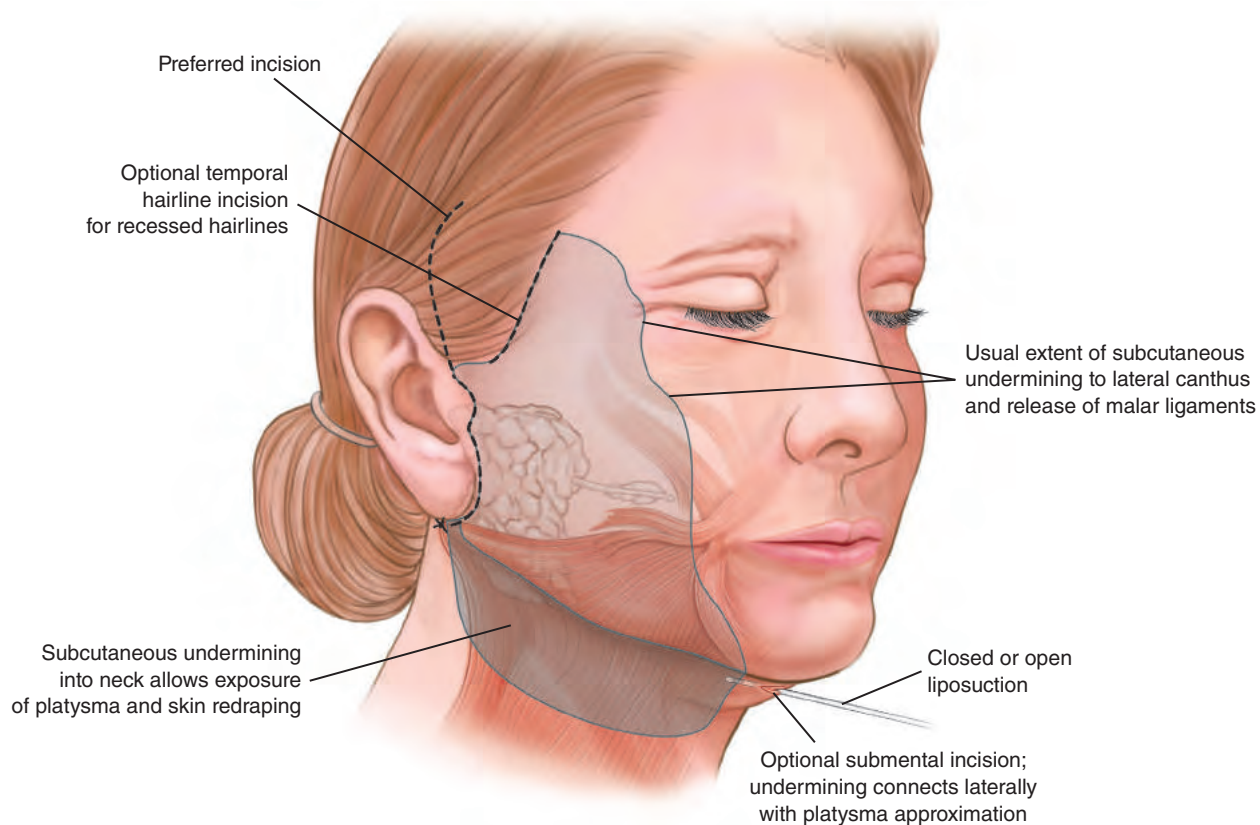
Operative Technique

Anesthesia

In virtually all of the face lifts I perform, the patient is under monitored intravenous propofol sedation. Patients are given oral clonidine, 0.1 to 0.2 mg, 30 minutes before surgery to control their blood pressure. The face and neck are infiltrated with local anesthetic, 0.5% lidocaine with 1:200,000 epinephrine, through a 22-gauge spinal needle. I inject the face before I scrub to provide the requisite 10 minutes for vasoconstriction to occur.

Incisions

When the temporal hairline shift is minimal, the preferred incision is placed well within the temporal hair. With this incision it is often necessary to excise a triangle of skin below the temporal sideburn at the level of the superior root of the helix.



When a larger skin shift is anticipated (frequently the lift is more vertical with a short-scar rhytidectomy) or the distance between the lateral canthus and the temporal hairline is greater than 5 cm, the incision is made a few millimeters within the temporal hairline. Although this is a compromise, the alternative of a receding temporal hair-

line is rarely acceptable to female patients. When the incisions are executed properly (it is essential to bevel the incision at least 45 degrees through the hair follicles as well as the redraped flap so hair can grow through the incision), these scars heal well and are easy to revise or camouflage. The only exception might be in a patient with deeply pigmented skin in whom the scar will contrast and appear as a white line.

The choice of preauricular incision is left to the surgeon. When executed properly, all of these incisions heal well and are imperceptible. I usually prefer a curved incision anterior to the helix and continue inferiorly anterior to the tragus in a natural skinfold. This preserves the thin, pale, hairless tragal skin and its demarcation from the cheek skin, which is usually coarser, thicker, darker, and has lanugo hairs. I perform intratragal incisions in patients in whom the cheek and tragal skin is similar and the tragal cartilage is not sharp or prominent. Closure must be without tension and the flap overlying the tragus defatted to the dermis.

In a short-scar rhytidectomy, I try to end the incision at the base of the earlobe. This is usually possible in type I or II patients, but in type III or IV patients a shorter retroauricular incision is often necessary to correct a dog-ear after the facial flap rotation.

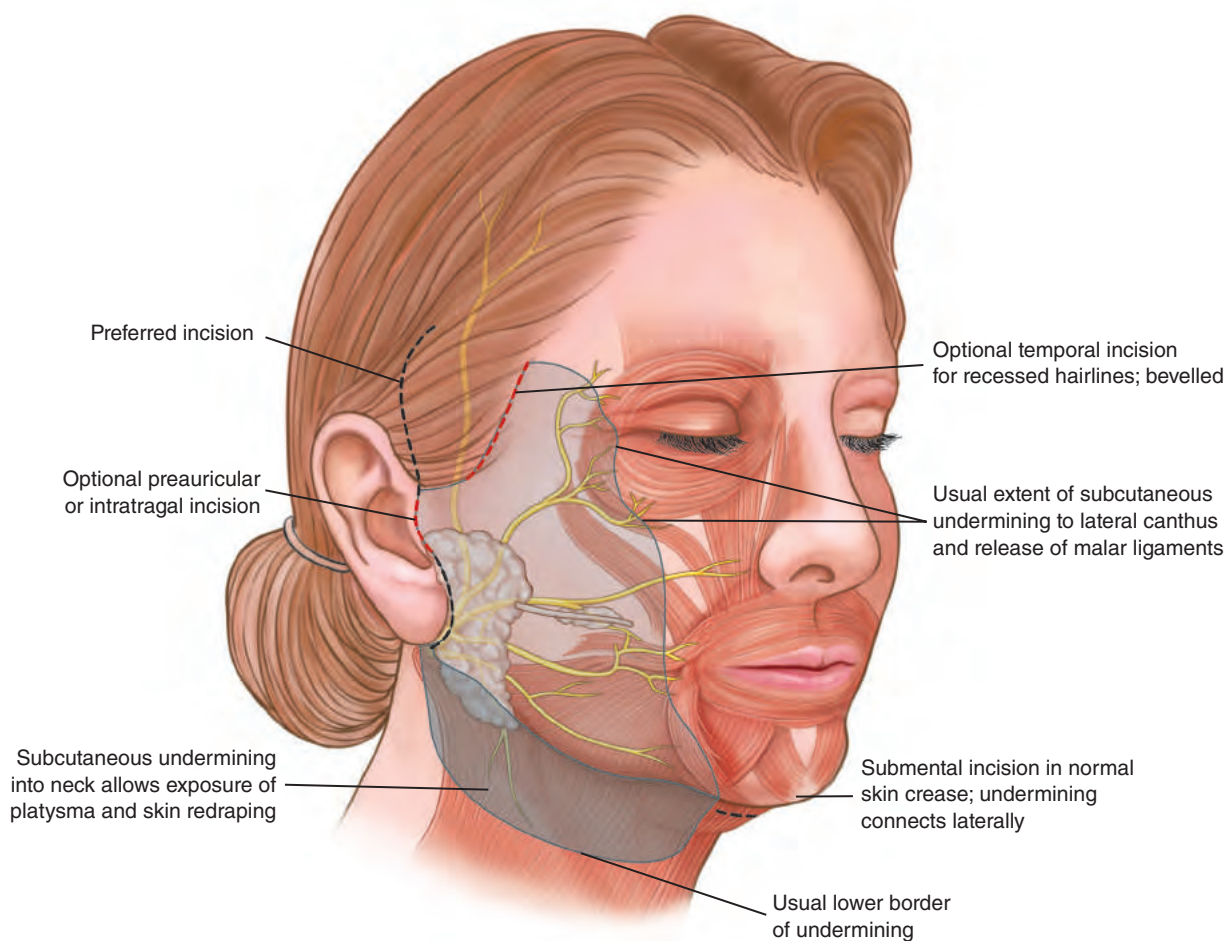
Skin Flap Elevation

All skin flap undermining is carried out under direct visualization with scissors dissection to minimize trauma to the subdermal plexus and preserve a significant layer of subcutaneous fat on the undersurface of the flap. I prefer subcutaneous dissection in the temporal region, because the skin seems to redrape better. I believe that hair loss results primarily from tension rather than superficial undermining. Subcutaneous dissection in the temporal region must be performed carefully to avoid penetrating the superficial temporal fascia that protects the frontal branch of the facial nerve. All dermal attachments between the orbicularis oculi muscle and the skin are separated up to the lateral canthus.

Dissection extends across the zygoma to release the zygomatic ligaments but stops several centimeters short of the nasolabial fold. I have never believed that further dissection provides significant benefits; on the contrary, the only result is increased bleeding. In the cheek, dissection releases the masseteric-cutaneous ligaments and, if necessary, the mandibular ligaments.

Subcutaneous dissection continues over the angle of the mandible and sternocleidomastoid for 5 to 6 cm into the neck. This exposes the posterior half of the platysma muscle. If a submental incision has been made, the facial and lateral neck dissection is connected through and through to the submental dissection.

Defatting the Neck and Jowls



The extent of subcutaneous undermining in the temporal area, cheek, and lateral neck is shown. If excess fat is present, closed or open liposuction superficial to the platysma is performed in the submental and submandibular areas. When necessary, medial platysma approximation is done through the submental incision.

Whenever possible, I prefer closed suction–assisted lipoplasty in the neck and jowls. A 2.4 mm Mercedes-tip cannula is used; it is kept under constant, steady motion in the subcutaneous space. A 3 to 5 mm layer of subcutaneous fat is left on the under-surface of the cervical skin. If the jowls are suctioned, this is always done conserva-

tively. Subplatysmal fat is rarely suctioned or removed, because the facial nerves run just beneath the platysma. Additionally, any patient with significant subplatysmal fat probably has a fat, round face, so removing subplatysmal fat could create an over-operated look. This, of course, is a personal aesthetic surgical judgment.

Lipoplasty is usually performed before elevating the skin flaps, taking care not to oversuction the portion of the SMAS-platysma that will be elevated over the mandible with the lateral SMASectomy.

Open Submental Incision With Medial Platysma Approximation

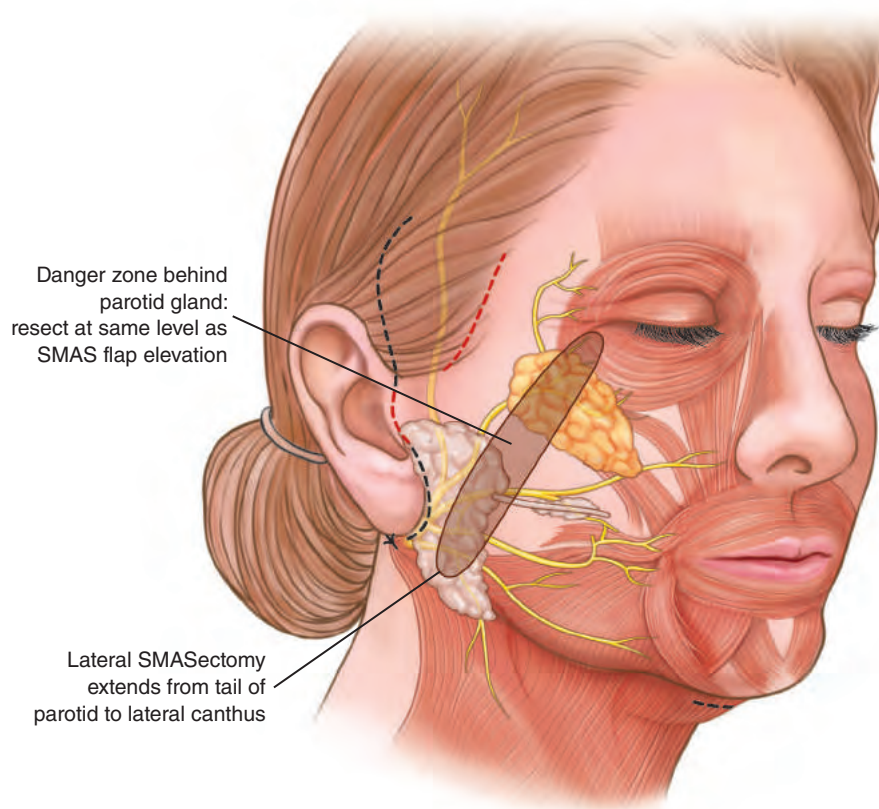
After many years, I now only open the neck when prominent active platysma bands are present. I have found that I can achieve excellent results with closed lipoplasty and a strong lateral platysma vector. Therefore, in type III and IV patients with active platysma bands on animation, the medial approximation provides another vector to enhance the cervicomental recontouring.

I prefer to make the submental incision in the submental crease. The subcutaneous dissection is performed with the patient's neck hyperextended. Undermining is usually to the level of the thyroid cartilage and the angle of the mandible. Suction-assisted lipoplasty is then performed with a large, single-hole cannula under direct vision. Direct fat excision is carried out, if necessary, but to avoid creating depressions, subplatysma fat is rarely removed.

The medial borders of the platysma muscle are identified and elevated for several centimeters. To break the continuity of the bands, a wedge of muscle is removed at the level of the hyoid bone. The medial borders of the muscle are then sutured together with interrupted buried 3-0 PDS sutures.

The submental incision is left open to allow a final confirmation hemostasis and recontouring after communication with the facial dissection and completion of the lateral SMASectomy.

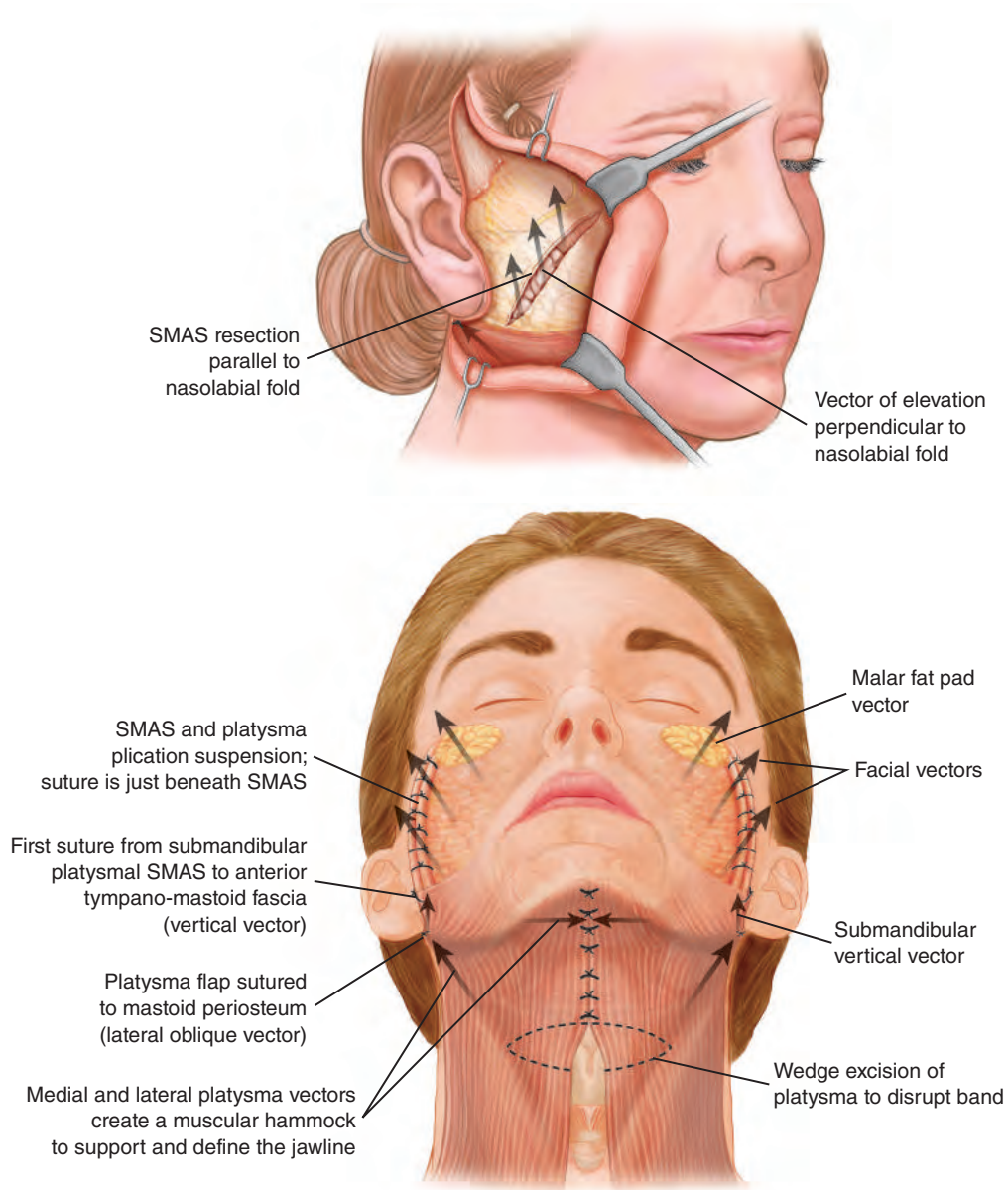
Lateral SMAS Plication



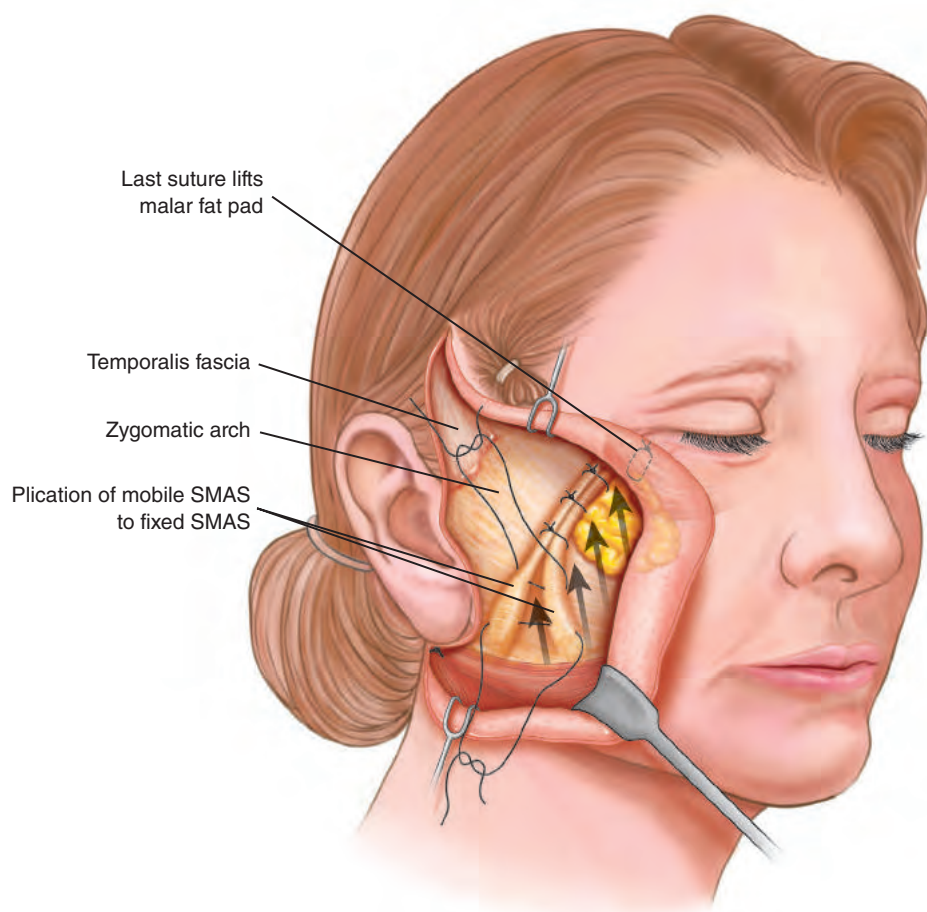
In the SMAS-platysma resection, the level of resection is superficial to the parotid masseteric fascia that overlies the facial nerve branches. The outline of the SMAS-ectomy is marked on a tangent from the lateral malar eminence to the angle of the mandible, essentially in the region along the anterior edge of the parotid gland. In most patients this involves a line of resection extending from the lateral aspect of the malar eminence toward the tail of the parotid gland. Frequently, orbicularis oculi muscle fibers are exposed at the superior limit of the excision. Usually a 2 to 4 cm segment of superficial fascia is excised, depending on the degree of SMAS-platysma laxity and debulking required.

In a SMAS resection, I like to pick up the superficial fascia in the region of the tail of the parotid gland, extending the resection from inferior to superior in a controlled fashion. When SMAS resection is being performed, it is important to keep the dissection superficial to the deep fascia and avoid dissection into the parotid parenchyma. The size of the parotid gland varies from patient to patient; consequently, the amount of protection needed for the underlying facial nerve branches will also vary. Despite this, as long as the dissection is carried superficial to the deep facial fascia, ensuring that only the superficial fascia is resected, facial nerve injury as well as parotid injury will be prevented. In essence, this is a resection of the superficial fascia in the same plane of dissection in which one would normally raise a SMAS flap.

Vectors



The following vectors are illustrated: (1) vectors of elevation of the SMAS-platysma and (2) vectors of superolateral elevation of the SMAS-platysma and medial approximation of the anterior platysma in the submental area above the hyoid bone. The various vectors accomplish corrections of the anterior neck, cervicomental angle, jowls, and nasolabial folds. The first key suture grasps the platysma at the angle of the mandible and advances it in a posterosuperior direction; it is secured with figure-of-eight 2-0 Maxon sutures to the fixed lateral SMAS overlying the parotid gland. This lifts the cervical platysma and cervical skin, helps to define the jawline, and improves contouring in the submandibular region.



The lines of closure of the lateral SMAS–platysma in the cheek and the lateral neck and medial platysma approximation in the submental area are depicted. Excess fat in the mastoid and submandibular areas is removed by liposuction. After SMAS resection, interrupted 3-0 and 4-0 PDS buried sutures are used to close the SMASectomy; the fixed lateral SMAS is evenly sutured to the more mobile anterior superficial fascia. The last suture lifts the malar fat pad, securing it to the malar fascia. It is important to obtain a secure fixation to prevent postoperative dehiscence and relapse of the facial contour.

If firm monofilament sutures are used, such as PDS or Maxon, the sutures should be buried and the sharp ends on the knot trimmed. Final contouring of any SMAS or fat irregularities along the suture line is completed with scissors. Fat can also be trimmed at the sternomandibular trough; final contouring is accomplished with liposuction.

Skin Closure, Temporal Fascia, and Earlobe Dog-Ears

After SMAS and platysma approximation, some tethering of the skin might appear at the anterior extent of the subcutaneous dissection because of the pull of the underlying SMAS. This can also occur in the lower eyelid with elevation of the malar fat pad. Further subcutaneous undermining is necessary to free these tethers, allowing the skin to redrape.

Facial skin redraping is done with a less-vertical vector than with the SMAS. The first key skin suture rotates the facial flap posteriorly to redrape the midface, jowls, and submandibular skin. Suture fixation is at the level of the insertion of the superior helix. I like to use a buried 3-0 PDS suture through the temporal fascia with a generous bite of dermis on the skin flap. The closure is performed with minimal tension. Staples are used to close any incisions in the hair. A wedge is usually removed at the level of the sideburn to preserve the hairline. If an anterior hairline incision has been made, I like to close it with buried 5-0 Monocryl sutures and 5-0 nylon sutures. Extra time and attention must be spent on this closure to eliminate any dog-ears and obtain the finest scar. Bevelling the facial flap will enhance hair growth through the scar.

Excess skin is then trimmed from the facial flap so that there is no tension on the preauricular closure. Wound edges should be “kissing” without sutures. Trimming at the earlobe must also be without tension, and the skin flap is tucked under the lobe with 4-0 PDS sutures, taking a bite of earlobe dermis, cheek flap dermis, and conchal perichondrium to minimize any tension. A small dog-ear might be present behind the earlobe; this is easily trimmed and tailored into a short incision in the retroauricular sulcus. A closed suction drain is usually brought out through a separate stab wound in the retroauricular sulcus to drain the neck, and a Penrose drain is placed through the temporal incision to drain the face.



This patient underwent a lateral SMASectomy via short-scar rhytidectomy with an anterior hairline incision. She is shown postoperatively at the conclusion of surgery before dermabrasion (A), after dermabrasion (B), in frontal and lateral views 1 week after dermabrasion (C and D), and in a retroauricular view at 2 weeks (E). The bunching around the earlobe will smooth with the passage of time; the retroauricular crease and occipital hairline are undisturbed. The preauricular and temporal hairline inci-

sion is shown 2 weeks postoperatively (*F*). Ancillary procedures included an upper lid blepharoplasty, rasping of the nasal dorsum, insertion of an extended chin implant, perioral and glabellar dermabrasion, and lower lid laser resurfacing.

Complications

The table summarizes the complications of short-scar rhytidectomy in my series, which are consistent with those of other standard face-lift operations. Despite special attention to blood pressure control in the postoperative period, the hematoma rate is still 1.5%. The most common problems are the need for minor revisions of the earlobe and temporal hairline scars, but these are far less significant than when I was revising retroauricular scars or trying to repair posterior hairlines.

Complications of the Short-Scar Face Lift

Complication	Frequency (%)
Hematoma	1.5
Facial paralysis (all resolved in 2 months)	0.3
Infection (abscess)	0.8
Skin slough (minor)	1.0
Hypertrophic scars	2.0
Suture granuloma (PDS)	3.5
Earlobe deformity	0.8
Retroauricular pleating	2.0
Temporal hairline scar revision	3.0
Cervical tightening/platysmaplasty in poorly selected patients	2.0

Outcomes

In properly selected patients, the results and duration seem similar to what is achieved with classic rhytidectomies. Type I and II patients who have returned at 8 to 10 years for secondary lifts were very pleased with the results of the first operation. The short-scar technique was used for all secondary lifts. For type III and IV patients, the result in the neck will not be as good when classic retroauricular incisions are made. This category of patients is more likely to require some type of neck revision. The limitations must be discussed preoperatively.

Of the short-scar rhytidectomies I performed from 1990 to 2009, all but 15 were performed on women. Because a man's neck usually has a thicker layer of skin and muscle, few male patients are candidates for this procedure.

After 20 years and 2400 short-scar rhytidectomies, I implemented stricter indications:

- Young
- Good skin elasticity
- Minimal cervical laxity
- Open neck for platysma
- Rarely compromise the result for a short scar

Results



This 44-year-old woman exhibited the signs of a typical type II patient. She underwent a short-scar rhytidectomy with a SMASectomy and an upper eyelid blepharoplasty. We also inserted a chin implant. She is shown 2½ years postoperatively, with an absence of retroauricular and occipital incision scars.



This 68-year-old woman underwent a short-scar rhytidectomy. A 35% trichloroacetic total facial peel and perioral and glabellar dermabrasion were performed at the time of surgery. A small, extended chin implant was also inserted. This woman was a heavy smoker, so the submental area was not opened. She is shown 5 months post-operatively.

Concluding Thoughts

The short-scar rhytidectomy is an excellent face-lift technique for younger patients with good skin elasticity and minimal cervical laxity. Older patients with excessive cervical laxity and poor skin elasticity do not get optimal results from this technique, so it is a compromise for them. Rarely will I sacrifice the result for a shorter scar.

Clinical Caveats

When the temporal hairline shift is assessed as minimal, the preferred incision is well within the temporal hair.

The temporal hairline incision allows a more vertical elevation of the facial flap while preserving the hairline.

All skin flap undermining is carried out under direct vision (with scissors dissection) to minimize trauma to the subdermal plexus and preserve a significant layer of subcutaneous fat on the undersurface of the flap.

Subcutaneous dissection in the temporal region must be performed carefully to avoid penetrating the superficial temporal fascia that protects the frontal branch of the facial nerve.

Whenever possible, I prefer to use closed section-assisted lipoplasty in the neck and jowls.

I usually perform lipoplasty before elevating the skin flaps. In doing so, I am careful not to oversuction the portion of the SMAS-platysma that will be elevated over the mandible with the lateral SMASectomy.

When SMAS resection is being performed, it is important to keep the dissection superficial to the deep fascia and avoid dissection into the parotid parenchyma. Because the size of the parotid gland varies from patient to patient, the amount of protection for the underlying facial nerve branches will also vary.

After SMAS resection, interrupted 3-0 PDS buried sutures are used to close the SMASectomy, the fixed lateral SMAS being evenly sutured to the more mobile anterior superficial fascia. The last suture lifts the malar fat pad, securing it to the malar fascia. It is important to obtain a secure fixation to prevent postoperative dehiscence and relapse of facial contour.

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Suggested Readings

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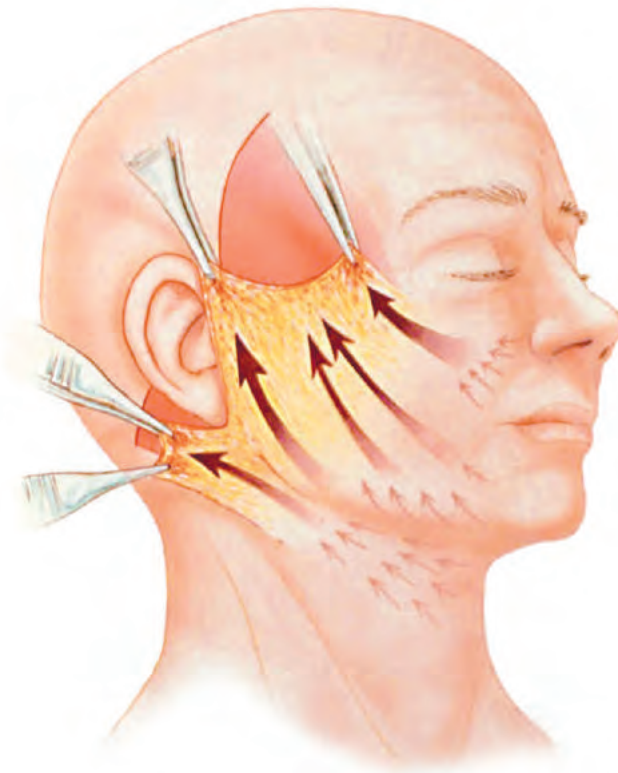
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CHAPTER 44



Extended SMAS Technique in Facial Rejuvenation

JAMES M. STUZIN

Surgical rejuvenation of the aging face has become one of the most frequently performed surgical procedures in the United States. Face lifting, introduced as a skin tightening procedure in the early 1900s, has technically matured during the past quarter-century. This evolution is directly related to scientific investigation of facial soft tissue anatomy, resulting in a better understanding of the changes that occur with aging. Over the past 30 years, a number of procedures have been developed with a variety of technical approaches to reconstruct aging-related anatomic changes.

When the face lift was first developed, both patients and surgeons focused on the laxity that occurs with facial aging, and efforts were directed to tightening what was loose rather than to restoring the shape of the face—hence the term *face lift* (rather than *facialplasty*), a mechanical term that implies a procedure to lift what has fallen. Unfortunately, this mechanical approach often produced a tight, operated look—the wind-tunnel appearance that has so often been associated with surgical rejuvenation of the aging face. Today, based on a better understanding of facial soft tissue anatomy and the anatomic changes that occur during aging, face lifting has developed into both a reconstructive procedure (to reconstruct the anatomic changes from aging) and a more artistically defined technique that attempts to enhance facial appearance while minimizing any signs that a surgical procedure has been performed.

There are many treatment goals for face lifting other than simply correcting the hallmarks of the aging face, including improvement of the nasolabial folds, jowls, and cervical contour. A face lift must also address the aesthetic concepts of improving shape and bringing out the beauty of the face that existed during youth. The surgeon attempting to meet these goals must have a thorough understanding of facial soft tissue anatomy, the anatomic changes that occur from aging, and the ideal facial shape that can be obtained for a particular patient. The design of the surgical access incisions must minimize scar perceptibility and avoid hairline distortion to prevent surgical stigmata.

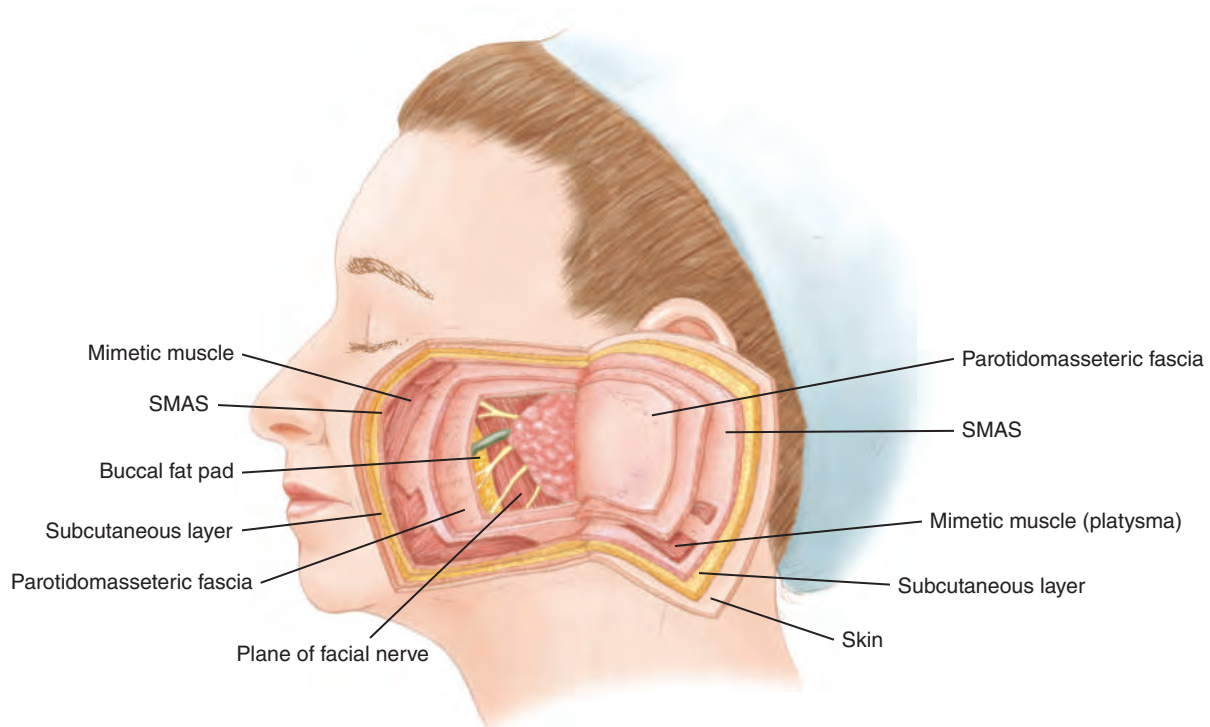
Aging in the face is complex and multifactorial, and plastic surgeons may encounter a number of problems during midface rejuvenation, including the following:

- The dermal component of aging related to intrinsic and extrinsic skin changes (dermal elastosis)
- Descent of facial fat
- Facial deflation, which tends to be regionally specific
- Radial expansion as facial fat becomes centrifugally situated away from the facial skeleton

All of these factors influence facial shape with aging. Individual patients exhibit various degrees of all these problems, and each component of the aging face should be addressed according to a patient's specific needs.

Patient photos taken during youth and as the individual has grown older are very helpful in determining how a patient has aged. Youthful photos usually reveal the location of the volumetric highlights present, document areas that have deflated over time, and indicate both the position and vector of facial fat descent. These factors illustrate patient-specific changes in facial shape and clarify the possible methods for repositioning facial fat to improve and restore shape. From my perspective, restoring facial shape is a more worthy aesthetic goal than attempting to tighten a loose face.

Pertinent Anatomy



The anatomy that allows a rhytidectomy to be performed safely is the arrangement of the facial soft tissue in concentric layers. This arrangement allows dissection within one anatomic plane to proceed completely separate from structures lying within another anatomic plane. The layers of the face are the skin; subcutaneous fat; superficial facial fascia (superficial musculoaponeurotic system [SMAS]); mimetic muscles; parotidomasseteric fascia (deep facial fascia); and the plane of the facial nerve, parotid duct, buccal fat pad, and facial artery and vein.

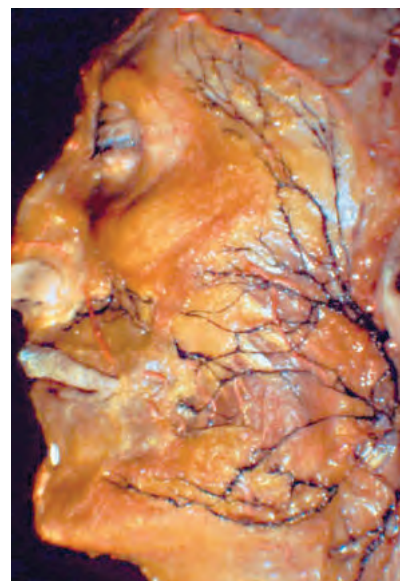
A surgeon attempting to master sub-SMAS dissection must understand the following anatomic components of facial soft tissue anatomy.

ANATOMIC CONSISTENCY Although the thickness of the various layers differ from patient to patient, structures within each layer are anatomically consistent. Considered two-dimensionally, the facial nerve exhibits a variety of branching patterns, but on a three-dimensional basis, the facial nerve always lies within a specific anatomic plane. This arrangement allows the surgeon to perform extensive sub-SMAS dissection safely, as long as the dissection proceeds at a level superficial to the plane of the facial nerve.

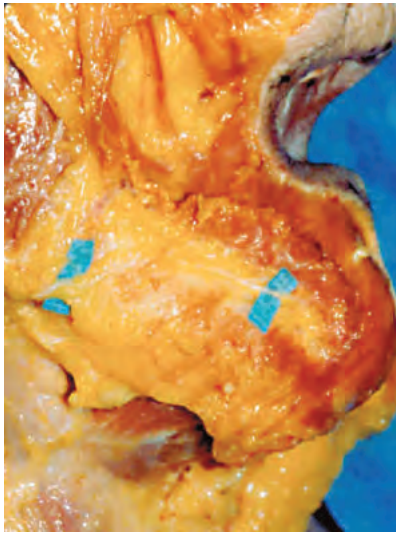
SMAS THICKNESS The thickness of the SMAS may vary significantly from patient to patient as well as from one region of the face to another. Overlying the parotid gland, within the temporal region (temporoparietal fascia), and within the scalp (galea), the SMAS is a substantial, discrete layer. As the SMAS is traced anteriorly in the face, overlying the masseter and buccal fat pad and into the malar region, it tends to become thinner and less substantial. Elevating the SMAS in these areas requires precise dissection so the flap is thick enough to be useful in facial contouring.

MUSCLE LAYERS The muscles of facial expression are arranged in four overlapping anatomic layers. The muscles that are encountered during a face lift procedure include the platysma, orbicularis oculi, zygomaticus major and minor, and risorius muscles, which are all superficial mimetic muscles. The deeply situated mimetic muscles are the buccinator and mentalis muscles. Most of the muscles of facial expression lie superficial to the plane of the facial nerve and therefore receive their innervation along their deep surfaces. The only muscles within the facial soft tissue architecture that lie deep to the plane of the facial nerve are the mentalis, buccinator, and levator anguli oris muscles; they receive their innervation along their superficial surfaces.

In this cadaver dissection of the facial nerve, it can be seen that the area directly overlying the zygomatic buttress is devoid of motor branches, and the only nerves in this region are sensory branches. For this reason, dissection in the malar area is quite safe—the malar eminence represents a watershed between the frontal branches of the facial nerve lying superiorly and the zygomatic branches of the facial nerve that lie just inferior to the zygomatic buttress.



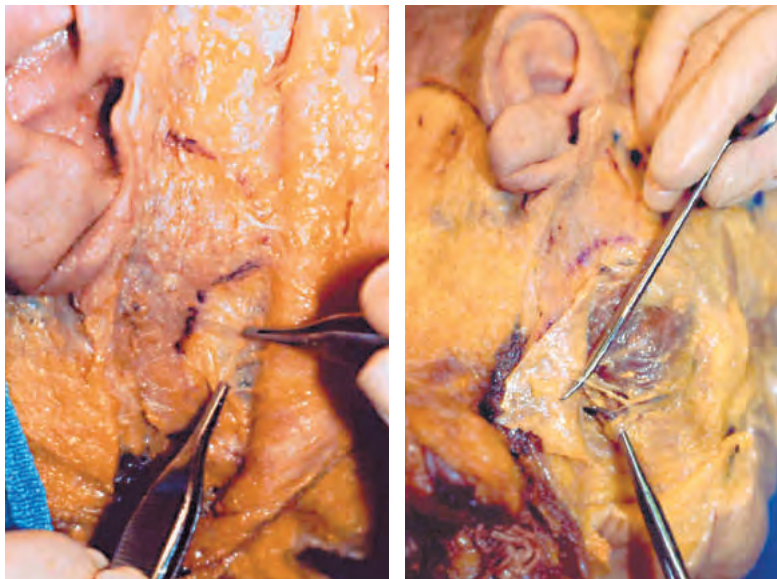
Courtesy J.K. Terzis, MD



This cadaver dissection shows the path of the marginal mandibular nerve. The depressor anguli oris muscle has been divided so that the nerve can be seen lying along the deep surface of this muscle. The depressor anguli oris and the depressor inferioris muscles are typical of facial muscles that lie superficial to the plane of the facial nerve and receive their innervation along their deep surfaces.

ANATOMIC FACIAL UNITS The muscles of facial expression that are situated superficially within the facial soft tissue architecture are invested by the superficial fascia. By *invested*, I mean that the superficial fascia lines both the superficial and deep surfaces of these muscles. This SMAS–mimetic muscle complex thus forms a single anatomic and functional unit that moves facial skin during animation.

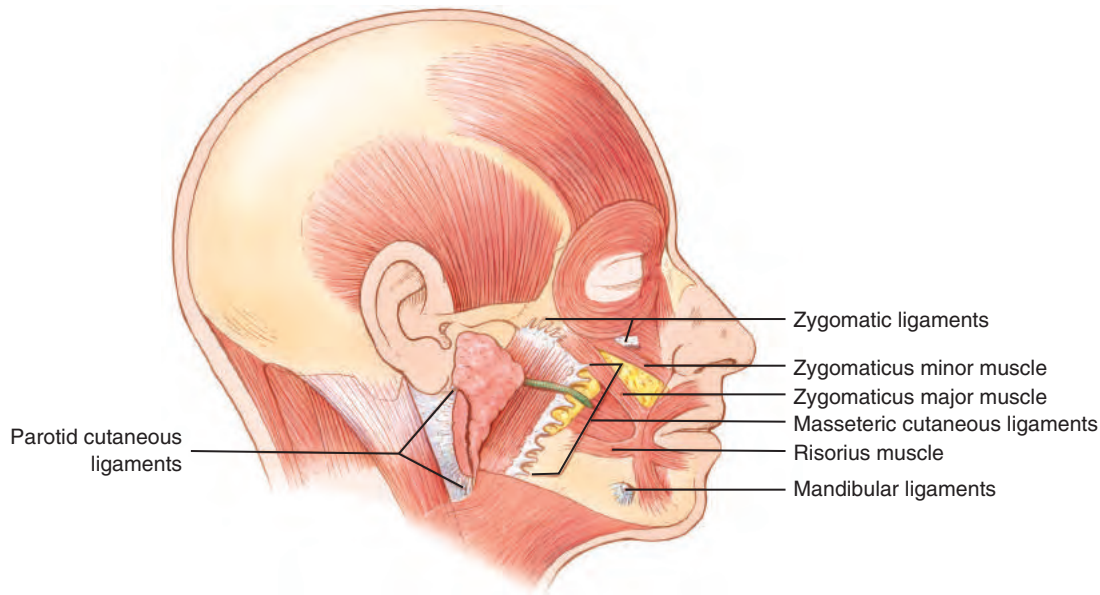
FACIAL FASCIA Deep to the SMAS–mimetic muscle complex lies the deep facial fascia. The deep facial fascia is a continuation of the superficial layer of the deep cervical fascia cephalad into the face. Where this fascial layer is identified, it is given specific nomenclature. Overlying the parotid gland, the deep fascia is called the *parotid fascia* or *parotid capsule*; overlying the masseter muscle, it is called the *masseteric fascia*; and in the temporal region, it is called the *deep temporal fascia*.



The cadaver dissection on the left is seen after SMAS-platysma elevation within the cheek; the underlying parotid gland, the anterior border of the parotid (marked in ink), and the parotidomasseteric fascia (held in forceps) are exposed. *The significance of the deep facial fascia is that all the facial nerve branches within the cheek lie deep to this layer.* Typically, these nerve branches course deep to the deep fascia until they reach the muscles of facial expression, at which point they penetrate the deep fascia to innervate these mimetic muscles along their deep surfaces. In the cadaver dissection on the right, the parotidomasseteric fascia has been elevated to expose the underlying masseter muscle and the marginal mandibular nerve as it crosses the facial artery and vein.

The essential point regarding the architectural arrangement of the facial soft tissue is that there is a superficial component of the facial soft tissue that is defined by the superficial facial fascia and includes the SMAS and those components that move facial skin (including superficially situated mimetic muscle invested by the SMAS, the subcutaneous fat, and skin). This is in contrast to the deeper component of the facial soft tissue, which is defined by the deep facial fascia and the structures related to the deep fascia, including the relatively fixed structures of the face, such as the parotid gland, masseter muscle, periosteum of the facial bones, and facial nerve branches. As the face ages, many of the typical changes seen are associated with a change in the anatomic relationship between the superficial and deep facial fascia. With age, facial fat descends in the plane between superficial and deep facial fascia, thereby justifying reelevation of fat through sub-SMAS dissection to improve facial shape.

Retaining Ligaments



Communication between the superficial and deep facial fascia occurs at the level of the retaining ligaments. These structures fix facial soft tissue in a normal anatomic position, resisting gravitational forces. Retaining ligaments exist in specific locations of the face, including (1) the malar area, where they are called *zygomatic ligaments*, (2) along the anterior border of the masseter muscle, forming the *masseteric cutaneous ligaments*, (3) over the parotid gland, forming the *parotid cutaneous ligaments*, and (4) in the parasymphysial and symphyseal region of the mandible, where they are called *mandibular ligaments*.

There are two types of retaining ligaments, as defined by their origins. The osteocutaneous ligaments are a series of fibrous bands that run from periosteum to dermis. The zygomatic and mandibular ligaments are examples of these structures.

The second system of supporting ligaments is formed by a coalescence of the superficial and deep facial fascia in certain regions of the face (the parotid-cutaneous ligaments and the masseteric cutaneous ligaments). These fascial connections, which fix both superficial and deep fascia to underlying facial structures, such as the parotid gland and masseter muscle, similarly lend support against gravitational forces through fibrous septa that extend into the dermis. Attenuation of support from the retaining ligaments is responsible for many of the features of facial aging.

In the evolution of midface aging, the zygomatic and masseteric cutaneous ligaments are particularly important. The zygomatic ligaments originate from the periosteum of the malar region as a series of fibrous septa that begin laterally in the region where the zygomatic arch joins the body of the zygoma and permeate the malar pad (fibrous McGregor's patch). A particularly stout ligament originates along the medialmost portion of the zygoma, medial to the zygomaticus minor. The zygomatic ligaments fix the malar pad to the underlying zygomatic eminence in a youthful face.



Attenuation of the zygomatic ligamentous support suspending the malar pad and the medial cheek leads to an inferior migration of these soft tissues adjacent to the line of the muscular fixation of the nasolabial fold. The fold not only deepens with aging, but an accumulation of cheek soft tissue lateral to the nasolabial line also accounts for fold prominence.

Soft tissue support in the medial cheek is provided by a series of fibrous bands that extend along the entire anterior border of the masseter muscle. These fibers, called *masseteric cutaneous ligaments*, are identified superiorly in the malar area, where they mingle with the zygomatic ligaments and extend along the anterior border of the masseter as far inferiorly as the mandibular border. These fibers represent coalescence between the superficial and deep fascia, extending from the masseter muscle vertically to insert into the overlying dermis. When an individual is young, the masseteric ligaments support the soft tissues of the medial cheek superiorly above the mandibular border.



Attenuation of support from the masseteric cutaneous ligament allows the soft tissues of the medial cheek to descend inferiorly, leading to the formation of the facial jowl.

Because of the anatomic relationships of the retaining ligaments, the jowl has constant borders. Anteriorly, the jowl is bordered by the mandibular ligaments. Posteriorly, the jowl complex is positioned along the anterior border of the masseter muscle.

Aesthetic Analysis and Treatment Planning

As the face ages, facial shape changes multifactorially. Some of these changes can be addressed in a straightforward manner, whereas others present difficult technical challenges. A paradox for me has always been that facial anatomy (in terms of basic soft tissue architecture) is essentially unchanged from youth to middle age, but facial appearance changes greatly over time and is patient specific. Although each face ages differently, there are common features in all of them.

Descent of Facial Fat



As the face ages, facial fat descends. As seen in a photograph taken at age 25, this woman has a youthful face full of well-supported facial fat, typically overlying the malar eminence and along the lateral cheek, which overlies the parotid gland and masseter muscle. In addition, there is generally a concavity or depression overlying the buccal recess just anterior to the masseter muscle. The combination of fullness in the malar region and lateral cheek and a concavity overlying the buccal recess accounts for the angular, tapered appearance of the youthful face. In the same woman at age 55, 30 years later, the aesthetic effect of facial fat descent becomes obvious.

Typically, faces in middle age are square, with little differential between malar highlight and midfacial fat. As facial fat becomes more inferior in the face, the face appears visually longer. The aesthetic consequences of loss of facial angularity with aging are as important as the depth of the nasolabial fold and jowling. For me, an improvement of facial shape is one of the primary goals of facial rejuvenation.

Volume Loss and Facial Deflation

Youthful faces are full of well-supported fat. Deflation occurs over time, soft tissue becomes less supported and appears lax, and it tends to be most apparent in areas of the face that have a high density of retaining ligaments (the malar pad, prepatrotid area, lateral and infraorbital rim, and the lateral chin). Youthful faces have a smooth contour between the aesthetic subunits. Middle-aged faces, as a result of both deflation and fat descent, develop lines between the regions. An appropriate aesthetic treatment plan requires repositioning of the descended soft tissue into areas of facial deflation to improve shape, not only to restore the volume of youth, but also to blunt the lines between aesthetic subunits. Volumetric augmentation through autologous fat injection or other injectable soft tissue fillers is an ancillary procedure that can be useful for augmenting areas of deflation.

Deflation is a complex process that tends to be regional and age specific. A breakthrough in understanding how deflation occurs came with a discovery by Rohrich and Pessa. These investigators realized that the subcutaneous fat of the cheek, rather than being homogeneous, is broken into compartments, each with an independent perforator blood supply and surrounded by specific septal membranes. The aesthetic significance of fat compartmentalization is that deflation tends to occur within a specific region of the cheek, rather than deflating homogeneously.

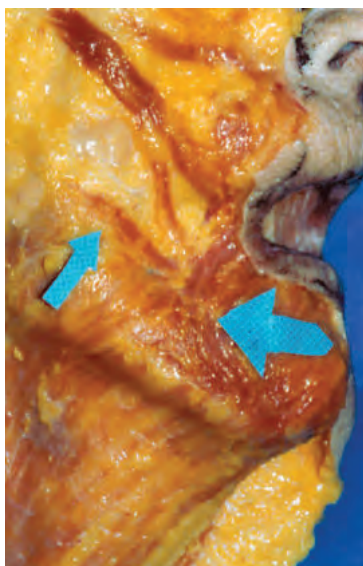
At the risk of oversimplification, one key to understanding facial deflation is the location of the zygomaticus major muscle, which traverses from the malar eminence to the oral commissure. Deflation of the cheek lateral to the zygomaticus major muscle tends to occur independent of deflation in the malar region, medial to the zygomaticus major. For many patients, lateral cheek deflation develops at a younger age than malar pad deflation, and it often appears in patients in their forties.



This 42-year-old patient has early facial aging resulting primarily from deflation. She has a hollowing effect in the lateral cheek and preparotid region. Deflation has occurred in the fat compartments lateral to the zygomaticus major muscle. She is seen before and after a face and neck lift. Anteriorly situated fat was brought into the upper lateral midface, where it filled the areas of deflation, thereby blunting the lines between aesthetic subunits. The change in facial shape is evident; her face appears more structured and supported after facial fat repositioning.

Medial cheek and malar pad deflation tends to occur later in life and is responsible not only for the loss of volumetric support within the anterior cheek, but also for the development of the infraorbital V deformity. Deflation in this region results in an apparent increase in the vertical length of the lower lid as the lid cheek junction visually descends inferiorly into the poorly supported anterior cheek.

An interesting region of deflation develops in some patients in the submalar region lateral to the oral commissure. In these patients, deflation can result in accentuation of the submalar concavity, which can become more obvious after the vertical soft tissue shifts associated with face lifts. An accentuation of the submalar depression lateral to the oral commissure can result in the development of joker lines, or cross-cheek depressions, which may appear in patients who have undergone a face lift. Avoidance of vertical soft tissue repositioning in conjunction with volume addition in the submalar recess lateral to the oral commissure can help prevent the accentuation of postoperative cross-cheek depressions.



This cadaver dissection illustrates the muscular insertions into the oral commissure and modiolus. The small arrow overlies the facial portion of the platysma and points to the risorius muscle; the large arrow points to the depressor anguli oris muscle, where it merges with the platysma. Superiorly, the insertion of the zygomaticus major into the lateral commissure can be seen, with a slip of muscle inserting inferiorly into the modiolus. After deflation in this area, the medial component of the cross-cheek depression develops in the area between the elevator and the depressors of the lip.

Radial Expansion

Not all facial aging is vertical; one major challenge in facial rejuvenation is the radial expansion of facial soft tissue that occurs in the midface. In youth, the skin and underlying subcutaneous fat are densely attached to the deep facial fascia by retinacular fibers running through skin, subcutaneous fat, and superficial fascia that insert into the deep fascia and facial musculature. Over time, with prolonged animation such as smiling, the skin along the nasolabial line is forced deep to the subcutaneous fat, positioned lateral to the nasolabial fold, which attenuates these retinacular attachments. Animation forces the skin and fat lateral to the nasolabial fold to expand radially and prolapse outward from the facial skeleton, accounting for much of the nasolabial fold prominence in an aging face. Radial expansion lateral to the oral commissure and marionette line similarly accounts for the prominence of the jowl in many patients, making older faces appear square and bottom-heavy.

Radial expansion is technically difficult to correct, because there are few surgical solutions for reestablishing the retinacular attachments between skin, subcutaneous fat, and deep fascia. Nevertheless, repositioning facial fat through some form of support to the superficial fascia not only repositions fat vertically, but also provides internal repositioning so that the facial soft tissues lie closer to the facial skeleton. As the soft tissues become situated closer to the underlying deeper structures of the face, facial morphology tends to be restored to a more youthful configuration. Because of the technical difficulty of completely treating radial expansion in many faces, incomplete correction of both the jowl and nasolabial fold is common postoperatively, despite efforts to reposition descended facial fat.



This 59-year-old man lost 41 kg (90 pounds) after a gastric bypass procedure. There are areas of deflation along the infraorbital rim, lateral orbital rim, and malar region. Also noticeable is the apparent length of the lower lid from the infraorbital V deformity in association with malar pad deflation. The radial expansion of skin and fat lateral to the nasolabial fold is most marked on the right side. Not only does the malar fat deflate and descend, but also attenuation of the retinacular connections between skin, fat, and deep facial fascia lateral to the nasolabial line allows centrifugal prolapse of soft tissue, which accentuates the nasolabial prominence. This patient's postoperative results show that the deflated areas have been improved by repositioning fat into them. The nasolabial folds are improved after malar pad repositioning, but the correction is incomplete, especially on the right. Malar pad elevation helps flatten the prominent nasolabial fold and improve the infraorbital V deformity, but it does little to correct radial expansion, with the skin lateral to the nasolabial line remaining prolapsed from its attachments to the facial skeleton.

The Role of Skeletal Support in Formulating a Surgical Treatment Plan

Facial shape and contour are intuitively evaluated when the surgeon analyzes a patient for facial rejuvenation. Often the two-dimensional considerations seen in photographs are the easiest aspects of aging to identify, and factors such as nasolabial fold depth, jowl prominence, and cervical contour become the primary focus for improving the appearance of a middle-aged face. Although these factors are certainly important for treatment planning, the more subtle, three-dimensional qualities of facial shape are equally important and are greatly influenced by underlying skeletal support.

When evaluating facial shape during preoperative analysis, there are several major factors that I have found helpful to consider.

FACIAL WIDTH, BIZYGOMATIC DIAMETER, AND MALAR VOLUME The emphasis of face lifting over the last 20 years has been on malar pad elevation. Although malar pad elevation and restoration of malar highlights is important for improving facial shape, it needs to be patient-specific. Many patients present preoperatively with wide faces, strong malar eminences, and large malar volume with little evidence of malar fat descent. In these individuals it is necessary to evaluate preoperatively the degree of malar pad elevation required to improve facial shape.



Facial width and bizygomatic diameter reflect the underlying degree of skeletal support. Patients who exhibit strong malar eminences and wide bizygomatic diameter often benefit from having malar highlights restored but usually do not require significant enhancement of malar volume, because that causes a wide face to appear even wider postoperatively. Shaping in these faces usually focuses on improving the lower two thirds of the cheek, specifically addressing jowl fat repositioning as well as creating submalar hollowing to improve the aesthetic relationship between malar and submalar regions.

FACIAL LENGTH AND THE RELATIVE VERTICAL HEIGHTS OF THE LOWER AND MIDDLE THIRD OF THE FACE Compared with wide faces, patients who present with vertical maxillary excess often have long, thin faces on the front view. As facial fat descends, it becomes situated anteriorly and inferiorly, making the face appears even longer.



Long, thin faces often benefit from an enhancement of malar volume. SMAS dissection and facial fat repositioning anteriorly over the zygomatic eminence allow the surgeon to restore malar volume, thereby increasing bizygomatic diameter. When malar volume is enhanced, the face appears wider.

CONVEXITY OF THE MALAR REGION JUXTAPOSED WITH THE CONCAVITY OF THE SUBMALAR REGION In youth, facial fat is situated over the malar and prepatid region. Malar fullness is juxtaposed with a concavity in the submalar region overlying the buccinator muscle. As patients age, the relationship between the malar and submalar regions changes, and facial shape changes with it. As facial fat descends and facial deflation occurs, there is less volume overlying the malar eminence, and there is an associated fullness increase in the submalar region. As the aesthetic rela-

tionship between the malar and submalar region changes, there is a loss of the angular, tapered shape of youth, making middle-aged faces often appear oval. With even greater facial fat descent and an increase in submalar fullness, older faces appear square.



Preoperatively, this patient's face is oval as a result of malar deflation. Evaluating the relationship between the malar and submalar regions on the front view, for me, is an essential component of aesthetic treatment planning. For many patients, restoring this relationship by increasing malar highlights and malar volume and reconstructing the concavity in the submalar region becomes a central component of improving facial shape.

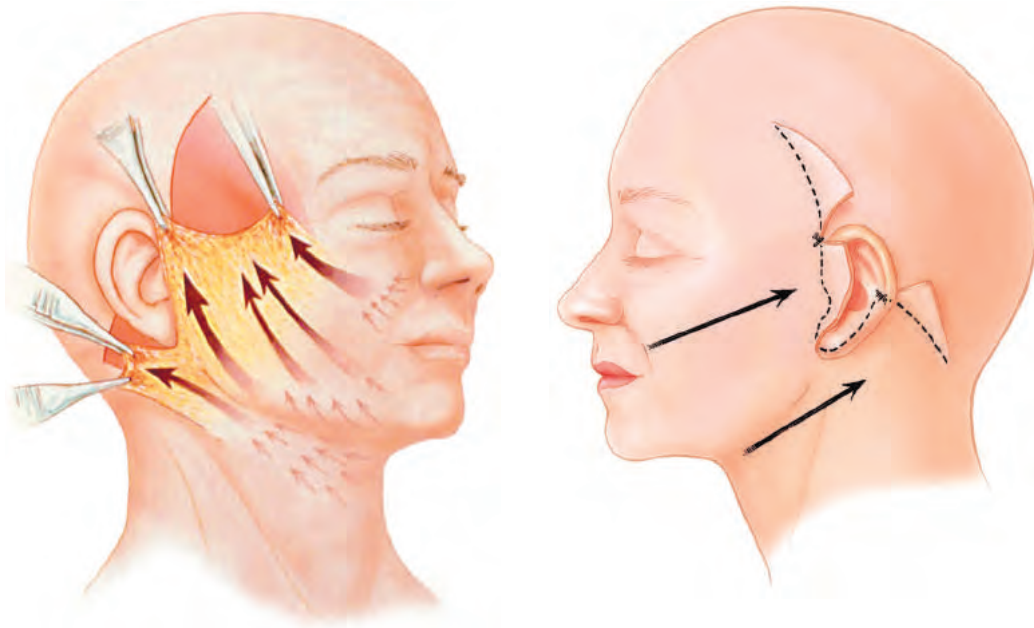


Preoperatively, this patient shows a blunting of the relationship between the malar and submalar regions. Postoperatively, enhancing malar volume and the bizygomatic diameter, and restoring the concavity within the submalar region have made her face appear more angular as well as shorter vertically.

The Vertical Height of the Mandibular Ramus and the Horizontal Length of the Mandibular Body

The vertical height of the mandibular ramus and the horizontal length of the mandibular body provide skeletal support for the lower two thirds of the face. Patients who present with a normal mandibular ramus height, as well as adequate horizontal length of the mandibular body, usually have excellent skeletal support for soft tissue repositioning and are, therefore, less of a surgical challenge. Patients with a short mandibular ramus, an open mandibular plane angle, and a short length of the mandibular body typically have poor skeletal support for midface and perioral soft tissue repositioning. These patients are a greater surgical challenge for restoring facial shape, and they often benefit from volumetric augmentation, either alloplastic or autogenous, to enhance skeletal support.

Differential Vectors for Redraping SMAS Dissection and Skin Flap



Dermal elastosis and skin laxity in an aging face often do not occur in the same direction nor at the same rate as the descent of fat and other factors affecting the superficial fascia. The main advantages of performing skin dissection separate from SMAS dissection is that it allows these two layers to be draped along vectors that are independent of one another. Another advantage of a two-layer SMAS face lift is that the contouring tension is placed on the superficial fascia, thereby allowing the surgeon to use less tension for skin closure. This also improves control over scar perceptibility. In my experience, facial fat is usually repositioned in a more vertical vec-

tor than skin flap redraping. Strong vertical shifting of the cervicofacial flap is traditional in many face lift techniques. Although skin tightening can produce a dramatic improvement in facial laxity, the aesthetic effects of vertical skin vectoring unfortunately have been poorly defined. Specifically, when skin is shifted in a cephalad direction, the effect of skin tension commonly produces an accentuation of flatness in the prepatotid region, an area that typically deflates with aging. In my opinion, vertical skin shifting often produces an unnatural tightness, producing the typical effects associated with rhytidectomy. If the surgeon has been successful in repositioning descended facial fat, strong vertical skin tension is neither desirable nor required to enhance the postoperative result.



These two patients show the effect of vertical rotation of the cervicofacial flap associated with hairline distortion. A skin flap that is overrotated in a cephalad direction not only can compromise the temporal hairline, but also tends to produce flatness in the lateral midface overlying the masseter and parotid. This imparts a tight, unnatural appearance to the face. The effects of scar perceptibility is evident when strong skin tension is used in an attempt to contour the face.

Surgical Technique: Extended SMAS Dissection

Most patients who have enough laxity to justify a face lift will benefit from tightening the superficial fascial layer. Restoring support to the underlying deeper facial soft tissues has become a key part of my approach to improve facial aging. If the SMAS is thin and tenuous, plication of this layer is an alternative to formal SMAS elevation. However, in my opinion, better contouring and longer-lasting results are obtained after a formal dissection of the superficial fascia.

In skin flap dissection, it is important to develop uniform skin flaps during the subcutaneous undermining, taking care to leave some intact fat along the superficial sur-



44-1 Face lift with
extended SMAS
Vicryl mesh fixation

face of the SMAS, especially where the SMAS is to be dissected. If the skin flaps are dissected so that no fat is left along the superficial surface of the SMAS, then the SMAS becomes more difficult to raise, being thin, tenuous, and prone to tearing. In a SMAS-type face lift, much of the contouring is obtained by elevation and fixation of the SMAS layer. The more substantial the SMAS flap, the better long-term results that can be obtained.

I carry the subcutaneous skin flap dissection well into the malar region and usually undermine the skin overlying the lateral two thirds of the zygomatic eminence. I prefer to stop undermining the skin several centimeters lateral to the nasolabial fold, because this preserves some of the attachments that go from SMAS to the facial skin. The preservation of these attachments, followed by adequate undermining of the SMAS, allows the surgeon to reelevate anteriorly displaced fat and skin through SMAS rotation rather than by redraping the superficial fascia completely independent of skin flap redraping. In my opinion, this maneuver produces a more pleasing aesthetic result in most patients and preserves some of the peripheral vascularity to the facial skin flap.

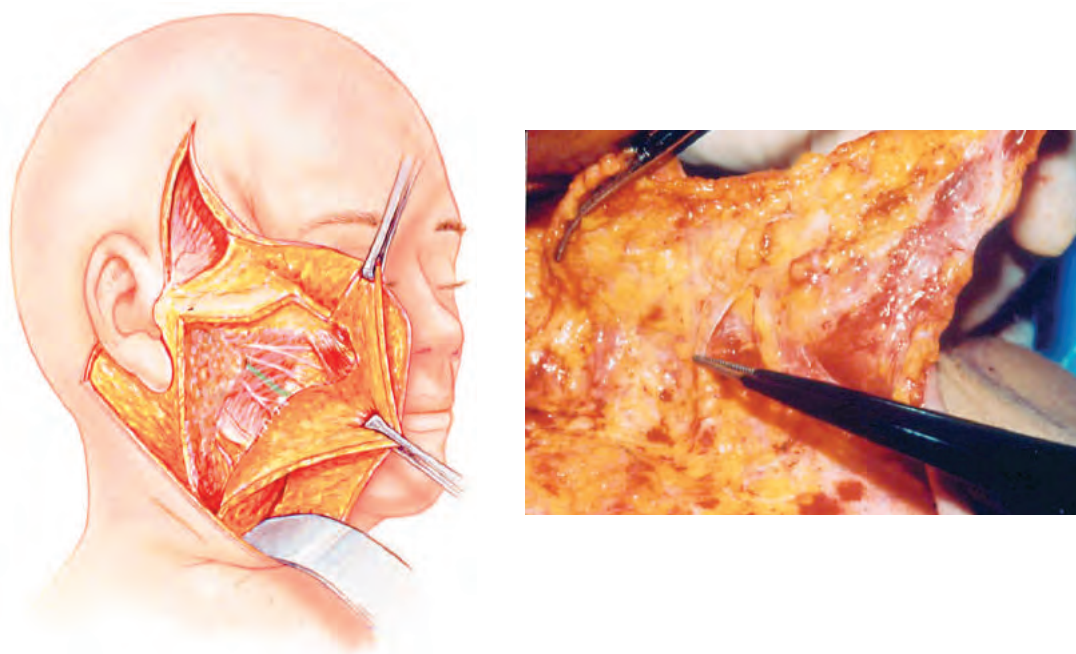
SMAS Elevation

The dissection of the superficial fascia allows the surgeon to reelevate the jowl and descended malar fat upward into the face. In patients with prominent nasolabial folds and significant extraorbital hollowing, the SMAS dissection should extend into the malar region to reelevate the malar fat pad over the zygomatic eminence. An added benefit of performing a more extensive anterior dissection of the SMAS is that it frees this layer from the restraint of both the zygomatic and masseteric ligaments, and this anterior release provides for a more complete elevation of the facial fat below the oral commissure and along the anterior portion of the jowl.



The incision design for the extended SMAS dissection is an extension of a standard lateral SMAS dissection. The malar aspect of the dissection allows for the repositioning of facial fat along the infraorbital and lateral orbital rim, as well as restoring malar volume. The SMAS dissection just lateral to the zygomatic eminence provides access to the masseteric ligaments to allow jowl fat elevation and restoring submalar concavity. The dissection laterally in the cheek frees the SMAS from the parotid, providing for repositioning descended platysma, thereby improving mandibular border contour.

The incisions for extended SMAS dissection begin approximately 1 cm inferior to the zygomatic arch to ensure that the frontal branch of the facial nerve is preserved. This horizontal incision is continued several centimeters forward to the region where the zygomatic arch joins the body of the zygoma. At this point, the malar extension of the SMAS dissection begins with the incision angling superiorly over the malar eminence toward the lateral canthus for a distance of 3 to 4 cm. On reaching the edge of the subcutaneous skin flap in the region of the lateral orbit, the incision is carried inferiorly at a 90-degree angle toward the superior aspect of the nasolabial fold. A vertical incision is designed along the preauricular region, extending along the posterior border of the platysma to a point 5 to 6 cm below the mandibular border. In essence, the malar extension of the SMAS dissection simply represents an extension of a standard SMAS dissection into the malar region in an attempt to obtain a more complete form of deep layer support.



To obtain mobility of the superficial fascia in an extended SMAS dissection, the surgeon must mobilize the SMAS peripheral to the restraint of the retaining ligaments. To ensure adequate flap mobility, the SMAS needs to be completely dissected from the underlying parotid gland and from the superior aspect of the masseteric ligaments and the zygomatic ligaments.

The SMAS in the malar region is then elevated in continuity with the SMAS of the cheek. When elevating this flap, the fibers of the orbicularis oculi, as well as the zygomaticus major and minor, are usually evident and the flap is elevated directly along

the superficial surface of these muscles. It is important to carry the dissection directly external to these muscle fibers, where a natural plane exists, remembering that the facial nerve branches lie deep to these muscular bellies. The malar SMAS is elevated until the flap is freed from the underlying zygomatic prominence.

Completely freeing the SMAS from the zygomatic attachments is an important technical point in obtaining the mobility necessary to reposition the malar soft tissue superiorly. To obtain this mobility usually requires a division of the upper fibers of the masseteric cutaneous ligaments, which will expose the underlying body of the buccal fat pad. The cheek portion of the SMAS dissection is performed beginning directly overlying the parotid gland and then extending this dissection anterior to the parotid utilizing a combination of sharp and blunt dissection toward the anterior border of the masseter.



It is often necessary to extend the malar SMAS dissection more peripherally than the subcutaneous dissection to obtain adequate flap mobility of the soft tissues lateral to the nasolabial fold. This portion of the dissection is easily performed by simply inserting the scissors in the plane between the superficial surface of the elevators of the upper lip and the overlying subcutaneous fat. Once the scissors are inserted in the proper plane, the surgeon bluntly dissects in a series of passes toward the nasolabial fold (*green area*). *The scissors must remain superficial to the elevators of the upper lip to prevent motor nerve injury.* Usually three or four passes are required to obtain adequate flap mobility.

In most patients, after extended SMAS dissection of the cheek and malar regions, mobility of the soft tissues lying lateral to the nasolabial fold remains restricted unless the dissection is carried more medially. This restriction in movement results from the undivided retaining ligaments that originate medial to the zygomaticus minor. To improve mobility, I commonly continue malar pad elevation medially in an area where I have not subcutaneously undermined the skin. This dissection is carried directly in the plane between the malar fat and the superficial surface of the elevators of the upper lip. It is usually quite easy to delineate this level of dissection after the malar SMAS elevation is complete, and the superficial surface of the elevators of the upper lip visualized. The scissors are then inserted directly superficial to the elevators of the upper lip, and blunt dissection is quickly performed by pushing the scissors in a series of passes bluntly toward the nasolabial fold. I find that when we insert the scissors in the proper plane, the dissection quickly glides through the malar soft tissues, and I usually feel a “snap” as we dissect through the remaining retaining ligaments. Once these structures are divided, greater mobility can be felt when traction is applied to the malar portion of the SMAS flap, translating into greater movement along the uppermost portion of the nasolabial fold.

Repositioning and closure of the SMAS is then performed. The malar SMAS flap is advanced superolaterally over the zygomatic prominence in a direction perpendicular to the nasolabial fold, and usually paralleling the zygomaticus major muscle. After superior and lateral advancement, if a malar augmentation is not planned, the excess tissue can be excised and the flap securely fixated to the zygomatic periosteum with interrupted sutures.

Once the malar flap is secure, the cheek-SMAS flap is rotated superiorly perpendicular to the mandibular border. This portion of the SMAS flap is used to contour jawline and jowl. The SMAS overlying the preauricular region and ear is then treated as a transposition flap and carried posteriorly behind the ear, helping to restore tone to the submental region and neck. After trimming, the SMAS flap is carefully secured with multiple interrupted sutures. Occasionally skin dimpling is noted after securing the SMAS flap; this results from the forces of SMAS rotation on resuspended facial skin. Skin dimpling is treated by simply performing a bit more subcutaneous undermining before skin flap redraping.

That the SMAS has been adequately mobilized can be determined by observing the effect of facial contouring when traction on the SMAS is applied. In general, freeing the SMAS past the restraint of the retaining ligaments provides the mobility necessary to obtain consistent facial contouring through SMAS redraping.

After proper contouring of the SMAS dissection, the facial skin flaps are rotated and closed in the direction decided on based on preoperative evaluation. In general, these skin flaps are inset with a minimum degree of tension placed along the key sutures and then the skin flaps are trimmed with a degree of redundancy between the key sutures to minimize tension along the incision sites. I favor restoring contour face lifting through deep layer support, placing the tension on the SMAS and platysma closure, and minimizing the tension on skin flap closure to obtain consistency in terms of scar perceptibility. Stated in other terms, facial contouring is restored through deep layer support rather than through tension in skin flap redraping.

To summarize, the key points in mobilizing the superficial fascia from the restraint of the retaining ligaments of the cheek are as follows:

The SMAS overlying the parotid gland and malar eminence tends to be substantial and easy to dissect, with both the parotid and zygomaticus major and minor muscles protecting the underlying facial nerve branches. These areas are very safe regions to begin SMAS elevation and delineate the sub-SMAS plane. The thinnest fascial component of an extended SMAS dissection is in the region just lateral to the zygomaticus major muscle, where the SMAS splits to invest the elevators of the upper lip. Dissecting the skin flap thinly in this region leaves a substantial amount of subcutaneous fat intact along the surface of the superficial fascia, providing greater ease in SMAS dissection and minimizing the possibility of tearing this layer.

The most difficult portion of an extended SMAS dissection is freeing the superficial fascia from the restraint of the superior masseteric ligaments, which are lateral to the zygomaticus major muscle. If these ligaments are not mobilized, restricted movement is noted in the portion of superficial fascia that affects contouring along the lower nasolabial fold, oral commissure, and anterior jowl. The zygomatic branches of the facial nerve are in close proximity to the upper masseteric ligament. At times it can prove difficult to differentiate between ligaments and facial nerve branches. Caution is essential in this region of dissection.

Variations in Extended SMAS Technique to Effect a Restoration in Facial Shape

The biomechanics of SMAS repositioning have been previously described and are influenced by the degree of release, vector of fat repositioning and how the superficial fascia is fixated. As postoperative contour is dependent on each of these factors, preoperative planning needs to be patient specific in terms of the degree of SMAS release required, the vectors in which facial fat is repositioned, and the location and method for SMAS fixation.

Release

The incision design of an extended SMAS dissection allows for complete release of the SMAS from its underlying retaining ligamentous attachment in the lateral midface. As surgeons, there is a tendency to believe that a greater degree of SMAS dissection equates with a better result, but this has not been my experience. Rather, precision in the degree of SMAS dissection and its release from the retaining ligaments as dictated by the aesthetic needs of a patient increases surgical control and consistency in while minimizing morbidity.

How much to release the SMAS, and how high and anterior to carry the SMAS dissection, needs to be decided preoperatively. In patients who present with adequate malar volume, wide bizygomatic diameter and little evidence of malar pad descent, it is usually unnecessary to carry the SMAS dissection medial to the lateral orbital rim (although I usually carry the dissection high within the malar eminence to allow fat repositioning along the infraorbital and lateral orbital rims). Most commonly, these types of patients require only a restoration of malar highlight and not significant anterior malar volume enhancement. Limiting the SMAS dissection to the lateral aspect of the malar eminence will not increase facial width on the front view. Typically, the shaping considerations for these patients is focused on reducing fullness in the submalar region. Sub-SMAS dissection along the lateral aspect of the zygomatic eminence provides exposure to the juxtaposed masseteric ligaments, allowing the submalar fat to be repositioned superiorly along the concavity of the underlying buccinator, thereby restoring submalar hollowing.



Long faces often benefit from carrying the malar portion of the extended SMAS dissection anteriorly, medial to the lateral orbital rim so that malar volume restoration is performed along the anterior aspect of the zygomatic eminence. Carrying the SMAS dissection more medially allows the surgeon to enhance malar volume and restore malar highlights anteriorly over the zygomatic eminence, thereby increasing facial width on the front view.



Patients with wide bizygomatic diameters and good underlying skeletal support typically do not require a significant anterior malar dissection to improve facial shape. Most commonly, the SMAS dissection in these patients, while kept high, is extended only as medial as the lateral orbital rim, so that malar volume restoration is limited to the lateral aspect of the zygomatic eminence. The shaping considerations for these types of faces usually emphasize reducing fullness within the submalar area, as well as jowl fat elevation. Postoperatively, the patient's face appears more tapered and thinner in morphology through facial fat repositioning without removal of facial fat.

Vectors of Fat Elevation: Facial Asymmetry

All patients exhibit some degree of facial asymmetry. Commonly, one side of the face is vertically longer, and the short side of the face is usually wider than the long side. Malar highlights are typically more superiorly located on the long side of the face and, with age, facial fat tends to descend in a more vertical direction on the long side. As facial asymmetry and facial skeletal configuration are asymmetric in most individuals, it follows that the vectors of fat elevation (SMAS repositioning) should be specific for the right and the left side of the face.

The vector in which the SMAS is repositioned has a significant impact on the location and volume of elevated facial fat, thereby influencing facial shape. Decisions regarding the direction of SMAS vectoring for the right and left side of the face are best determined preoperatively, as it is very difficult to make aesthetic vector judgments intraoperatively with the patient recumbent.



SMAS vectors influence postoperative facial shape. Vertical SMAS repositioning typically provides a larger amount of fat for enhancing the malar eminence, as well as allowing for a reduction in fullness within the submalar region as fat is forced vertically along the concavity of the buccinator. For this reason, vertical SMAS vectors are often indicated to reshape round, full faces, allowing them to appear more tapered and thinner postoperatively. In this patient, a small amount of jowl defatting through needle aspiration was also performed.

If the SMAS is vectored more obliquely, there is less volume of fat brought into the malar region and a greater volume of fat repositioned into the submalar region. Oblique SMAS repositioning is therefore helpful in elderly patients who appear gaunt over the buccal recess, as it allows the surgeon to volumetrically enhance the submalar region.



This patient exhibited asymmetry in the submalar region preoperatively. The area appeared hollow and concave on the right and fuller on the left side. For this reason, the SMAS was vectored obliquely on the right to volumetrically enhance the submalar region; it was vertically vectored on the left to restore submalar hollowing and balance the two sides of her face.

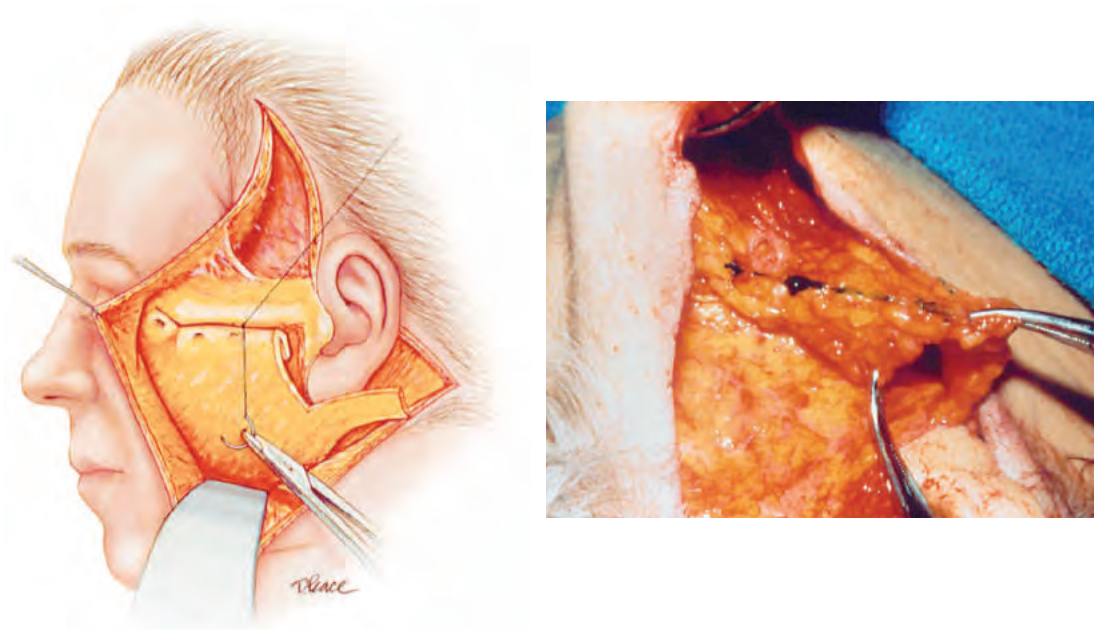
SMAS Fixation

In a two-layer SMAS-type face lift, the tension of contouring is placed on the superficial fascia rather than on the skin envelope. Thus the fascial quality and tensile strength of the superficial fascia has an influence on both the longevity of result and the volume of fat, which can be repositioned intraoperatively and maintained postoperatively. In other words, soft tissue quality influences long-term contour and is the primary reason that face lifts in young patients are more predictable.

In an effort to improve fascial quality in a SMAS face lift, for over a decade I incorporated Vicryl mesh into the SMAS fixation. It was my initial observation that incorporating Vicryl mesh into fixation improved not only longevity of result, but also provided greater aesthetic control. However, for the past 2 years I have stopped using Vicryl mesh, because I have come to realize that the predominant factor in improving fixation is the method in which the superficial fascia is secured. Obtaining a secure fixation using multiple sutures placed deep within the superficial fascia allows the surgeon greater control in postoperative shape. Suturing the SMAS under moderate tension affects facial shape:

Adding more sutures allows the surgeon to stack volume in specific areas of the midface, which is useful in augmenting areas of deflation, as well as augmenting volume along the malar eminence.

As the superficial fascia is sutured under tension, facial fat is not only repositioned vertically, but also repositioned internally, forcing the soft tissue to conform to the underlying deep facial structures. This gives the surgeon greater control in improving radial expansion.

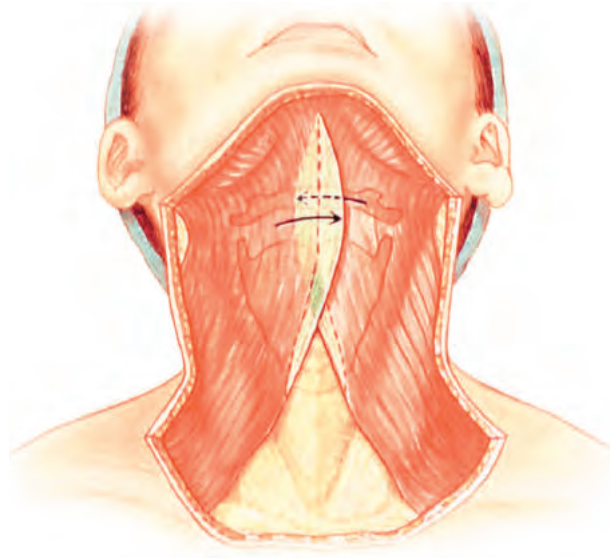


The excess SMAS, rather than being excised, is rolled onto itself to form a double layer of SMAS thickness. It is then fixated to the periosteum of the zygomatic eminence. An added benefit of preserving the excess SMAS rather than excising it is that as the thickened SMAS layer is secured to the zygomatic eminence, it highlights the malar region, serving as an autogenous malar augmentation. Highlighting the malar area tends to enhance angularity in facial contour.

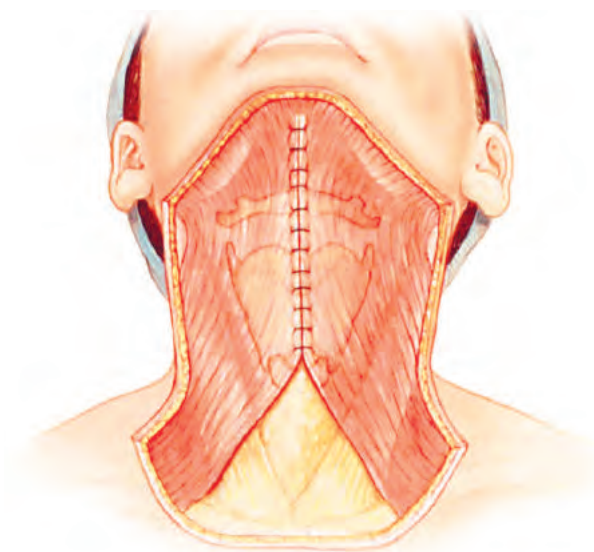
Correction of Platysma Bands and Cervical Obliquity

The best approach to the anterior platysma is through a submental incision, placed just caudal to the submental skin crease. If this crease is very deep, the skin cephalad is elevated toward the base of the chin pad and along the caudal mandibular border to free any retaining mandibular ligaments, which tend to accentuate the crease. After this, the cervical skin is carefully elevated. The cervical skin is usually undermined at least to the level of the cricoid.

When the platysma muscle is exposed anteriorly, most patients exhibit a decussation of platysmal fibers across the midline, at least for a few centimeters below the mentum. If platysma band surgery is planned, these decussating fibers must be sharply divided with scissor dissection directly in the midline. Then the medial edge of the platysma is mobilized from the mentum inferiorly at least to the hyoid and commonly as caudal as the cricoid cartilage. Mobilization, usually performed using a combination of sharp and blunt dissection, separates the platysma from the underlying subplatysmal fat, the anterior belly of the digastric muscle, and the strap muscles overlying the thyroid cartilage. At times numerous small venules are encountered within the subplatysmal fat and careful hemostasis must be obtained. After mobilization of the medial edges of the platysma, the subplatysmal fat is conservatively contoured according to preoperative planning.

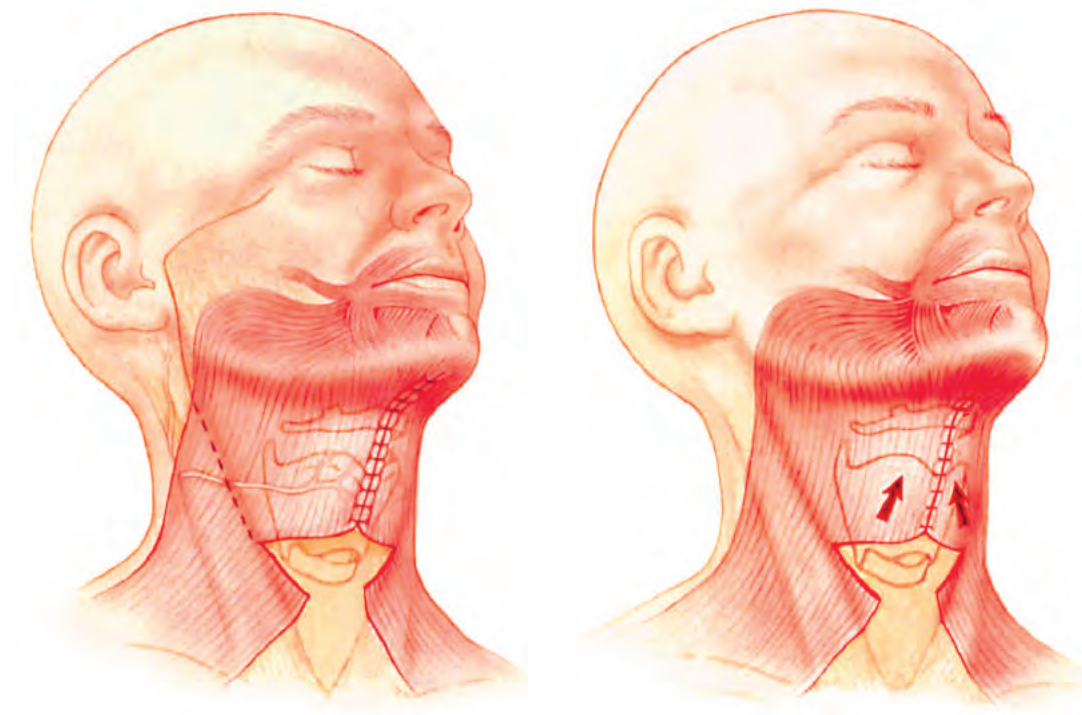


Following mobilization, the medial edge of the platysma muscle is grasped on either side and overlapped in the midline to estimate the amount of excess muscle present. Muscle excess varies from patient to patient. A portion of the medial edge can be excised to remove redundancy within the platysma. A conservative resection is performed to avoid undue tension at the time of suture plication.



Muscular plication consists of edge-to-edge approximation using multiple interrupted sutures at the mentum and extending at least to the level of the hyoid. This longer plication enhances the surgeon's ability to tighten and contour the platysma so that it adheres to the floor of the mouth and the thyroid cartilage. This produces a better foundation for redraping of cervical skin. Suture placement back from the leading edge of the muscle, in areas of intact muscular fascia, is an important technical point in preventing suture pull-through postoperatively.

In most patients, the edge-to-edge suturing below the hyoid is continued inferiorly toward the cricoid cartilage. A low plication joining a widely separated platysma over a prominent thyroid cartilage tends to blunt a prominent larynx and produce a rounder, more feminine appearance to the neck.



After edge-to-edge approximation of the platysma, some form of muscular release is performed. This muscular release commonly involves a partial transection of the platysma muscle, with the myotomy performed inferiorly within the neck. This usually consists of a horizontal cut extending from the midline to the anterior border of the sternocleidomastoid muscle.

Platysma transection is an effective technique for treating platysma bands and obtaining the desired cervical contour. This procedure must be performed meticulously. Early experience with transection was fraught with complications; specifically, if the transection was performed at a high level, it could cause unveiling of the submaxillary glands and denervation of the platysma, leading to lower lip dysfunction. Also, obvious contour depressions associated with divided muscular edges could occur in an overly thin neck.

The key to platysma transection is that the transection of the muscle must be performed lower in the neck, often as inferior as the level of the cricoid cartilage. The disadvantage of horizontal transection at this level is that a depression in the neck can develop if preplatysmal fat has been removed at the level at which the transection is performed. Preservation of preplatysmal fat lower in the neck where the transection is to be performed is obviously an important factor in preventing this problem.

In most patients, only partial division is required. The myotomy is performed from the midline laterally until the tension is completely released from the platysmaplasty closure (approximately the anterior border of the sternocleidomastoid muscle in most patients).

The muscular release seen after platysma transection serves many purposes:

- It alleviates tension along the medial portion of the platysma transection following plication.

- It allows the platysma to shift superiorly, producing a deeper cervicomental angle.

- It prevents the conversion of two platysmal bands to a single band after edge-to-edge approximation, which can be visible when the neck is extended.

Sequence of SMAS Fixation Versus Platysmaplasty

Because the SMAS and the platysma lie in the same anatomic layer, if platysmaplasty is performed before the SMAS dissection, it can adversely affect facial contour. Contouring the neck before the midface can also present problems. When the platysmaplasty is performed first, the descended jowl fat is locked down into the neck, and movement of the superficial fascia diminishes after elevation of the SMAS. This diminished movement tends to lessen the surgeon's ability to modify facial shape; it also produces a less aesthetic contour. If the SMAS dissection is performed before the platysmaplasty, descended jowl fat is brought cephalad to the mandibular border and is easily repositioned. After the SMAS has been securely sutured bilaterally, the mandibular border appears more distinct, making cervical contouring less demanding. When performing platysmaplasty subsequent to SMAS fixation, the surgeon will notice less redundancy along the medial borders of the platysma; there is also less need to resect muscle at the time of platysmaplasty. The enhanced contour effects of extended SMAS dissection, associated with precise platysmaplasty, tend to diminish the need to remove cervical fat. In general, the neck and jawline appear softer if preplatysmal fat is preserved when contouring the neck.



This patient illustrates how facial fat reelevation influences cervical appearance. Sequencing errors can lead to loss of contour; I prefer to perform SMAS elevation and fixation before performing platysmaplasty. As the facial fat and skin are reelevated upward into the midface through SMAS rotation, the mandibular border becomes more distinct, making cervical contouring more predictable.



This woman demonstrates the result after extended SMAS repositioning and platysmaplasty.



This patient is shown before and after an extended SMAS dissection. By reelevating descended facial fat back up toward the malar region and lateral midface and securing it there intraoperatively, her facial shape is improved. The mandibular border has been enhanced through SMAS repositioning and platysmaplasty.

Incisions

The importance of incision quality cannot be overemphasized in diminishing signs that the patient has undergone a surgical procedure. One of the major advantages of a two-layer face lift is that the tension of contouring is along the superficial fascia, and thus there is less need to redrape the skin flap with great force. Decreased tension on the key sutures in both the preauricular and postauricular region provides greater control over scar perceptibility. If the incisions are artistically designed, patients can typically wear their hair up off their ears without the obvious stigma that a face lift has been performed.

Many authors have described the salient factors regarding incision design, these main points should be emphasized:

Tragal incisions, placed at the margin of the tragus rather than preauricularly, are preferable, because the color difference between the pale skin of the ear and the blush skin of the cheek is usually better camouflaged when the incision is brought internally into the ear.

Tragal incisions are more demanding than preauricular incisions, requiring precise design and placement so that the tragus is not distorted. The aesthetic unit of the tragus is rectangular, as opposed to semilunar. If the surgeon designs the tragal incision properly, respecting the incisura of the tragus, the tragus will appear normal in its shape postoperatively, exhibiting both a visual beginning at its junction with the helix and a visual ending along the preserved incisura.

Detached earlobes tend to appear more natural than attached earlobes. If a small cuff of cheek skin is left attached to the earlobe, it will allow surgical rotation of the skin up under the earlobe during skin flap redraping, with suturing of the earlobe distinct from the cheek flap. The earlobe should be inset in an axis posterior to the axis of the pinna, thereby avoiding a pixie deformity.



This intraoperative photograph illustrates the standard tragal incision with preservation of the incisura of the tragus. The incision is carried around the earlobe approximately 1 to 2 mm caudal to the junction of the earlobe with the cheek skin.



Left: A preauricular incision is shown 2 months postoperatively. Again, the problem with preauricular incisions is that the difference in color between the skin of the cheek and the skin of the ear is more visible in this anterior incision location. *Center:* A tragal incision is seen 5 months postoperatively; this incision was patterned after the

methods described in the preceding figure. *Right:* A well-designed and inset tragal incision should produce an imperceptible, normal-appearing tragus that exhibits both a visual beginning and end and a detached-appearing earlobe.

There is an increasing public demand for facial rejuvenation at earlier ages, when facial laxity is often minimal. This places the onus on the surgeon to create incisions that are imperceptible if these procedures are to be justified. No matter how well deep-layer support is obtained and facial contour improved by SMAS elevation and platysmaplasty, if the incision is obvious, scar quality poor, the hairline disturbed, or the earlobe deformed, the overall result will be disappointing.

Concluding Thoughts

From a personal perspective, after close to two decades of striving to improve techniques in facial rejuvenation, it is my firm conviction that improving technical control when contouring the superficial facial fascia and platysma provides a more consistent, aesthetically pleasing result that is nonsurgical in appearance. To perform a successful two-layer SMAS-type face lift, the surgeon must not only understand facial soft tissue anatomy, but also must perform a procedure that demands technical precision. A two-layer SMAS-type face lift is a time-consuming operation, with both the skin flap elevation and the dissection of the SMAS requiring meticulous, accurate dissection. Obtaining consistency with this procedure is challenging because of the variability among individuals in the thickness of subcutaneous fat and the SMAS. After precise dissection, secure fixation of both the SMAS and platysma is essential to maintain the desired postoperative contour. Ensuring meticulous hemostasis, followed by careful skin flap inset, are required to minimize postoperative scar perceptibility and ensure a rapid postoperative recovery.

Despite these demands, I have found the extended SMAS technique to be rewarding, with a high degree of patient satisfaction. All techniques have advantages and disadvantages. For me, the biggest advantage of the extended SMAS technique remains its aesthetic versatility, allowing the surgeon to vary the contouring aspects of the procedure according to the aesthetic needs of the patient.

Clinical Caveats

Patient selection is probably the most critical factor when determining the success of a proposed aesthetic procedure.

The anatomic arrangement of the facial soft tissues as a series of concentric layers is key to the safety of rhytidectomy procedures. This concentric arrangement allows dissection within one anatomic plane to proceed completely independent of structures lying within another anatomic plane.

Improving technical control when contouring the superficial facial fascia and platysma provides a more consistent, aesthetically pleasing, nonsurgical-looking result.

The surgical significance of the deep facial fascia is that all the facial nerve branches within the cheek lie deep to the deep facial fascia.

Although aging is a complex process, many of the stigmata developing in the aging face involve a change in the relationship between the superficial and deep facial fascia, with the superficial unit of the facial soft tissue descending inferiorly in relation to the fixed deeper structures of the face.

The importance of the zygomatic ligaments lies in their ability to suspend malar soft tissue superiorly over the zygomatic eminence. With aging, malar support commonly attenuates, leading to an inferior migration of malar soft tissue. Attenuation of support from retaining ligaments, dermal elastosis, and facial lipodystrophy are the three main components that must be addressed to reconstruct the anatomic changes resulting from aging.

The principal advantage of performing skin undermining separately from SMAS dissection is that it allows these two layers to be redraped along vectors that are independent of one another.

The significance of the retaining ligaments is their location, which determines the degree of surgical dissection necessary in face lifting.

In face lifting, it would seem that wide mobilization and aggressive dissection would improve contour, but my experience with wide dissection has led me to a contrary view. I have found that wide dissection peripheral to the restraint of the retaining ligaments to be counterproductive in an extended SMAS face-lift technique.

Rhytidectomy can be considered a reconstructive procedure in that facial soft tissue anatomy is restored to a state resembling its structure before the degenerative effects of aging occurred.

More than any other factors, skin quality and elasticity have perhaps the greatest influence on outcome after a rhytidectomy.

Buccal fat removal tends to reduce facial fullness, but rarely does it improve prominent jowls.

In most patients, jowling can be improved through SMAS rotation.

The prominent nasolabial fold requires restoration of malar support to produce a lasting change in contour. In my experience, extending the cheek SMAS dissection into the malar region to restore malar support has been helpful in improving prominent nasolabial folds.

Correction of the obtuse neck involves restoration of skin tone, contouring of regional lipodystrophy, and restoration of platysma support.

One of the major advantages of a two-layer face lift is that the tension of contouring is along the superficial fascia, and thus there is less need to redrape the skin flap with great force.

The importance of incision quality cannot be overemphasized in diminishing the signs that the patient has undergone a surgical procedure.

The postauricular incision extends along the postauricular groove, not up onto the conchal surface.

Because the SMAS and platysma represent the same anatomic layer, if platysmoplasty is performed before the SMAS dissection, it can adversely affect facial contour. Contouring the neck before the midface can also present problems.

In skin flap dissection, it is important to develop uniform skin flaps during the subcutaneous undermining, taking care to leave some fat intact along the superficial surface of the SMAS, especially in the regions where the SMAS is to be dissected.

The SMAS overlying the parotid gland and malar eminence tends to be substantial and easy to dissect, with both the parotid and zygomaticus major and minor muscles protecting the underlying facial nerve branches. These areas are very safe regions to begin SMAS elevation and delineate the sub-SMAS plane.

Because the SMAS and platysma are in the same layer, what the surgeon does in the face influences the contour in the neck.

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The nasolabial fold has defied satisfactory correction with the face-lift operation despite variations of the SMAS technique over the past 20 years. In this study, the nasolabial fold is shown to be part of the overall aging deformity that affects the cheek and perioral region. The relevant anatomy is reviewed and the safety of the procedure is assessed in a personal series of 135 patients. It is concluded that the two principles of this technique, that is, complete SMAS release and reattachment to the zygoma, safely and effectively achieve a natural-appearing rejuvenation of the cheek and nasolabial fold.

Stuzin JM, Baker TJ, Gordon HL, Baker TM. Extended SMAS dissection as an approach to midface rejuvenation. *Clin Plast Surg* 22:295-311, 1995.

The objective in rhytidectomy is to rejuvenate and improve facial appearance. To obtain consistent results, face lifting should be approached not just as a tightening or lifting procedure but also as a reconstructive procedure, reversing the anatomic changes that occur in aging. The authors discuss the blending of surgical technique, anatomic knowledge, and artistic sensitivity to individualize the surgical approach for patients. Furthermore, the authors stress that obtaining surgical rejuvenation while minimizing signs of surgical distortion should be the ultimate goal of face-lifting procedures.

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CHAPTER 45



High SMAS Face Lift With Orbicularis Redraping and Septal Reset

FRITZ E. BARTON, JR.

The traditional method of soft tissue facial rejuvenation has been segmental, skin-based surgery. Most commonly, early signs of aging have been addressed with initial blepharoplasty, followed later by correction of the cheek and/or neck and occasionally, rejuvenation of the forehead. This approach was and still is popular for several reasons. First, the patient views it as logical to do multiple, small, stepwise procedures. The patient assumes that if less is done, the less likelihood that he or she will look “operated on.” Second, it seems less threatening when the procedures can be done with a local anesthetic and sedation, rather than with a general anesthetic. Third, the procedures are quick for the surgeon, and recovery is quick for the patient. Limited skin-based procedures, with or without superficial plication sutures in the SMAS, are simple in concept as well as in application.

In this chapter, I will present an approach that challenges most of those tenets.

I believe that paramount to the maintenance of facial beauty in aging is the maintenance of facial harmony. At any age, one of the requirements for looking natural is for all segments of the facial aesthetic complex—from the hairline to the clavicles—to match. Generalized laxity looks natural; generalized firmness looks natural. But a lax segment juxtaposed against a firm segment looks unnatural. As I explain to patients, no matter how skillfully you shorten two legs of a chair, it never looks in balance. Not only is this disharmony important initially, but as aging progresses, disharmony often becomes more apparent.

It is my firm belief that at the time of the initial facial rejuvenation surgery, changes that are present throughout should be treated simultaneously and comprehensively. I think that the subunits of the face and neck overlap. Thus mobilizing only one unit is restricted by the attachments of the adjacent units. Mobilizing and repositioning all of the subunits simultaneously allows a harmonious blending. Nowhere is this more important than in the lower eyelid and the cheek.

Pertinent Anatomy

Several surgical principles are incorporated in surgical planning. First, the cheek unit is dealt with as a single composite unit. Although some faces have significant facial atrophy with volume loss, descent is not only a prominent factor, but it is also the most correctable factor. The facial soft tissues, skin and subcutaneous fat, are attached to the facial skeleton by osteocutaneous fibrous connections—“ligaments” and fascias. Over time these supporting fibrous attachments relax, allowing descent, particularly of the superficial subcutaneous fat and skin. Just as the skin was not holding the soft tissues in place initially, it is not a useful layer for resupport. Skin is a viscoelastic structure, designed to be flexible and expansile. By definition, an elastic structure is

not a good choice for bearing the load of suspension. Dense collagenous structures, fascia and tendon, are designed to carry load. Therefore retightening the deep fascia is the best way to resuspend the facial fatty mass and skin.

Critics of this load-bearing suspension concept argue that any tension in a face lift creates flattening of the facial contours and should be avoided. I agree that any tension in the skin is to be avoided to avoid stress relaxation and a stretched look. Skin will not support even its own weight, much less the weight of the cheek mass. It is the skin tension from skin-based procedures that has produced the large number of stretched, distorted faces that have given face-lift surgery a bad name.

However, vertical repositioning of the subcutaneous facial mass by means of fascial (SMAS) advancement does not flatten contour or create skin tension.

The second principle in my approach is to leave skin attached to the SMAS and subcutaneous fatty mass, so the entire cheek moves as a whole. This approach is a modification of the original Skoog procedure.

Our previous studies have shown that the platysma/SMAS serves as a myocutaneous unit. After transection of the anterior branch of the superficial temporal artery with the surgical dissection, the branches of the anterior facial artery supply the midcheek skin via the platysma. Moreover, the SMAS sends fibrous connections through the overlying subcutaneous fat to the dermis. Therefore elevation of the subcutaneous mass through the SMAS indirectly advances the skin without causing direct dermal tension.

Some have criticized advancing the cheek as a composite of skin and SMAS, contending that the skin and SMAS cannot be redraped in different directions. I do not believe this opinion to be valid. First, as has recently become accepted, the best direction for redraping both the skin and the SMAS in the cheek is vertical. However, the neck often requires more horizontal (or oblique) redraping. Thus the skin and platysma are dissected as separate layers in the neck below the mandible.

The third principle is that advancement is facilitated by release. As previously discussed, the subcutaneous fatty mass and SMAS are fixed by retaining ligaments and fascial attachments. The fatty mass is secured by the zygomatic retaining ligament. The SMAS is restricted by its attachment to the parotid capsule as well as its investment of the superficial layer of the facial mimetic muscles. Advancement vertically is restricted by these attachments. Conversely, I believe that advancement is facilitated by release of these attachments. This approach is central to the debate over whether plication (infolding without undermining) is as effective as imbrication (undermining, advancement, and overlapping) in long-term maintenance of cheek suspension. Having performed both techniques for many years, I think that imbrication is more long lasting.

A wide variety of methods have been described for using the SMAS to elevate the subcutaneous facial fat. Early attempts at SMAS advancement were timid dissections only over the parotid gland. Because the SMAS is broadly laminated to the parotid capsule, the SMAS is immobile in this area. As a result, these initial experiences were disappointing, and the value of the SMAS was questioned.

With extended dissection, however, the restriction of the parotid capsule is released, and the areolar gliding plane over the buccal area is entered. With this maneuver, the cheek mass over the buccal and mandibular area is well mobilized. This step in the evolution of SMAS dissection I regard as a low SMAS technique, in that its effect is limited to below the zygomatic arch. The upper subcutaneous mass, or malar pad, is left unsuspended.

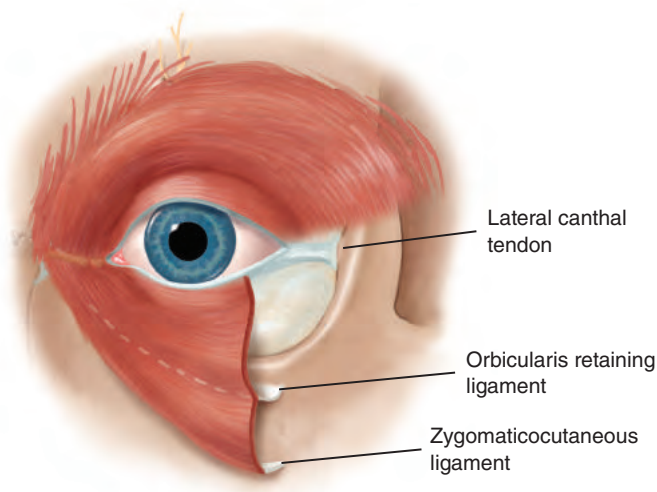
It was my goal to suspend the entire cheek subcutaneous mass, mandibular and malar, as a single unit to provide pansupport. In 1984, after several years of anatomic dissections and experience with sub-SMAS dissections in reconstructive cheek flaps, I performed my first high SMAS procedure. Other than several variations of the extent of anterior dissection, I have persisted with the original technique. As with any procedure, the application subtleties vary with each patient, but I have found the high SMAS face lift to deliver consistent, predictable, long-lasting benefits. Although the cheek mass suspension method remained rather constant, what I have added is the approach to the lower orbit and lid-cheek junction.

As with surgery of the cheek and neck, early lower blepharoplasty techniques focused on skin excess. I initially performed skin flap elevation and excision, in association with selective fat removal, for many years. In some patients, it was and remains an adequate technique. However, I began to observe that the result in many patients was not of the highest quality.

One group that failed with the skin flap technique was patients with so-called malar bags. It was not until the sentinel publications of Furnas describing *festoons* and Hamra observing the *orbicularis crescent* that I came to understand, and look for, the importance of orbicularis ptosis in lower eyelid surgery. Like many unnoticed deformities, the more you look for it, the more prevalent you realize it is. I am now convinced that orbicularis ptosis is present in essentially every aging eyelid. Thus orbicularis suspension in the lower eyelid is comparable to SMAS suspension in the cheek.

It is imperative to understand the partitioning of the orbit from the cheek to understand how to safely deal with the lid-cheek junction. Extending from the lacrimal bone medially to the inner orbit laterally, the fibrous sling encases the lower lid tarsal plate and soft tissue. The lower eyelid is a rather slight and fragile structure, so the suspensory apparatus can be delicate.

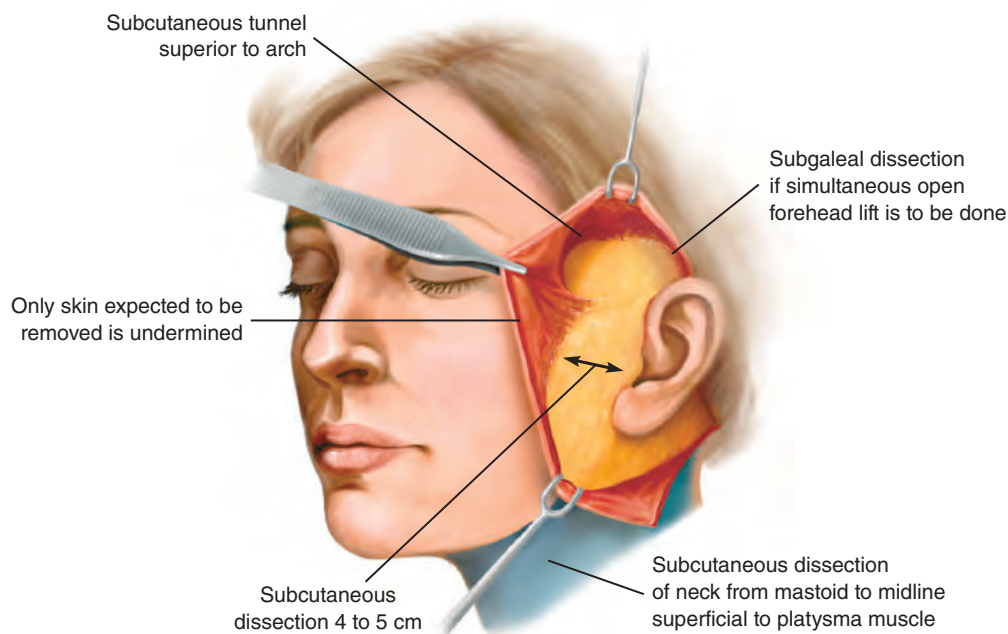
The cheek mass, by contrast, is much more massive, and accordingly, it is heavier. Unopposed, the weight of the cheek would overwhelm the fragile lid suspensory system and pull the lid down into ectropion. However, the eyelid is protected by two barriers.



The orbicularis retaining ligament (or orbitomalar ligament) extends from just below the orbital rim to the junction between the preseptal and periorbital orbicularis oculi. Originating medially at the orbital rim and extending obliquely downward through the cheek at the lower border of the periorbital orbicularis oculi is the zygomaticocutaneous ligament (or malar membrane). In combination, these two osteocutaneous ligaments serve as “check rein” partitions from which the weight of the cheek is partially suspended. As long as they are intact, the lower eyelid is protected. Procedures developed to blend the lid-cheek junction, however, frequently disrupt these barriers. To avoid potential ectropion of the lower eyelid with release of the barriers, protective independent suspension of the cheek should be done. This protection gains in importance as patients with increasingly negative-vector orbits are treated.

Operative Technique

To begin a high SMAS face lift, a preauricular skin incision is usually brought posttragally. The mastoid extent of the incision is determined by the degree of neck skin excess.



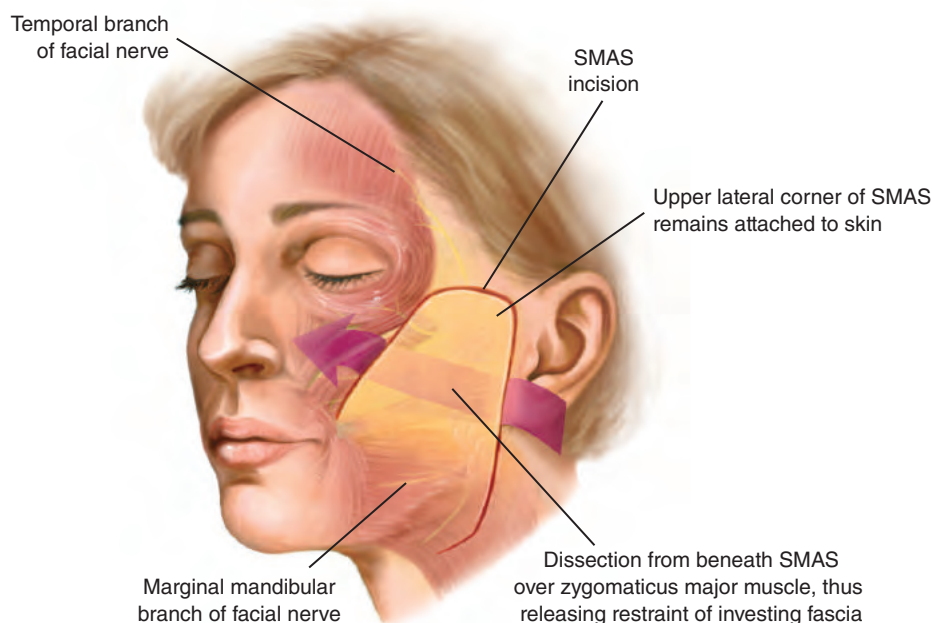
A limited subcutaneous dissection is carried out in the preauricular area to the extent of the estimated skin excision. The goal is to leave minimal undermined skin at the completion of the procedure. The subcutaneous dissection is continued above the zygomatic arch in a tunnel over to the lateral border of the orbicularis oculi.

The SMAS is then initially incised from the top of the tragus to the bottom of the earlobe to establish the proper plane over the parotid. It is at this location that the SMAS is thickest and the facial nerve is the deepest within the parotid gland.

With the sub-SMAS plane established, dissection is continued anteriorly to the border of the parotid, where it becomes areolar in nature. It is at this point that the facial nerves exit the parotid gland, and the dissection is switched from sharp to blunt spreading. With vertical spreading, the buccal dissection is carried into the area of the mobile SMAS. It is imperative to leave the translucent buccal fascia intact as a protection over the facial nerve branches.

At the lower extent of the sub-SMAS dissection, approximately 4 cm below the mandibular border, a small horizontal backcut is made to allow the SMAS to displace upward without restriction from the investing fascia.

Next the upper border of the SMAS is transected above the zygomatic arch over to the lateral border of the orbicularis oculi muscle. It is this maneuver that facilitates upward repositioning of the upper malar fat. It has also been the most controversial portion of the technique. Traditional teaching has been that transection of the SMAS at this level would sever the frontal branch of the facial nerve. However, that anatomic dictum is incorrect. In fact, the facial nerve branch courses deeper over the zygomatic arch, and the SMAS can be safely elevated and separated from it.

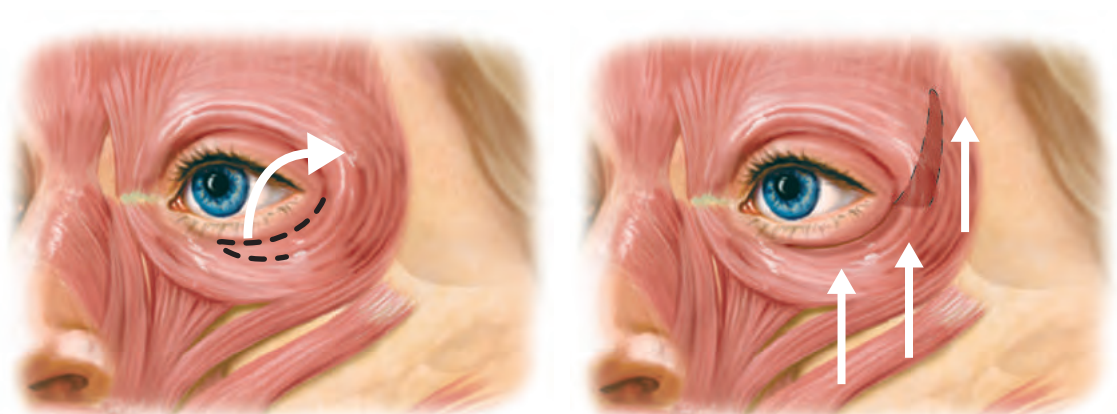


Once the upper SMAS is released above the zygomatic arch, it is severed from the zygomatic retaining ligaments and its investment of the zygomaticus major muscle. Using the visible border of the orbicularis oculi as a point of origin, the surgeon can identify the path of the zygomaticus major muscle. A thin layer of fat should be left on the muscle to protect the motor branch to the lateral orbicularis, which courses over the external surface of the zygomaticus major muscle origin. The plane of dissection is continued from beneath the SMAS over the external surface of the zygomaticus major muscle and into the subcutaneous plane, releasing the investing fascia connection of the SMAS.

The cheek mass is then relocated in a vertical direction and secured to the deep temporal fascia above the auricle. The periauricular SMAS is then reapproximated to provide a broad, secure closure. This vertical suspension of the cheek mass not only supports the cheek mass, but also provides something of a shelving support below the orbital tissues.

Orbicularis Suspension

The first step in orbicularis suspension is to perform a subciliary incision. The skin is then elevated over the pretarsal and preseptal orbicularis muscle. The lateral half of the orbicularis muscle is incised, leaving a pretarsal strip intact. Dissection is carried beneath the orbicularis muscle down to the level of the orbital rim. At this point the orbicularis retaining ligament and attachment over the zygomatic body are freed to allow mobilization. Without release of these attachments, the orbicularis muscle cannot be adequately mobilized superiorly.

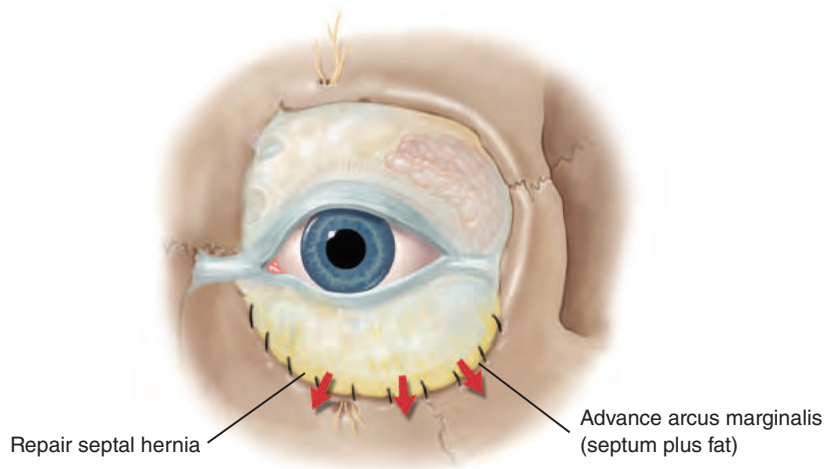


A laterally based interpolation flap is then formed from the redundant upper edge of the orbicularis muscle. This muscular pennant is then tunneled beneath the superficial head of the lateral canthal raphe to be secured to the lateral orbital rim periosteum above. Tarsal protection during the healing phase is accomplished by either canthopexy or canthoplasty of the lateral canthal tendon. Redundant skin is then conservatively trimmed.

In patients with vector-positive orbits, only orbicularis redraping is necessary to smooth a prominent arcus marginalis.

Septal Reset

In patients with a negative-vector orbit, a prominent tear-trough configuration may be present consisting of malar bone deficiency, deep set arcus marginalis, and herniation of orbital fat. A septal reset procedure may be beneficial in addition to the orbicularis suspension and skin removal.



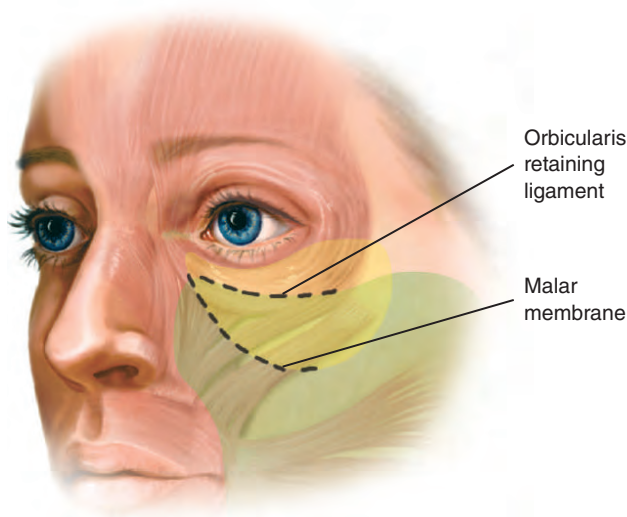
After elevation and release of the orbicularis muscle, the orbital septum is divided along the arcus marginalis. The orbital fat is extruded over the orbital rim. The orbital septum and orbital fat are then sutured together to the periosteum of the anterior orbital rim.

The remainder of the procedure of orbicularis suspension is then completed as previously described.

Benefits of the Combined Procedures

Although any of the aforementioned procedures can be performed alone, I think they are much more effective and much safer when performed together.

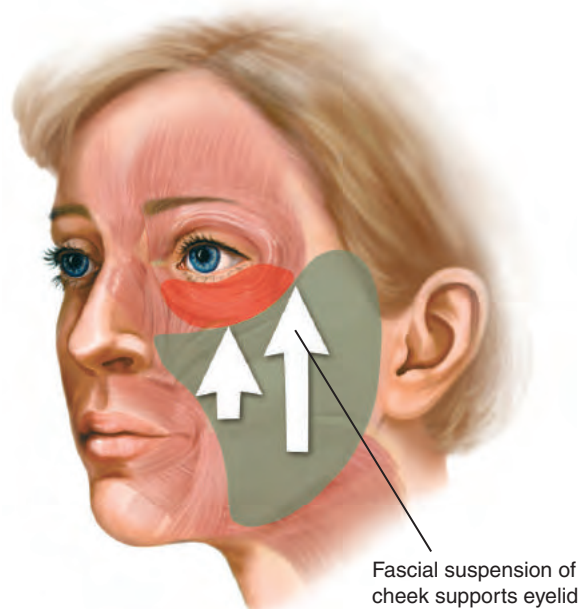
Effectiveness



The vertical elevation of the malar fat partially effaces the visible depression along the arcus marginalis, but it also transfers skin into the eyelid, usually necessitating lower lid skin removal. In addition, the malar fat elevation undercuts the redundant lower border of the orbicularis oculi, creating or accentuating a *malar crescent*.

Suspension of the orbicularis corrects this problem. In negative-vector patients with fat herniation, release of the orbital septum and reset of the orbital fat with the septum to the anterior orbital rim enhances the procedure.

Safety



From a safety viewpoint, independent suspension of the cheek protects the eyelid suspensory mechanism. To redrape the orbicularis oculi to correct orbicularis ptosis, release of the orbicularis retaining ligament is necessary. Furthermore, release of the malar membrane softens the oblique depression sometimes present across the cheek. The release of these osseocutaneous ligaments removes the protective partition between the lower eyelid and cheek. Independent vertical cheek elevation not only removes the weight of the cheek from the eyelid, but it also creates a “shelving” sling to support the eyelid.

For both reasons, when presented with a patient with aging in both the eyelid and cheek, I prefer to redrape them simultaneously, rather than sequentially.

Result



This 63-year-old woman has significant facial laxity, a negative-vector orbit with a tear-trough triad, and poor dermal tone. In my clinical experience, this type of patient is not uncommon, yet the quality of her tissue makes her challenging. She underwent a high SMAS face lift with orbicularis suspension and septal reset. She also had a simultaneous forehead lift. Her clinical result at 12 months postoperatively is shown.

Clinical Caveats

Faces age in all areas; therefore all aged areas should be addressed simultaneously to preserve facial harmony.

Skin undergoes stress relaxation. Therefore, to avoid a stretched look, skin should not be placed under tension.

The SMAS is the best “handle” with which to reposition the subcutaneous facial mass.

Leaving the SMAS attached to the skin allows the skin to be repositioned without tension.

Annotated Bibliography

Barton FE Jr. Facial Rejuvenation. St Louis: Quality Medical Publishing, 2008.

This text offers a more complete explanation of office organization, patient consultation, variations in panfacial rejuvenation, and skin surface care.

Furnas DW. Festoons of orbicularis muscle as a cause of baggy eyelids. *Plast Reconstr Surg* 61:540-546, 1978.

This classic article brought clarity and attention to orbicularis ptosis and the cause of “malar bags.” Surgical resuspension is described.

Furnas DW. The retaining ligaments of the cheek. *Plast Reconstr Surg* 83:11-16, 1989.

This classic article first defined the osteocutaneous ligaments of the face. Release of these ligaments is necessary to completely mobilize the SMAS and subcutaneous cheek mass.

Mitz V, Peyronie M. The superficial musculo-aponeurotic system (SMAS) in the parotid and cheek area. *Plast Reconstr Surg* 58:80-88, 1976.

These young surgeons, working with Tessier, published the first detailed anatomic description of the subcutaneous fascia in the face, which they called the superficial musculoaponeurotic system (SMAS).

Skoog T. Plastic Surgery—New Methods. Philadelphia: WB Saunders, 1974.

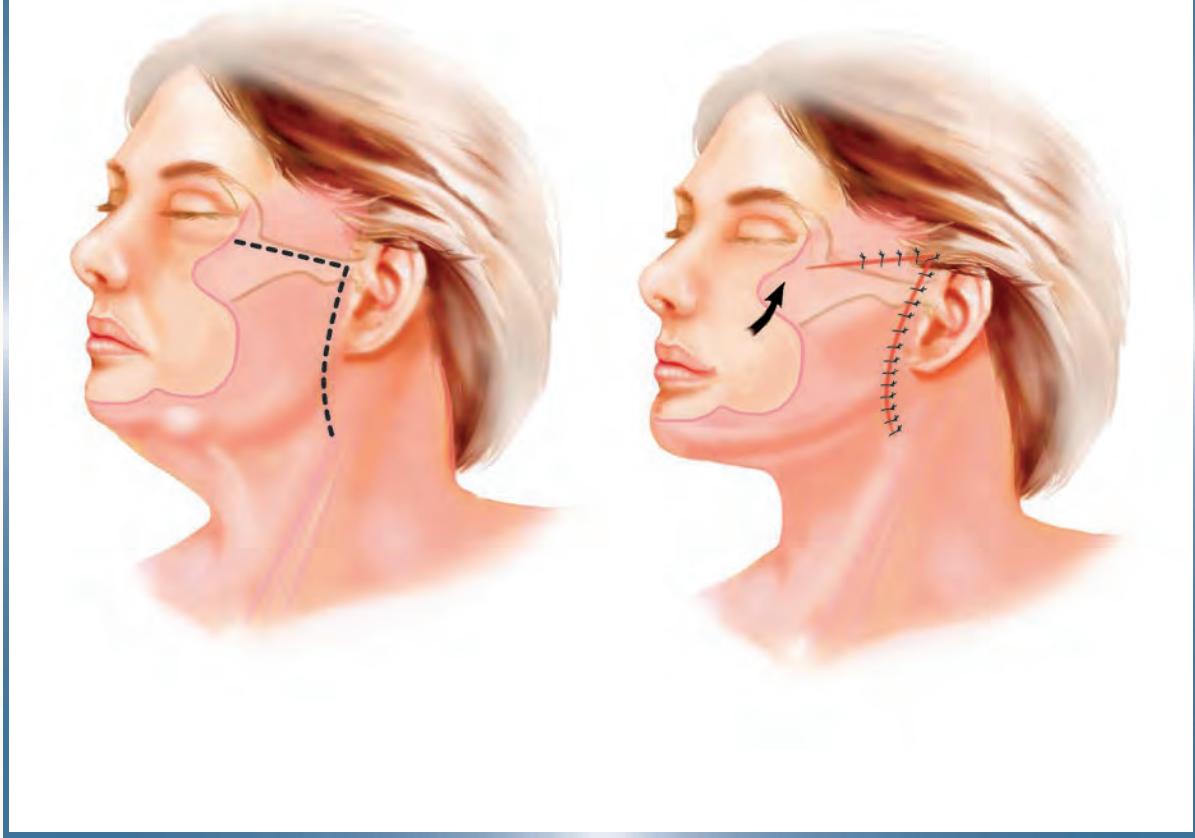
Although the superficial subcutaneous fascial had been noted by earlier anatomists and surgeons, it was Tord Skoog who conceived using the subcutaneous fascia to mobilize a composite cheek flap.

Suggested Readings

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CHAPTER 46



Lamellar High SMAS Face and Midface Lift:

*A Comprehensive Technique for
Natural-Appearing Rejuvenation of the Face*

TIMOTHY J. MARTEN

Traditional face-lift techniques have relied on the tightening of thin flaps of aging skin to elevate and support sagging deeper facial tissue. Although initial results from these procedures often appeared good, early recurrence of the original deformity was common, and poor scars and healing problems were frequently seen as a result of the obligatory wide flap undermining and unavoidable skin flap tension. These procedures also typically produced an easily recognized tight or face-lifted look that was usually exacerbated with subsequent procedures.

As plastic surgeons have pursued an improved outcome, our understanding of the aging process has improved, and face-lift techniques have evolved. Experience has since confirmed that an attractive, natural-appearing result is not possible without diverting tension away from the skin to the superficial musculoaponeurotic system (SMAS) and platysma and unless other deep layer structures and the aging midface are addressed. For many patients, an improved result is obtained if age-related facial atrophy is concomitantly corrected with fat injections or by other means (see Chapter 47).

Fundamental Concepts

Why Use the SMAS?

The fundamental flaw in “skin-only” face lifts, mini-lifts, and similar procedures is the fact that skin was meant to serve a covering function—not a structural or supporting one. Skin is inherently elastic and was intended to stretch and move as we express ourselves; it is not structurally capable of supporting sagging muscle, fat, and other structures that lie beneath it. Using skin as a vehicle to support sagging deep-layer tissue corrupts its covering function and results in abnormal skin tension and related secondary problems, including poor scars, tragal retraction, earlobe malposition, and a tight, unnatural appearance. Skin tension also flattens contour rather than restoring it, and because skin stretches as tension is applied, objectionable temple, sideburn, and occipital hairline displacement is common when skin-only techniques are used. In addition, because skin is inherently elastic and not capable of providing sustained support of deep facial tissues, the improvements achieved through most skin-only face lifts and mini-lifts are usually short lived.

Using the SMAS to lift sagging facial tissues and restore facial contour circumvents the problems associated with skin-only lifts as it is an inelastic structural layer capable of providing meaningful and sustained support. Although skin must be excised in SMAS procedures and proper excision will produce an improved result, only redundant tissue is sacrificed, and closure can be made under normal skin tension. Facial skin so treated will distribute itself naturally over new contours and is capable of some self-repair and contraction. This averts a tight or lifted appearance and further enhances the result.

Using the SMAS and platysma to elevate sagging facial tissues and to create an attractive face and neck contour provides a means by which sustained support can be obtained from nonelastic, structural tissue layers, and tension can be transferred away from the skin. This results in a soft, natural facial appearance, high-quality scars, and often doubles or triples the lifespan of the improvement. Diverting tension to the SMAS and platysma and away from the skin also preserves delicate preauricular contours and minimizes displacement of temporal and sideburn hairlines. In addition, unlike skin-only face lifts and mini-lifts in which subsequent procedures worsen skin tightness and problems associated with it, SMAS face lifts, at least in theory, can be repeated as often as needed without producing skin tightness and an abnormal appearance. This removes the “two face-lift limit” set by many surgeons performing skin-only procedures and allows patients to undergo procedures at an earlier age and more frequently, if desired.

Sustained and attractive support of the deep layers of the face cannot be predictably obtained by the placement of long “suspension” and “cable” sutures, even if soft, partially elastic materials are used. These “suture lift” procedures have led to a variety of problems for many patients, including suture extrusion, traction dimples, visible bowstringing, nerve injuries, facial dyskinesias, chronic pain syndromes, and an abnormal appearance on animation. Suspension sutures placed in the neck can also create a tight or choking feeling that is disturbing to patients, and can result in difficulties in speaking and swallowing. In addition, if large, stiff, permanent sutures are used, the suture knots and the sutures themselves can often be felt beneath the skin. In some cases these suture knots can erode overlying skin, necessitating their removal.

The fundamental flaw in “suture lifts” and the use of suspension sutures is that one must rely on a small, rigid thread to support a large area of delicate, inherently soft, mobile facial tissue. Over time, these sutures “cheese-wire” through the tissues they were intended to support and can injure important neuromuscular structures. Suspension sutures also prevent natural depression and downward movement of facial tissues, impeding certain expressions and creating an unnatural appearance.

Unlike suspension suture placement, SMAS elevation allows secure, balanced elevation of facial tissues without disruption of their natural relationships. Tissue anchoring is achieved through direct tissue contact and healing, not distant point suspension by a suture. SMAS elevation also allows natural gliding and depression of tissue and a more natural appearance on animation.

The periosteum has been advocated by some as the layer beneath which face-lift dissection should be performed and the layer by which sagging deep facial tissues should be elevated. When properly performed, such procedures divert some tension away from the skin and avoid many of the problems associated with skin-only procedures.

Improvement in the infraorbital and upper midface areas may also be obtained in some cases when the procedures are properly designed. However, this layer is a conceptually illogical choice for overall rejuvenation of the face in that it is densely adherent to the facial skeleton and does not significantly descend as part of the aging process. It is also not closely associated with the intermediate layers of the face, where most of the aging is known to occur, and its dissection results in prolonged swelling and induration and generally portends a longer recovery period for the patient. In addition, many subperiosteal face-lift techniques rely on the concomitant use of suspension sutures; thus these procedures often share many of the related problems. Unlike the periosteum, the SMAS is closely associated with tissues that sag as the face ages and actually envelopes many, if not most, of those of concern. It is thus arguably a more logical layer to use to restore them to a more youthful position.

The SMAS and the Midface

The midface is generally defined as an inverted triangular area situated over the anterior upper cheek that is bounded by the zygomaticus major muscle laterally, the nasolabial fold medially, and the infraorbital rim superiorly. In healthy, youthful-appearing individuals this area is full and confluent with the adjacent cheek and lower eyelid. As men and women age, however, and enter their early midlife and beyond, there is a general wasting of and loss of volume from this area. Over time, this results in a loss of the smooth, youthful transition from the lower eyelid to the cheek and eventually leads to an ill, haggard, elderly appearance. Midface atrophy is felt by some surgeons to also be accompanied by descent of midface tissues, and the aging change seen in the upper cheek area is thus often referred to as *midface ptosis*.

The recognition of midface ptosis as a significant component of the changes occurring in the aging face, combined with the realization that the traditional SMAS face lift produced little or no improvement in the midface region, has led to the development of a variety of procedures designed to specifically target the midface area. Many of these techniques are now being performed as isolated procedures or in conjunction with lower eyelid surgery.

Although there is merit in the idea of rejuvenating the midface, isolated midface lift procedures are still evolving and have not been perfected. Most procedures have a steep learning curve and have been fraught with complications, especially when performed through a blepharoplasty incision. These complications include lid retraction, ectropion, canthal displacement, and dry-eye problems. As a result, many midface lift techniques have come to incorporate potentially problematic aggressive adjunctive surgical maneuvers, including canthotomies, canthoplasties, and orbicularis oculi muscle suspensions to prevent these problems from occurring. These maneuvers often result in a “changed look” that is disturbing to many patients and carry a high risk of significant and troublesome complications of their own.

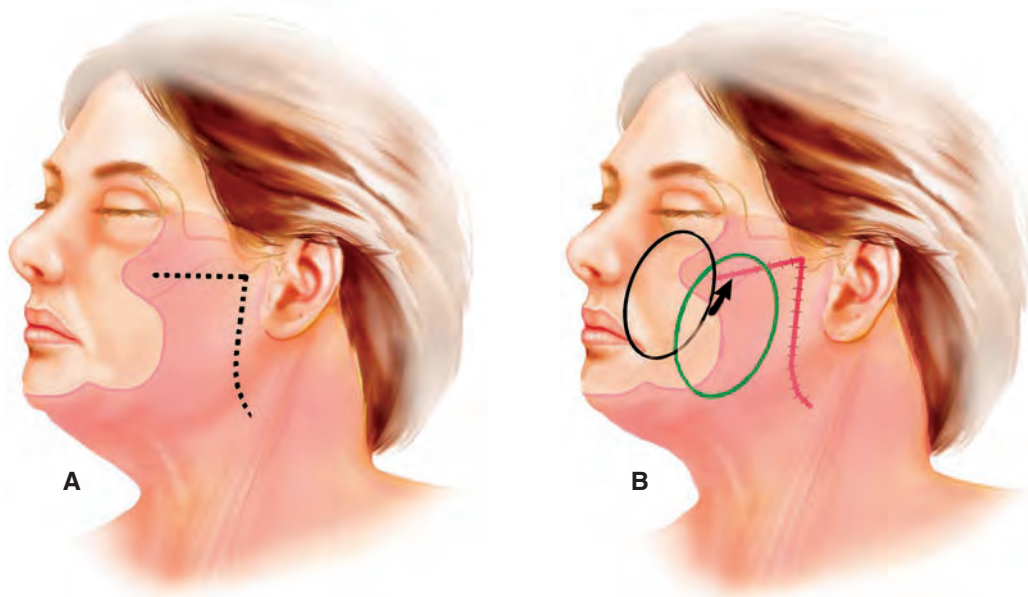
Many other arguments can be made against the use of isolated midface procedures, including the fact that attractive rejuvenation of the face is possible without complete elimination of the nasolabial fold. Most patients with nasolabial folds had them when they were young, and their presence reflects the patient's anatomic makeup, not necessarily an age-related, undesirable change. In such cases it is neither necessary nor desirable to completely eliminate them, because they are an inherent and appropriate feature of the patient's face. As a practical matter, however, most of the improvement obtained by midface lifts consists only of elevation of the lid-cheek junction, not correction of the nasolabial fold. Midface lifts also produce a subtle improvement that is not always noticed or appreciated by the patient. Because of this, time in the operating room is often arguably better spent on lower-risk maneuvers that result in more noticeable improvement that is of higher priority to the patient.

Careful evaluation of most patients who request a midface lift will show that they also need a face lift. It is rare to encounter a patient with midface aging who does not also have sagging in the cheek and jowl, and midface lifts are arguably more logically performed in conjunction with a formal face-lift procedure. When this is done, improvement is more balanced and comprehensive, producing a more harmonious and natural-appearing result. Healing is also faster and complications are less likely if midface improvement can be obtained through the face-lift incision rather than through a blepharoplasty or intraoral approach.

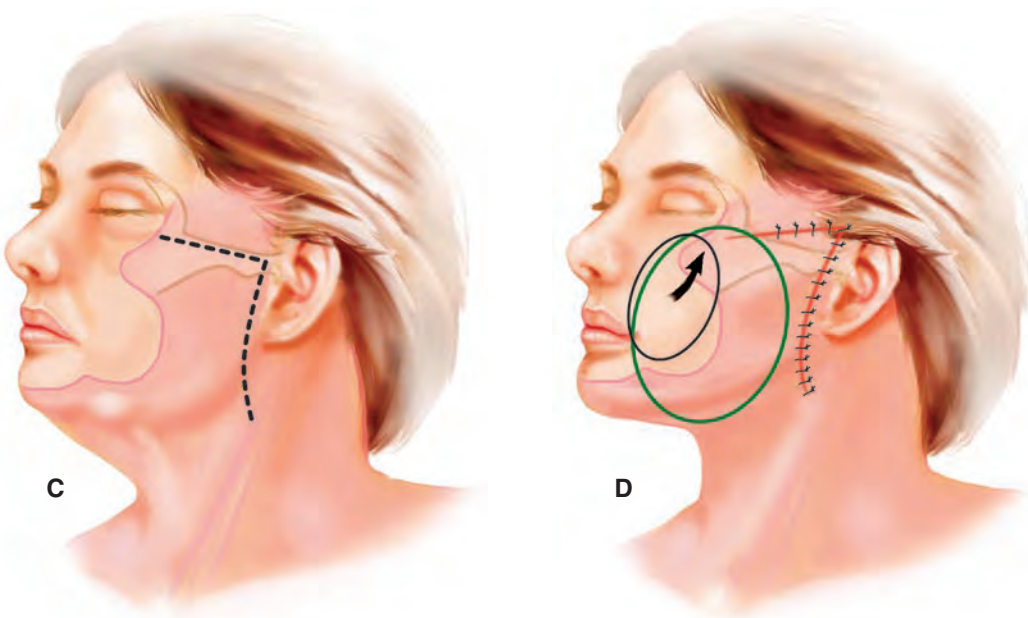
Most midface lifts are also generally conceptually flawed in that they are based on the erroneous assumption that the problem seen in the anterior upper cheek is solely one of tissue sagging. Failure to acknowledge the fact that *atrophy* is present to a significant degree in most cases has led to general disappointment following many procedures for both patients and surgeons and has resulted in the addition of dermal fat grafts, orbital fat transposition, and "septal resets" to midface lift procedures. However, it remains to be answered whether these procedures can restore lost volume as simply, naturally, and effectively as with fat injections.

The High SMAS Lift

The conventional low cheek SMAS flap elevated below the zygomatic arch suffers the drawback that it cannot by design have an impact on tissues of the midface and infraorbital region. Low designs target the lower cheek and jowl only and produce little if any improvement in the upper anterior cheek area. Planning the flap "higher," along the superior border of the zygomatic arch, and extending the dissection medially to mobilize midface tissue overcomes this problem and produces an improved result.



Low SMAS. A, Plan for a low SMAS procedure. Note that the upper border of the flap lies *below* the zygomatic arch. **B,** Low SMAS flap after dissection and suspension. The area of flap effect (*green circle*) is limited to the lower cheek and jowl, and no improvement is obtained in the midface, infraorbital, or perioral regions (*black circle*).



High SMAS. C, Plan for a high SMAS procedure. Note that the upper border of the flap lies *over* the zygomatic arch. **D,** High SMAS flap after dissection and suspension. The area of flap effect (*green circle*) includes not only the cheek and jowl, but also the midface, infraorbital, and perioral regions (*black circle*).

Benefits include restoration of a youthful upper cheek contour, an aesthetically significant fill of the infraorbital region, increased support of the lower eyelid, and correction of the nasolabial fold, all without the need to perform a separate or distinct midface lift. High SMAS procedures are also readily combined with midface fat injections, because midface and infraorbital tissue planes are not opened or dissected. This averts the need to perform complex and potentially problematic procedures in which orbital fat is transposed, the orbital septum “reset” or free grafts are placed.

At least part of the popularity of low SMAS designs can be attributed to perceived anatomic constraints about the zygomatic arch and laudable efforts to design flaps that could be dissected safely without jeopardizing the frontal branch of the facial nerve. However, careful reappraisal of this assumption has shown that high dissection is anatomically sound and clinically safe. For many if not most patients, the repositioning of midface tissue obtained with a high SMAS flap is satisfactory, and no additional or separate midface lift procedure is required.

Lamellar Dissection and Bidirectional Tissue Shifts

A number of specific strategies that merit review have been devised for use of the SMAS. These include composite dissections in which the SMAS and skin are elevated as a single unit and advanced in the same direction, and “lamellar” dissections in which skin and SMAS are elevated as separate layers and advanced bidirectionally along different vectors. Composite-type dissections have the potential advantage of being quicker to perform, and they result in a comparatively thicker, arguably more durable flap composed of both skin and SMAS. However, these dissections have the distinct disadvantage that skin and SMAS must be advanced the same amount, in the same direction, and suspended under more or less the same amount of tension. Because skin and SMAS age at different rates and along somewhat different vectors, optimal treatment of each layer is generally not possible when these techniques are employed, and skin overshifting, skin overtightening, hairline displacement, “wrinkle shift” from the neck to the cheek, and other objectionable occurrences and unnatural appearances can result. In addition, if the orbicularis oculi is included in a composite flap, the muscle’s motor nerve supply can be compromised and lid dysfunction, nerve cross-regeneration, and other disturbing and objectionable abnormalities can result.

Lamellar dissections offer the distinct advantage that skin and SMAS can be advanced different amounts, along separate vectors, and can be suspended under differential tension. This allows each of these layers to be addressed individually, avoiding skin tension, hairline displacement, and objectionable wrinkle shifts. This in turn results in a more natural appearance, a more comprehensive rejuvenation, and fewer secondary deformities. Lamellar techniques have the potential drawbacks that the SMAS flap is thinner and more fragile and that the dissection is technically more demanding and time consuming to perform.

Lateral Sweep

Traditional skin-only face lifts and low SMAS procedures typically resulted in over-tightening of the lateral cheek skin and provided little support of the perioral area and jowl. In time, these unsupported tissues continued to descend in a disproportionate fashion, resulting in a characteristic and objectionable “upswept” appearance. Although the unsupported tissue responsible for this problem is actually anteriorly situated, and it is perhaps more correctly referred to anatomically as an *anterior* phenomenon, this unattractive occurrence has come to be known as *lateral sweep*. Lateral sweep is generally most apparent in the lateral view when the patient looks down. In this position, lateral facial tightness is increased as a result of better tissue fixation in the preauricular area, and the “sweep” appearance is accentuated because of the comparatively poor support and fixation in the perioral and jowl areas.

Lateral sweep is an unavoidable eventual consequence of all traditional skin-lift, low SMAS, and low composite procedures. These skin-only and low deep-layer procedures are not capable of providing uniform support to both the anterior and lateral cheek and are biogeometrically inclined to produce an unbalanced, unnatural appearance. A high SMAS flap, in contrast, provides simultaneous uniform support of the lateral facial, midface, and lateral perioral areas. This results in a more balanced, comprehensive, and natural rejuvenation.

Lateral sweep can result when a high SMAS technique is used if the lateral perioral region is overdissected subcutaneously and ligamentous attachments between the SMAS and the skin are mistakenly and inappropriately divided. These ligaments are the means by which the high flap supports the lateral perioral area, and overdissection of this sort is a common error made by surgeons who erroneously assume that extended skin undermining will help improve the nasolabial fold. This is not a flaw in the technique; it is merely a failure to perform the procedure correctly.

Recognizing the Aging Deformity

Recognizing the elements of the aging deformity and appreciating the underlying anatomic changes are essential to properly advising patients and fundamental to the planning of any surgical repair.

Many if not most of the changes associated with loss of facial contour represent primarily deep-layer problems that will be inadequately corrected with traditional skin-only or low SMAS techniques. Regrettably, surgeons unfamiliar with deep-layer techniques often employ skin-only face lifts or mini-lifts and resort to misguided and misapplied ancillary procedures to overcome the shortcomings of these methods. These procedures include facial liposuction, buccal fat extraction, malarplasty, submalarplasty, geniomandibular groove augmentation (a prejowl implant), PTFE (Gore-

Tex) implantation, and various types of suspension suture placement. Although some of these procedures are sometimes indicated, they will be unnecessary in most cases if a high SMAS face lift and deep-layer rejuvenation are performed.



High SMAS face lift. **A,** This 47-year-old woman is shown before surgery. Note the loss of youthful contour. **B,** She is shown following a high SMAS face lift, neck lift, forehead lift, upper and lower blepharoplasties, and fat injections. Sagging tissues have been repositioned, her youthful jawline contour restored, and redundant skin has been excised without producing a tight or pulled appearance.

Patients with significant *facial atrophy* and age-related facial wasting will generally achieve suboptimal improvement from both surface treatments of facial skin and surgical lifts. Smoothing the skin will not hide a drawn appearance caused by the loss of facial volume, and it is difficult to create natural, attractive contours by lifting and repositioning tissues that have abnormally thinned and deflated with age. Restoring lost facial volume using fat injections is a powerful technique that has gained increased acceptance by plastic surgeons and other physicians who treat the aging face. When properly performed, the addition of fat to areas of the face that have atrophied from age or disease can produce a significant, sustained improvement in appearance that is unobtainable by other means. However, age-related facial atrophy rarely exists in isolation in a healthy individual; thus patients troubled by it are not always appropriately or logically treated by fat injections alone. Isolated fat injections are also of questionable benefit to a patient with significant facial sagging and skin redundancy. Although aggressive filling of the sagging face with fat can improve the facial contour, it generally results in an unusually large, overfilled face that appears both unnatural and unfeminine. Such an overfilled face is hard to correct attractively at a later date. It is both more logical and practical to perform fat injections in conjunction with formal surgical lifts if needed, or after ptotic tissue has been repositioned and redundant tissue has been removed. When a high SMAS tech-

nique is used in conjunction with fat injections, both loss of contour and facial atrophy can be corrected and optimal improvement can be obtained.

Panfacial Rejuvenation

Rarely does isolated aging occur in the lower face and neck, and nearly all patients who request face-lift surgery need to undergo some sort of forehead and eyelid surgery as well. Many are confused, however, by the term “face lift” and take it to imply correction will be made in all areas. These patients must be counseled carefully, because *the face lift itself will produce little if any improvement in upper facial deformities and in fact tends to unmask and draw attention to them.*

It is not uncommon for patients concerned with aging in their lower face and neck to question the need to undergo forehead surgery. Many unconsciously optimize their forehead appearance when looking in a mirror by raising their eyebrows, or they try to conceal the signs of forehead ptosis by aggressive plucking the lateral eyebrows or by futilely trying to hide dense transverse forehead wrinkles with hairstyles that conceal the forehead. Although chemodenervation with *botulinum* toxin injections (such as Botox or Dysport) can smooth forehead expression lines by relaxing hyperactive muscles and in some cases can be used to produce some lateral brow elevation, these injections cannot correct advanced brow ptosis. Failure to properly advise patients and perform forehead surgery can result in the disharmonious appearance often referred to as the *young face–old forehead deformity*.

It is also not uncommon for patients to request that surgery be performed on their neck only. Although such a plan is acceptable for some men, failure to concomitantly restore attractive cheek contour and lift sagging jowls in women generally results in an unnatural and unfeminine appearance. In addition, if an aggressive “corset” platysmaplasty is performed as part of an isolated neck lift, sagging in the cheeks and jowl area can be accentuated, because platysma tightening exerts a downward pull on tissue in these areas.

Face-lift surgery can unmask other existing deformities and create a need to perform additional procedures. This is commonly seen on the lower eyelid, where the ptotic cheek often smoothes lower lid skin preoperatively by dragging it inferiorly. *Properly executed repositioning of the midface and malar fat pad will usually result in some lower lid wrinkling and redundancy that was not present before surgery.* This can be demonstrated before the procedure to the patient by elevating the cheek to the predicted postoperative position while the patient holds a hand mirror and pointing out the resulting wrinkling in the lower lid area. In these cases some excision of lower lid skin must be made (or resurfacing performed), even if the lid appears smooth before surgery, if lower lid wrinkling is to be avoided postoperatively. It is also for this reason that lower blepharoplasty should be performed *after* face-lift surgery is complete, not at the beginning of the procedure.

Preoperative Planning

It is not possible to design or use a universal face-lift technique, and this is the fundamental flaw of all formulaic, “franchise,” “infomercial,” and other “cookie-cutter” types of face-lift procedures. Each patient has a unique set of problems that require precise anatomic diagnosis and an appropriately planned and individualized surgical repair. Committed study and careful planning will maximize improvement, limit complications, and minimize the secondary deformities commonly seen after an ill-conceived and inappropriate “one-size-fits-all” procedure.

Planning the Temple Incision

The temporal portion of the face-lift incision has traditionally been placed within the temporal scalp in a well-intended but often counterproductive attempt to hide the resulting scar. When cheek skin redundancy is small and abundant temple and sideburn hair is present, such a plan can be used without producing objectionable sideburn elevation and temporal hairline displacement. Patients best suited for this incision plan are usually young, with mild cheek laxity only. In many other situations, however, larger skin shifts and the presence of sparse temple hair can result in unnatural, telltale shifting and displacement of the temporal hairline and sideburn.



Displacement of the sideburn and temple hair as a result of poor incision planning.

In this woman the temporal portion of the face-lift incision was made in the temporal scalp in a well-intended effort to hide the resulting scar. Because the cheek flap redundancy was large and skin elasticity was poor, advancement of the cheek skin flap resulted in objectionable hairline displacement. An incision along the hairline would have prevented this deformity. Proper analysis, careful planning, and the use of an incision along the hairline, when indicated, can avert this problem without compromising the overall outcome of the procedure.



Healed incisions along the temporal hairline. The use of an incision along the hairline, when indicated, can prevent hairline and sideburn displacement without compromising the result. Although a fine scar is present along the hairline in each of these patients, it is not evident on casual inspection. Note the preservation of lush temple hair and a full, youthful, natural-appearing sideburn (compare with the patients shown on p. 1535).

In choosing the location of the temporal portion of the face-lift incision it is important to note the distance between the lateral orbit and the anterior aspect of the temporal hairline as this distance is aesthetically significant and increases with age.



Assessing temporal skin show. The distance between the lateral orbit and the temporal hairline and how it will change with skin flap shift must be considered when planning the temple portion of the face-lift incision.

In healthy, youthful-appearing individuals the distance between the lateral orbit and temporal hairline usually measures no more than 4 to 5 cm, but in older patients or in those who have had a prior face lift, it will often be seen to be considerably more.

Equally important as this distance is the surgeon's estimate of the skin redundancy over the upper cheek, and thus the skin shift that will occur when the face-lift flap is lifted. This can easily be assessed by simply pinching up redundant skin and measuring it. *Skin redundancy over the cheek, when considered in conjunction with the amount of existing temporal "skin show," allows rational selection of the best site for placement of the temporal incision.*

In patients in whom minimal or modest temporal skin shift is predicted to occur using the preceding method of analysis and for whom the temporal hairline will remain within 5 cm of the lateral orbit, the temporal portion of the face-lift incision can be placed in the traditional location 4 to 5 cm within the temporal scalp, extending superiorly from the anterior-superior aspect of the ear.



Plan for incision on temporal scalp. This plan is used for patients predicted to have minimal or modest shift of sideburn and temple hair after elevation of the cheek flap. It will *not* be appropriate for all patients.

When analysis of the amount of temple and sideburn hair present and the degree of redundant cheek skin that exists suggests the temporal hairline will be shifted more than 5 cm away from the lateral orbit and/or the sideburn hair shifted above the junction of the ear with the scalp, one should consider placing the incision along the hairline rather than within the temporal scalp.



Plan for incision along the temporal hairline.

An incision along the temporal hairline should be considered whenever objectionable displacement of the sideburn and temple hair is predicted.

This incision will accommodate large posterior-superior skin flap shifts and allows maximal improvement in the upper lateral face to be made without objectionable displacement of the temple and sideburn hair. If it is made with care *and closed under no tension*, the resulting scar is usually inconspicuous and far less troublesome for the patient than a displaced hairline would be (see p. 1535).

In light of the preceding discussion it can be seen that the position of the temporal portion of the face-lift incision cannot be arbitrary and must be based on the patient's individual anatomy, and options for the placement of the temporal portion of the face-lift incision should be discussed with any patient in whom significant displacement of the temporal hairline or elevation of the sideburn might occur. Incision placement is best presented as a choice between two imperfect alternatives and it is wise that the final decision as to where the incision will be located be left to patient after appropriate discussion has been made. Placing the incision in a traditional location within the temporal scalp (see p. 1537) will help conceal the scar, but often

at the expense of a large and objectionable displacement of the temporal hairline and sideburn, and compromised improvement over the temporal face. Inappropriate use of a temporal scalp incision inevitably results in an old and unnatural appearance that is usually immediately obvious, even on a casual glance and at a distance. An incision along the hairline, however, will prevent hairline displacement, and although a scar will undeniably be present where the incision was made, it is usually inconspicuous and will not be noticed by others. In addition, although a suboptimally healed incision along the hairline can be concealed with makeup or tattooed or revised, a significantly displaced hairline is difficult to conceal and a challenge to correct. It has been my experience that most patients are disturbed by the prospect of temple and sideburn hair displacement and recognize this occurrence as a telltale sign that a face lift has been performed. When counseled properly and given the choice, most will readily consent to incision placement along their hairline.

Planning the Preauricular Incision

Open to scrutiny, the preauricular region exists as a frequent point of reference for those seeking to identify a face-lift patient. Traditionally, incisions here are made well anterior to the anterior border of the helix and continued inferiorly, anterior to the tragus.



Traditional location of the preauricular incision. This plan places the scar in an area open to inspection by others and “brands” the patient as having had face-lift surgery. Makeup will not conceal a scar in this location, because the scar is smooth and the skin on either side of it not. Placing the incision in this location will also typically result in a difference of skin color on each side of the resulting scar—an additional telltale sign that surgery has been performed.

This design, however, works well only for the unusual patient with cheek and tragal skin of similar characteristics who also exhibits favorable healing. Unfortunately, most patients have a marked gradient of color, texture, and surface irregularities over these areas, and a telltale mismatch will be evident on each side of the scar, even if the scar itself heals inconspicuously. For these reasons, and *in all but the unusual case, the preauricular portion of the face-lift incision should be precisely placed along the posterior margin of the tragus, rather than in the pretragal sulcus.*



Marginal tragal (“retrotragal”) plan for the preauricular portion of the face-lift incision.

Placing the incision along natural anatomic contours conceals the scar and disguises differences in color and skin texture on each side of it. Note that the preauricular incision is composed of a prehelical, pretragal, and prelobular component incision.

In this location a mismatch of color, texture, or surface irregularities will not be noticed (or will appear appropriate), and the scar, if visible, will appear to be a tragal highlight.



Comparison of pretragal and marginal tragal (retrotragal) incisions. *Left,* In this patient the pretragal incision has healed satisfactorily, but the resulting scar is visible because of differences of color and texture on each side of it. *Right,* The same patient is seen after a secondary face lift in which the incision was moved to the posterior margin of the tragus (the retrotragal position). Color and texture differences, and the scar itself, are now hidden along natural anatomic interfaces.

In addition, and despite some claims to the contrary, a properly planned and executed incision along the *margin* of the tragus will not produce tragal retraction or other anatomic irregularity.



Healed retrotragal incisions. Close-up views of face-lift patients with preauricular incisions along the margin of the tragus. Scars are well concealed, and no tragal distortion is present.

In a man, the tragus can be kept free of beard hair by intraoperative destruction of beard follicles from the underside of the tragal flap.



Retrotragal incisions in male patients. In these men, the incision has been made along the posterior margin of the tragus in the same general plan as was used for the female patients shown above. This avoids a pretragal scar that is typically difficult for a man to conceal. The tragus is kept free of beard hair by intraoperative destruction of beard follicles from the underside of the tragal flap. This is accomplished by folding the tragal skin flap over the index fingertip of the surgeon's nondominant hand using small skin hooks and applying low electrocautery current to exposed beard follicles with a needle-tipped cautery instrument. Loupe magnification facilitates accurate destruction of individual follicles.

The superior (prehelical) portion of the preauricular incision should be planned as a soft curve paralleling the curve of the anterior border of the helix. This will result in a natural-appearing width to the helix in keeping with the rest of the ear, and the resultant scar, if visible, will appear to be a helical highlight. As the tragus is approached, the mark for incision is carried into the depression superior to it and then continued along the *posterior tragal margin*. In this location the scar, if visible, will appear as a natural highlight. *It is unnecessary and an error to place this incision in a retrotragal position on the inner surface of the tragus. This usually results in a bulky, amorphous-appearing tragus and obliteration of tragal anatomy.*

At the inferior portion of the tragus, the incision must turn anteriorly and then again inferiorly, into the crease between anterior lobule and cheek. If a more relaxed design is used, or if a straight line incision is made, skin settling and scar contraction will result in crowding of the incisura, obliteration of the inferior tragal border, and a telltale elongated and chopped-off tragal appearance.



“Chopped-off” tragus. An unnatural-appearing, elongated tragus with an indistinct inferior border results from poor incision planning and improper excision of skin during incision closure.

Planning the Perilobular Incision

To obtain a natural perilobular appearance, it is essential to preserve the natural sulcus between the earlobe and cheek and to avoid destruction of or excision of this and aesthetically important anatomic subunit. This is accomplished by marking the incision 1 to 2 mm inferior to this junction. All other factors being equal, a superior result will be obtained when such a plan is used, in comparison to any plan in which the incision is placed directly in the sulcus and an attempt is subsequently made to directly join a thin, soft earlobe with a coarse, thick cheek.

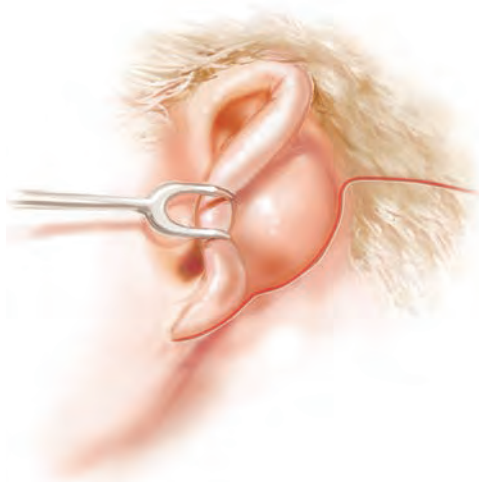
Planning the Postauricular Incision

Traditionally, the postauricular portion of the face-lift incision has been made over the posterior surface of the concha. This was done as part of a well-intended effort to offset the inevitable descent of the postauricular flap and inferior migration of the resulting scar that occurred when the skin was tightened in an attempt to improve neck contour. Many surgeons have come to realize that such a plan embodies erroneous assumptions and can result in undesirable effects, including hypertrophic scarring, postauricular webbing, and obliteration of the auriculomastoid crease. In addition, a scar on the posterior surface of the concha will not migrate inferiorly if the flap has been shifted and trimmed correctly and is suspended under minimal or no tension. It may thus be visible to those sitting behind the patient in some settings.

The postauricular portion of the face-lift incision should be marked directly in the existing auriculomastoid groove and the mark turned posteriorly at the approximate level of the anterior crus of the antihelix. *Marking must be made with the ear resting near its natural anatomic position. If the ear is pulled forward while the marks are made, mastoid skin will be pulled anteriorly over the posterior surface of the concha, and the incision will end up posterior to its intended location.* Incorrect marking in this manner is one of the most common causes of a poorly situated postauricular scar.

Planning the Occipital Incision

Planning the location for the occipital portion of the face-lift incision is conceptually similar to that for the temple region, and the incision plan must address similar concerns of hairline displacement and scar visibility. Traditionally this incision is arbitrarily placed transversely, high on the occipital scalp, in a well-intended but usually counterproductive attempt to hide the resultant scar.



Traditional plan for the occipital portion of the face-lift incision. The incision is made transversely into the occipital scalp in a well-intended but usually counterproductive attempt to hide the resultant scar. This incision plan should be used for access to the upper lateral neck only in younger patients and patients with minimal neck skin excess as it does not allow skin to be excised without notching of the occipital hairline (see p. 1544).

For patients with a minor redundancy of neck skin for whom excision of postauricular skin is unnecessary, such a plan is appropriate and will result in a well-concealed scar. Patients in this category are usually young and have only a mild neck deformity. In these cases *the incision is used for access to the lateral neck only, not as a means to remove postauricular skin*. Skin excision using this incision plan will result in the advancement of neck skin into the occipital scalp and notching of the occipital hairline.



Notching of the occipital hairline.

Notching of the occipital hairline is seen in these two patients, whose surgeons inappropriately used traditional occipital incision plans.

Although not all patients will recognize this deformity for what it is, most are nonetheless self-conscious about it, especially if they wear their hair up or back or lead active outdoor lives where activities, wind, and water may displace camouflaging wisps of remaining hair. Proper analysis, careful planning, and the use of an incision along the hairline, when indicated, can avert this problem without compromising the result.



Healed incisions along the occipital hairline.

Both of these patients are seen after surgery in which an incision along the occipital hairline was used. If this incision is planned carefully and properly closed, notching of the hairline is averted and an inconspicuous scar will result.

In choosing the location of the occipital portion of the face-lift incision, the surgeon must estimate the skin redundancy along the predicted posterior-superior direction of flap shift. This can be accomplished by pinching up tissue over the upper-lateral neck and measuring it. If 2 cm or less of excess neck skin is present, a “traditional” incision over the mastoid extending posteriorly into the scalp at the level of the mid ear (see p. 1544) will not, in most cases, result in an objectionable disruption of the occipital hairline. If more than 2 cm of neck skin redundancy is present, however, the incision should be placed along the occipital hairline but be designed so that a telltale scar will not be visible in front of the fine hair on the nape of the neck. This can be accomplished by turning the inferior portion of the incision back into the scalp at the junction of thick and thin hair. From a practical standpoint, the traditional incision on the occipital scalp should be used for access to the neck only and closed without skin flap shift or advancement. Any patient with significant neck skin redundancy will require an incision along the occipital hairline if skin is to be advanced and excised in a biogeometrically correct fashion and hairline displacement is to be avoided.



Plan for an incision along the occipital hairline. The incision is planned so that its inferior portion turns posteriorly into the occipital scalp at the junction of thick and thin hair. This incision plan allows excess neck skin to be excised biogeometrically, prevents hairline displacement, and produces a well-concealed scar.

As is the case with temporal incision placement, options for placement of the occipital portion of the face-lift incision should be discussed with the patient and presented as a choice between two imperfect alternatives; it is wise to let the patient make the final decision after the advantages and disadvantages of each location have been discussed. Although an incision along the hairline is usually inconspicuous, even on close inspection, a scar will undeniably be present. Placing the incision within the scalp may help conceal the scar but will usually do so at the expense of objectionable displacement of the occipital hairline. Although a suboptimally healed incision along the hairline can be revised, tattooed, or easily concealed with an appropriate hairstyle, a significantly displaced hairline is difficult to conceal and a challenge to correct. It has been my experience that most patients are disturbed by the prospect of occipital hairline displacement and recognize it as a telltale sign that a face lift has been performed. When properly counseled and given the choice, most patients will readily consent to an incision along the hairline.

Short-Scar Face Lift

The idea of shortening the incisions used for facial rejuvenation procedures is appealing to patients and surgeons alike. Indeed, the first face-lift procedures performed some 100 years ago consisted of small excisions of the skin near the ear and along the frontal and occipital hairlines. Ironically, and despite the many important advances in techniques to rejuvenate the face that have been made over the past century, as non-plastic surgeons have begun to perform aesthetic surgery procedures and market their services, a new emphasis has been placed on ill-conceived “short-scar” procedures of questionable value and that are nonetheless deceptively appealing to almost any patient. Although some short-scar techniques, such as a limited-incision forehead lift, have merit and have provided new and better options for many patients, skin redundancy remains a consistent and undeniable problem for the surgeon seeking to rejuvenate the face and neck, and shorter incision plans involve significant compromises in the overall improvement that can thus be obtained.

Short-scar incision plans suffer the significant drawbacks that they limit access to deep-layer structures and prevent redundant skin from being shifted along proper vectors that produce the most improvement and the most natural appearance. Typically, manipulations of deep-layer tissues performed through short-scar incision plans are ineffectual at best, and more often result in damage to or mutilation of the SMAS. Shorter incisions also require that skin be gathered up when sutured and prevent it from being excised in a smooth, well-tailored manner.



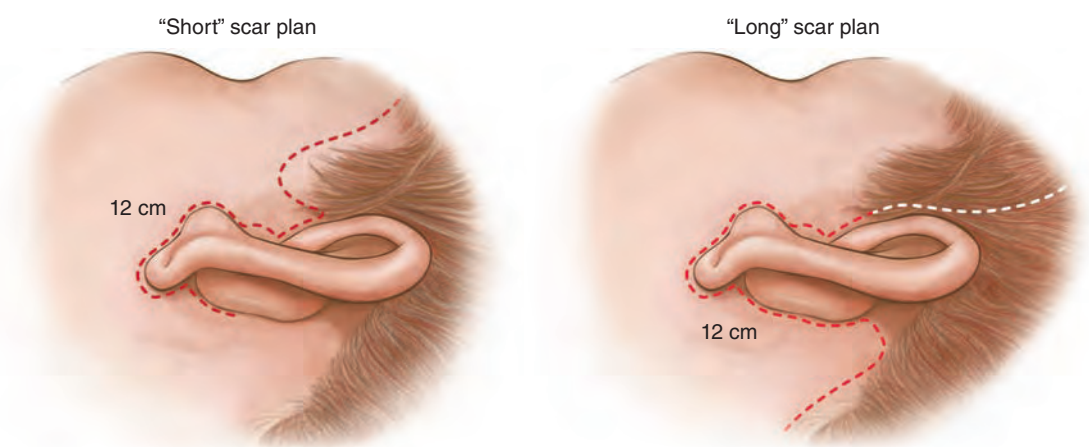
A longer scar, conversely, allows skin flaps to be shifted in a geometrically correct fashion (see p. 1544, *bottom*) and skin to be excised without objectionable puckering or gathering, as seen above.

Interestingly and somewhat perplexingly, most short-scar procedures focus on the postauricular area and seek to shorten the postauricular scar. This scar is situated in a well-concealed area, however, and if tension is diverted to deep-layer tissue and

skin excision is carefully planned and properly executed, an inconspicuous scar will usually result. A scar in the postauricular area is arguably less obvious, easier to conceal, and overall less disturbing to the patient than is a shorter but irregular, puckered scar. Shortening a scar under these circumstances in a concealed area defies logic and is of questionable value to the patient.

Perhaps the most difficult to understand aspect of short-scar incision plans is that to minimize puckering and gathering behind the earlobe, the cheek skin flap is shifted along a vector that is directed too superiorly, necessitating a scar along the far less well concealed sideburn and temporal hairline. Although an incision is sometimes required in this area in certain patients to prevent hairline displacement, as previously discussed, shortening a scar in a concealed area by shifting it to a more visible area is of dubious value to a patient who might not have required it.

Ironically, it is younger patients, whose fears of longer scars can easily be played to, who are typically thought of and said to be the best candidates for short-scar procedures. It is this group of patients, however, who are disproportionately burdened by a more visible scar along the temporal hairline that would typically heal more favorably and be of less concern to an older patient. When the patient is properly counseled and given the choice, I find that younger patients are relieved to learn that a scar along the temporal hairline is not necessary in most cases and that it can be instead hidden in the temporal scalp and along the hairline behind the ear.



Comparison of long- and short-scar face-lift incision plans. *Left*, Most short-scar plans seek to shorten the incision in the postauricular area. To avoid puckering and gathering behind the lobule (see p. 1546), a vertical vector is applied to the cheek skin flap, necessitating an incision along the temple hairline as shown. Total scar length is approximately 12 cm. *Right*, A typical "long-scar" plan. The temporal part of the incision (*white dashed line*) is hidden in the temporal scalp and if properly closed will be difficult to find. The total length of *visible* scar (*red dashed line*) is 12 cm—no different from the short-scar plan. However, no scar is present in the highly visible area along the temporal hairline.

The final misconception about short-scar procedures involves the idea of the length of the scar itself and the fact that it is the amount of *visible* scar that matters, and whether the scar is *concealed* or not. If the amount of scar present in potentially visible areas is measured, there is no actual difference between that present in typical short-scar and long-scar procedures. In this sense, the term short-scar is a misnomer, because the visible scars from short- and long-scar incision plans are in reality the same length.

When asked what motivated them to adopt a short-scar face-lift technique, many surgeons cite poor healing in the postauricular area as the overriding impetus. Inherent in such a claim, however, is the notion that the postauricular area somehow heals in a different way from the other areas of the face and in a consistently aberrant manner. In reality, their answer reveals that they have simply been performing the procedure incorrectly. Two avoidable problems are typically put forth as the reason for avoiding a postauricular scar: hairline displacement and wide (or irregular and hypertrophic) postauricular scars. Hairline displacement results from inappropriate use of a traditional postauricular incision plan made into the occipital scalp. Wide, irregular, and hypertrophic scars are the result of ill-conceived attempts to create contour in the neck by tightening neck skin. Both these problems are readily avoidable, as discussed earlier and later in this chapter.

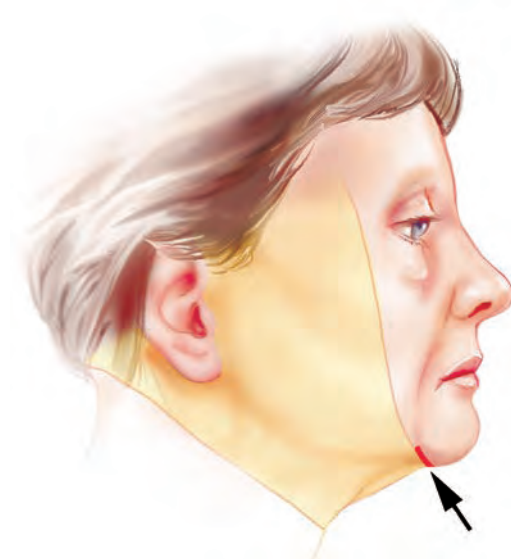
Ultimately, the purported advantages of short-scar procedures rest largely in their appeal to patients—and their allure and marketability on that basis. This, coupled with the growing demand for simplified face lifts, will likely ensure that such short-scar procedures will be with us in some form for some time to come. Nonetheless, the onus is on all physicians engaging in facial rejuvenative surgery to act in the best interest of the patient and to plan incisions to best suit each patient's circumstances. We must not simply do what is convenient, easily marketed, and quickly performed.

Drawbacks of Short-Scar Procedures

- Shortening the scar can result in puckers and folds in the perilobular area.
- Shortening the scar compromises access to deep layers of the face.
- Skin flaps cannot be shifted in the biogeometrically correct fashion that is of most benefit to the patient.
- The scar is shifted from a concealed area behind the ear to visible area in front of the temple hairline.
- A visible scar may not actually be shorter than that in a long-scar procedure.

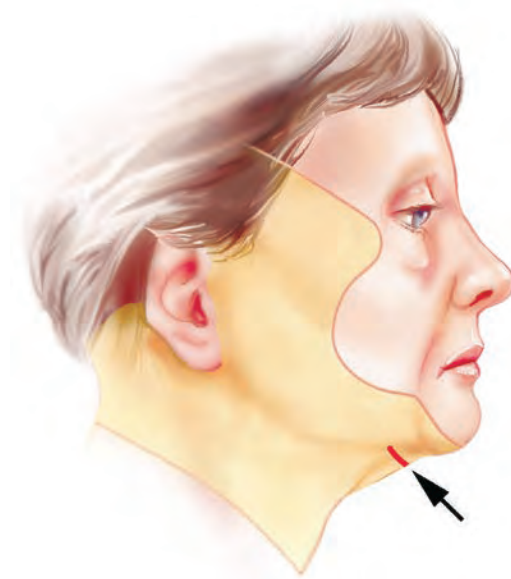
Planning the Submental Incision

Most face-lift patients require modification and repair of the neck and submental regions that can only be performed through a submental incision, and optimal improvement in the neck generally cannot be obtained unless a submental incision is made. Traditionally, this incision is placed directly in and along the submental crease in a well-intended but counterproductive attempt to conceal the resulting scar.



Traditional but *incorrect* plan for the submental incision. The incision should not be placed directly along the submental crease (*arrow*), because this will reinforce the submental retaining ligaments and accentuate the double-chin appearance. The typical plan of skin undermining (*yellow area*) also promotes a double-chin appearance, because the crease is not undermined, retaining ligaments are not released, and the fat of the chin and neck cannot be readily sculpted to create a smooth transition between them.

This incision plan should be avoided, however, because it will surgically reinforce the crease and accentuate a double-chin or witch's-chin deformity. Exposure of the submental region will also be compromised, and the surgeon will encounter difficulty when suturing or dissecting low in the neck. A more posterior placement of this incision will eliminate these problems but will still result in an inconspicuous and well-concealed scar.



Correct location for the submental incision. Placing the submental incision 1.5 cm posterior to the submental crease prevents accentuation of the "double chin" and witch's chin deformities and provides for easier dissection and suturing in the anterior neck (compare with the illustration above). This incision plan allows the submental crease to be undermined and submental retaining ligaments to be released, and the fat of the chin pad and neck can be sculpted to create a smooth transition between them (see p. 1550, *top*).



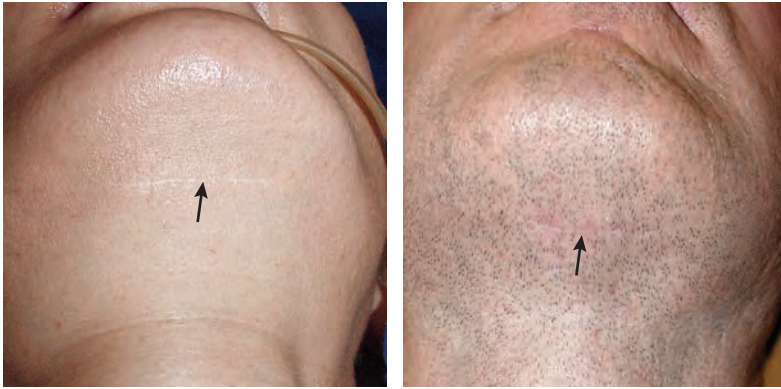
Correction of the double-chin deformity. *Left*, This patient, seen preoperatively, had a double chin. *Right*, The patient is shown after a face and neck lift. The submental incision was made posterior to the submental crease to allow undermining and release on the submental retaining ligaments and blending of chin and neck fat.

The submental incision should be placed well within the mandibular shadow and well posterior but parallel to the submental crease at a point lying roughly half the distance between the mentum and hyoid. This usually corresponds to a site 1 to 2 cm posterior to the crease.



Plan for a submental incision. The submental portion of the face-lift incision (*solid line*) should be placed well within the mandibular shadow and well posterior but parallel to the submental crease (*dotted line*), approximately half the distance between the mentum and hyoid (*arrows*). Usually this corresponds to a point about 1 to 2 cm posterior to the submental crease.

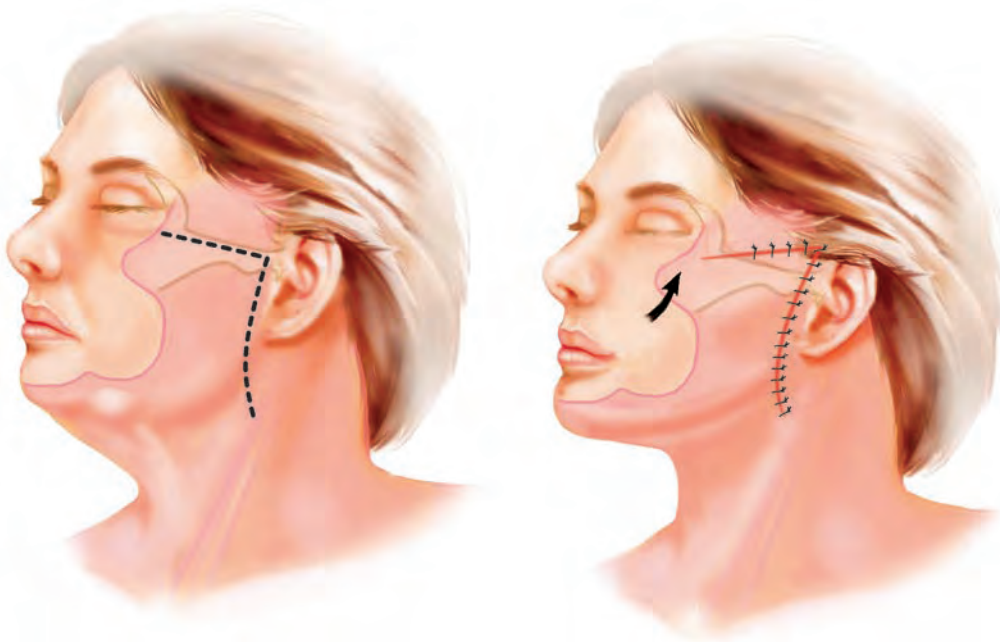
The incision should be approximately 3 to 3.5 cm in length but may be made longer if necessary, as long as neither end will be advanced up on a visible portion of the face when skin flaps are shifted. Healing will be best, and the scar will be best concealed, if it is made as a straight, not curved, line.



Healed submental incisions. Placement of the submental incision posterior to the submental crease will still result in an inconspicuous, well-concealed scar (*arrows*) as well as provide better access and exposure when working in the deep layers of the neck. The incision location is the same for a male or a female patient. *Left*, Close-up view of a healed submental scar in a female patient. *Right*, Close-up view of a healed submental scar in a male patient.

Planning Modification of the SMAS and Platysma

All patients undergoing a face lift will benefit from posterior-superior advancement of the cheek SMAS; this maneuver is the fundamental step in a natural-appearing, attractive rejuvenation of the face on which all others are based.



High SMAS flap. *Left*, Plan for a basic high SMAS flap. The superior margin of the flap is planned at the level of the zygomatic arch, not inferior to it. *Right*, High SMAS flap after advancement and suturing. Unlike traditional low SMAS procedures, the superior margin of the flap is suspended above the zygomatic arch to the innominate deep temporal fascia, and a broad effect across the entire hemiface is obtained that includes the midface, infraorbital, and perioral regions.

SMAS advancement provides a natural-appearing and long-lasting correction in the cheek and jaw and will strengthen, secure, stabilize, and reinforce the lower face. A high SMAS plan can be used to improve the midface and infraorbital and perioral areas without the need for a separate midface lift. For some patients, a simple SMAS flap advancement alone will provide appropriate correction. Others, however, will require additional maneuvers or modifications of this step to adequately address their problems.

Assessment of the Cervicosubmental Region

Each patient's cervicosubmental region must be carefully examined both at rest and during platysma activation to completely assess platysma deformity. The surgeon asks the patient to "push your jaw forward and tighten your neck," demonstrating this maneuver first so the patient can perform it correctly. Frequently an insignificant-appearing deformity at rest will be obvious when the muscles are clenched. Failure to recognize and appropriately correct these *dynamic deformities* is the reason too many face-lift patients appear improved in repose but unnatural or bizarre during conversation, animation, and other activities that require activation of the platysma muscle.

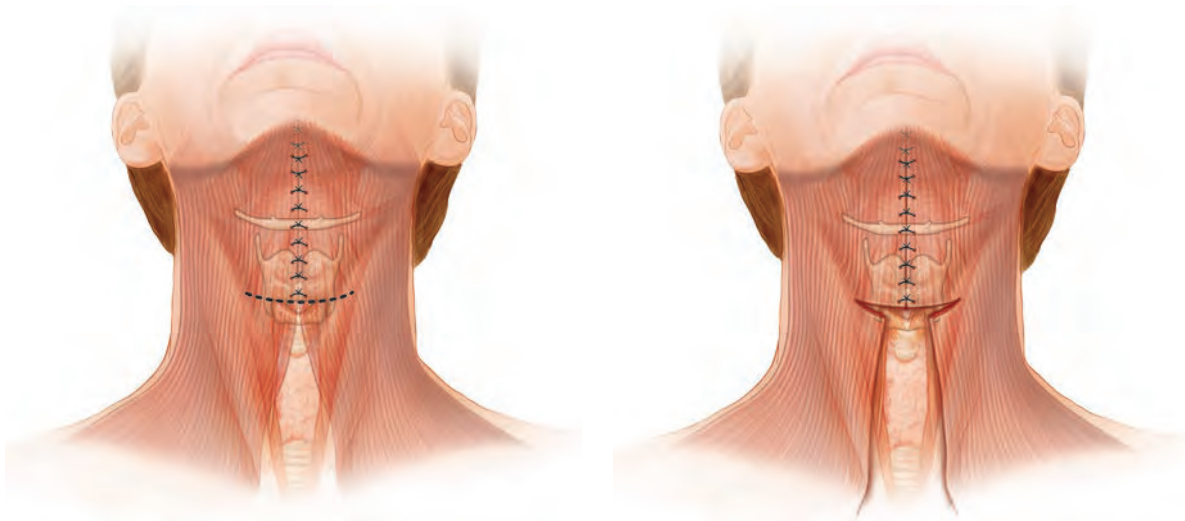


Dynamic assessment of the cervicosubmental region. The neck is examined as the platysma is contracted. Dynamic platysma muscle irregularities are often called *platysma bands*.

Examination of the cervicosubmental region with and without platysma activation allows one to distinguish between "soft" and "hard" cervical bands. Soft bands change little during platysma activation and are predominantly a problem of skin laxity. Hard bands are tight or become exaggerated when the platysma muscle is activated, indicating a problem of platysmal origin.

It is important to distinguish between soft and hard platysma bands, because treatment will vary, depending on the type of bands present. Patients with hard bands require a *transverse platysma myotomy*. The result of a platysma myotomy is immediate, dramatic, long-lasting, and superior to any suture, suture suspension, or corset technique. The length of the transection required will vary, depending on the configuration of bands present, and will thus differ from patient to patient. However, patients with soft bands can usually be adequately treated with skin excision, skin excision plus platysmaplasty (suturing of the medial muscle borders together, or lateral platysmapexy alone; see p. 1554).

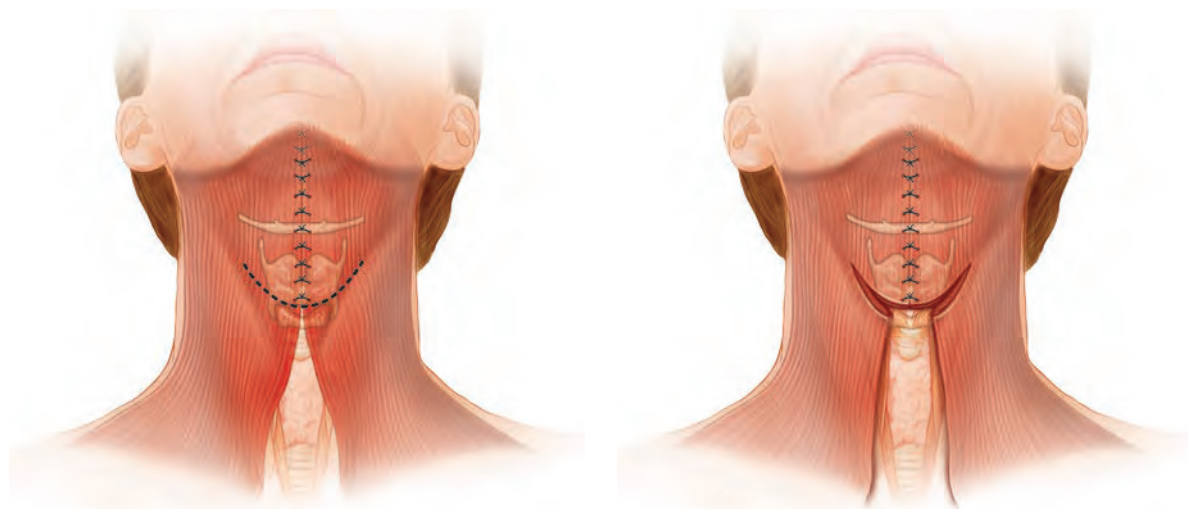
Platysma bands generally lie in medial and lateral locations. Each band is situated near the medial and lateral platysma muscle borders but does not usually correlate precisely with them. For patients with anterior platysma bands only, a transverse platysma myotomy is planned from jugular vein to jugular vein at the level of the cricoid cartilage. The muscles need not be completely transected under these circumstances; just the region where the platysma band is present.



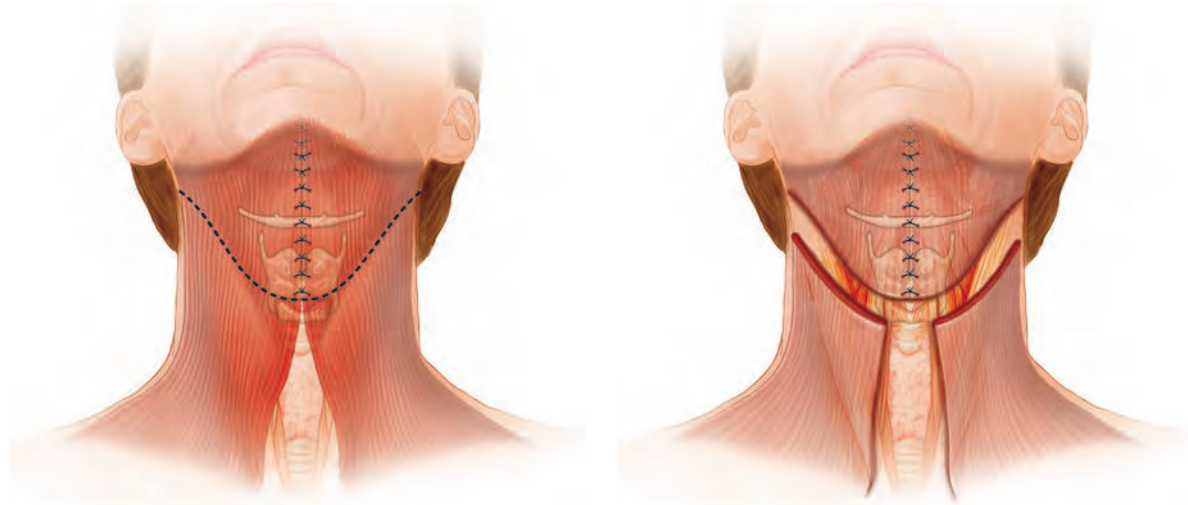
Plan for treatment of anterior platysma bands. Transverse platysma myotomy is performed in the region of the platysma muscle where the platysma band is present. *Left*, The anterior neck is illustrated after a platysmaplasty but before an anterior platysma myotomy. *Right*, After an anterior platysma myotomy at the level of the cricoid cartilage. (NOTE: Myotomy is most easily and effectively performed after the platysmaplasty has been completed.) Dividing the platysma at the level of the cricoid keeps the incision in an area where the muscle is thin and is less likely to bleed and show. Dividing the platysma in the cervicomental angle will result in an unnatural, harsh transition from the submental region to the neck and can cause lower lip dysfunction.

If lateral as well as anterior bands are present, the myotomy is carried more laterally to include them as well. If definition is poor over the lateral mandibular border, in addition to anterior and lateral neck bands, platysma myotomy is planned to continue full-width superolaterally up to the anterior border of the sternocleidomastoid muscle to join the incision in the SMAS. A similar full-width myotomy of this type is also indicated in an individual with a firm, obtuse neck with a short platysma and poor definition over the mandibular angle, but no bands.

In many necks, only a subtotal myotomy need be performed. As a practical matter, however, complete transection of the platysma is performed in most patients to ensure the best contour possible and to limit the potential of band recurrence or that residual platysma bands will be present. Despite assertions to the contrary, a full-width platysma myotomy will not result in a neck that appears to thin or reduced support of the submandibular glands. *Medial wedge resections of platysma at the hyoid and vertical excisions of platysma bands are not effective and usually result in secondary deformities.* These procedures are not recommended, and experience has shown that they should not be performed.

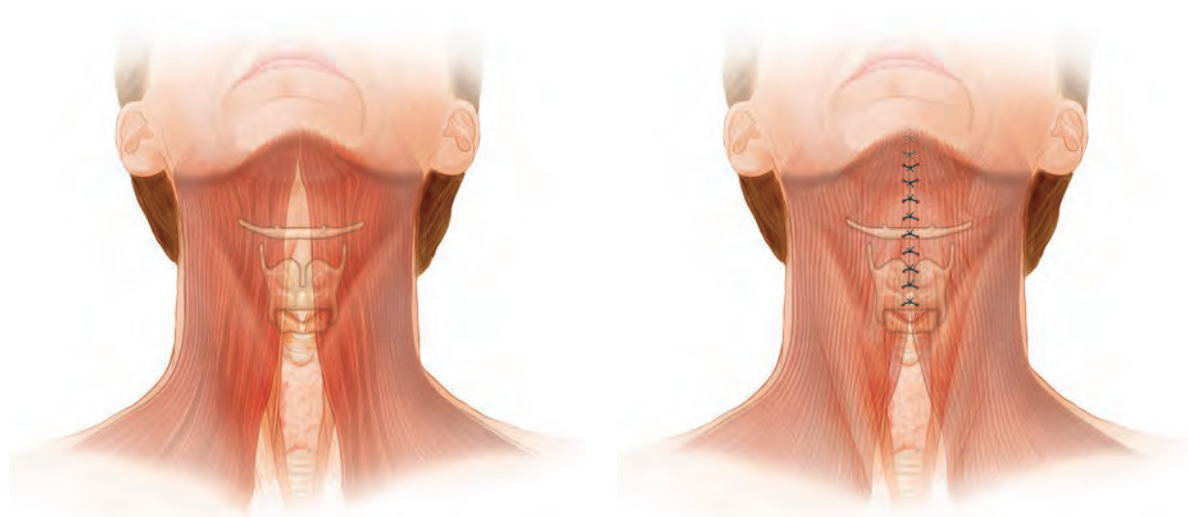


Plan for treatment of anterior and lateral platysma bands. If lateral bands are present, the myotomy is carried more laterally to include them. *Left*, The anterior neck is illustrated after a platysmaplasty but before an anterolateral platysma myotomy. *Right*, After an anterolateral myotomy at the level of the cricoid cartilage. (NOTE: Myotomy is most easily and effectively performed after the platysmaplasty has been completed.)



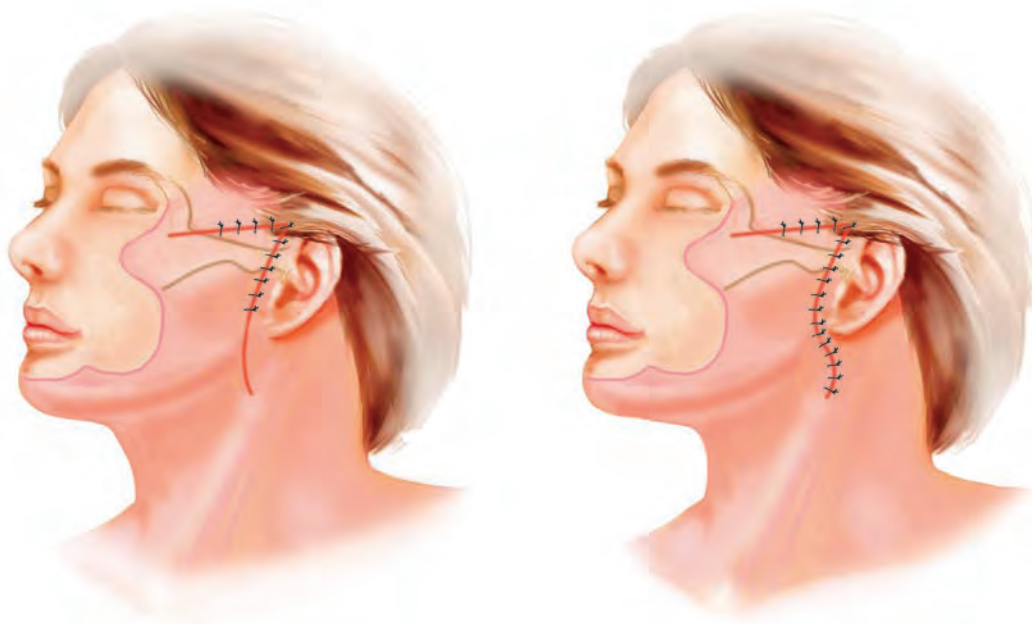
Plan for full-width platysma transection. A full-width myotomy corrects not only anterior and lateral bands, but also provides improved definition over the lateral mandibular border. *Left*, The anterior neck is illustrated after a platysmaplasty but before a full-width platysma myotomy. *Right*, After a full-width platysma myotomy at the level of the cricoid cartilage. (NOTE: Myotomy is most easily and effectively performed after the platysmaplasty has been completed.)

If submental support is poor and/or optimal improvement in the anterior neck is desired, *anterior platysmaplasty* is planned. Anterior platysmaplasty helps consolidate the neck and optimizes improvement in neck contour but is *not* adequate or effective in the treatment of platysma bands.



Anterior platysmaplasty. Repair of platysma diastasis improves submental support and helps consolidate the neck. However, it is *not* an adequate or effective treatment of platysma bands.

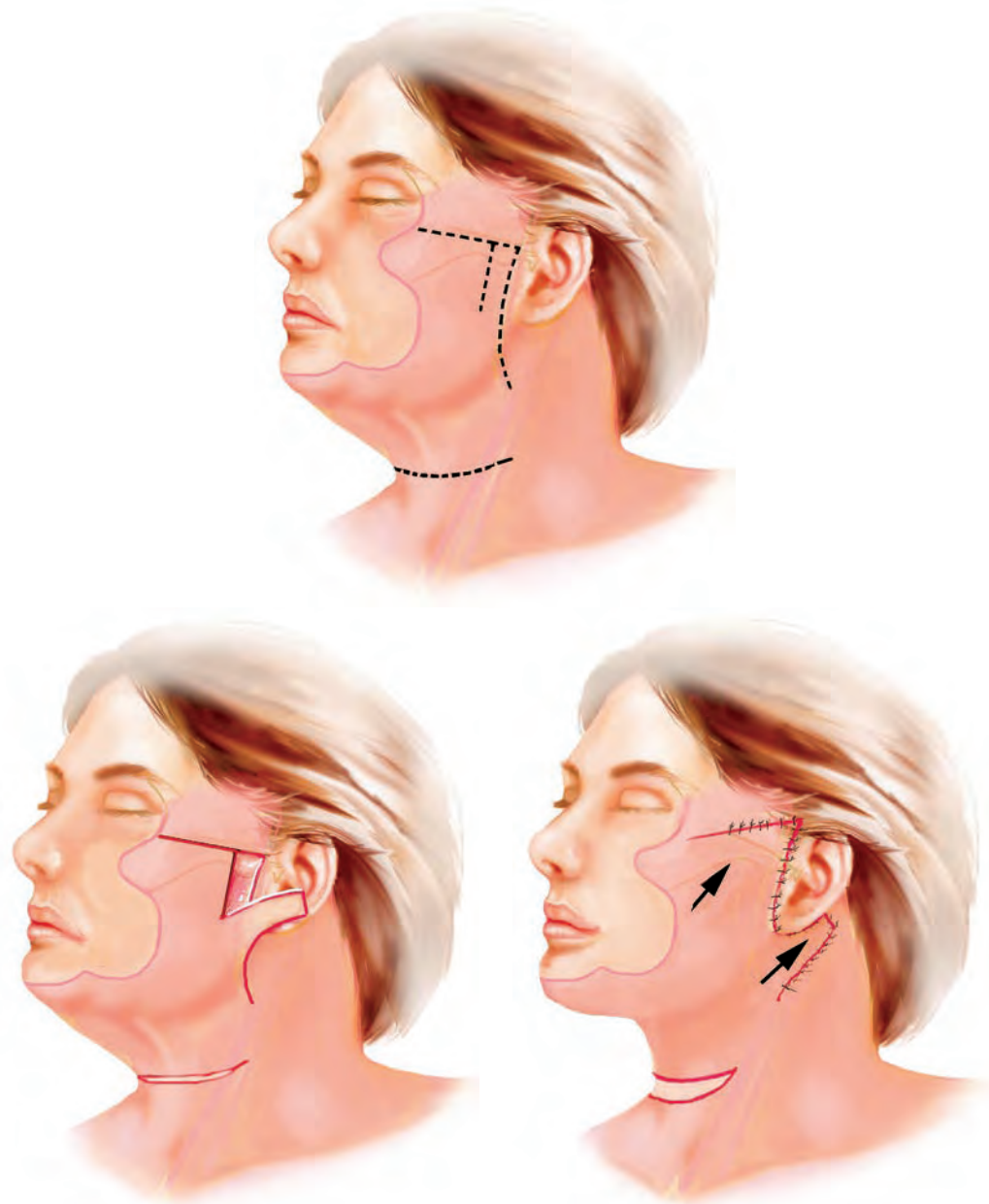
When mild horizontal platysma muscle redundancy is present in the neck, a *lateral platysmapexy* is planned. A lateral platysmapexy ensures that the platysma is draped smoothly and snugly along the cervicomental angle and helps to further improve and consolidate the neck, especially when the patient looks down. It is usually effective only when suturing is performed in the firm, dense tissue in the perilobular areas and over the upper fourth of the sternocleidomastoid muscle, where its fascia is immobile. In thin necks, the cut muscle edges can be overlapped. In fuller necks, redundant muscle can be trimmed and the muscle segments sutured edge-to-edge.



Lateral platysmapexy. *Left*, Before a lateral platysmapexy. *Right*, After a lateral platysmapexy. The lower lateral border of the SMAS flap is sutured to the dense fascia in the perilobular area and over the upper sternocleidomastoid muscle. (NOTE: The lateral platysmapexy should be performed *after* the anterior platysmaplasty.)

When a patient's horizontal platysma muscle redundancy is large or optimal improvement in cervicomental contour is desired, a *postauricular transposition flap* of cheek SMAS is planned. The postauricular transposition flap is created by splitting off redundant tissue from the posterior margin of the cheek SMAS flap, but leaving it attached inferiorly to the cervicosubmental platysma. If properly constructed and secured, this flap will provide dynamic reinforcement of the upper neck and submental areas when the patient looks down. When used in conjunction with an anterior platysmaplasty, postauricular transposition flaps result in a continuous mastoid-to-mastoid sling of muscle across the upper neck along the cervicomental angle.

From a practical standpoint, the final decision about how to manage horizontal platysma redundancy and whether platysmapexy or postauricular transposition flaps should be used is best deferred until the day of surgery, when the effects of SMAS advancement and anterior platysmaplasty can be determined.



Plan for postauricular transposition flap. *Top*, Plan for postauricular transposition flap. *Bottom left*, Elevation and transposition of flap to postauricular area. *Bottom right*, After SMAS elevation and suturing. To be effective and produce the best accentuation of the jawline, the flap must be fashioned so that it pulls posteriorly on the cervical platysma below the mandibular border, not on the lower cheek SMAS above it. (NOTE: From a technical standpoint, it is best to raise the entire SMAS flap and suspend it by its superior margin first. The postauricular transposition flap can then most easily be separated from its posterior margin.)

Planning the Modification of the Submental Region

Traditional face-lift techniques do not adequately address many aspects of aging in the submental region, and *it is not enough in most situations to limit treatment of the neck to preplatysmal lipectomy and postauricular skin excision*. For many patients subplatysmal fat accumulation, submandibular salivary gland “ptosis,” and digastric muscle hypertrophy will contribute significantly to their neck deformity, necessitating additional treatment.

In many patients a significant portion of cervical fat accumulation will be present in a *subplatysmal* location, and little if any fat will need to be removed from the preplatysmal layer. Indeed, as patients age, fat stores generally shift from preplatysmal to subplatysmal, and the small amount of subcutaneous fat present in a typical patient presenting for a face lift is necessary and must be preserved to maintain a soft, youthful, attractive appearance.

Abnormal collections of subplatysmal fat can be identified by preoperative palpation of the neck with and without platysma activation. Fat lying predominantly in a preplatysmal position will generally feel soft and will remain in the examiner’s grasp when the platysma muscle is activated. Fat lying in a subplatysmal position, however, will have a firmer feel, and will tend to be pulled superiorly out of the examiner’s grasp when the platysma is contracted.



Assessing the location of cervicosubmental fat. *Left*, The patient’s submental “wattle” is grasped with the face and neck in repose. *Right*, The patient is then asked to activate the platysma muscle. In this example, the fat is pulled superiorly from the examiner’s grasp, indicating a predominantly subplatysmal position. Fat lying predominantly in a subcutaneous, preplatysmal position would tend to remain within the examiner’s grasp when the platysma is contracted.

Subplatysmal fat accumulations are typically present in patients with firm, obtuse necks who have had lifelong cervicomental fullness. In these individuals, partial *sub*-platysmal lipectomy will be productive, but complete removal of all subplatysmal fat is rarely indicated. The final decision about performing a subplatysmal lipectomy is best made after the subplatysmal space has been explored.

The submandibular glands must be assessed preoperatively because they often contribute to the appearance of a full, “lumpy” neck. Large submandibular glands are most easily seen in a secondary face-lift patient who has had a prior aggressive cervicosubmental lipectomy. Large glands are frequently hidden by submental fat or a lax platysma muscle in a patient with a full neck presenting for a primary procedure, and a plan that does not recognize this fact will lead to disappointing and unexpected bulges in the lateral submental regions postoperatively.



Prominent submandibular glands. Submandibular glands are usually evident as protruding masses in the lateral submental triangle, lateral to the anterior belly of the ipsilateral digastric muscle and mandibular border. *Left*, This patient had residual prominent submandibular glands after a face lift with submental liposuction. His prior procedure made the prominent glands more obvious. *Right*, This patient had residual prominent submandibular glands after a “weekend neck lift.” Aggressive resection of subcutaneous fat had exposed the prominent gland.

Submandibular glands are usually palpable as firm, smooth, discrete, mobile masses in the lateral submental triangle, lateral to the anterior belly of the digastric muscle and medial to the inner aspect of the ipsilateral mandibular border. Submandibular glands lying deep to the plane tangent to the inferior border of the mandible and the ipsilateral anterior belly of the digastric muscle do *not* disrupt neck contour and will usually *not* require treatment. However, glands protruding *inferior* to this plane are likely to be problematic if excess cervical fat is removed and redundant skin is excised.

Despite some claims to the contrary, experience has shown that prominent submandibular glands are actually large, not ptotic, and that the platysma contributes little to their position or support. Attempts at tightening the platysma when a promi-

ment gland is present usually results in a modest, short-lived improvement. Careful sculpting of the periglandular fat will sometimes disguise small glands, but for large, prominent glands, the protruding portion must be resected to achieve a sustained, optimal improvement.

The decision to perform submandibular gland resection should be made in conjunction with the patient after appropriate discussion of the advantages and disadvantages of the procedure. Patients should know that the procedure may prolong submental induration and edema and carries a small theoretical (but unlikely) risk of bleeding, sialoma, salivary fistula, and dry-mouth symptoms.

A small subgroup of patients will have digastric muscles with large, bulky anterior bellies that are evident as linear paramedian submental fullness. Large anterior bellies of the digastric muscles are most easily seen in a secondary face-lift patient who has had prior aggressive cervicosubmental lipectomy. As in the case with large submandibular glands, large digastric muscles are frequently hidden by excess submental fat or lax platysma muscle in a patient presenting for primary procedures, and failure to identify them may lead to unexpected and objectionable submental bulges postoperatively. In these individuals, subtotal *superficial digastric myectomy* should be considered. The final decision to perform partial digastric muscle resection is best deferred until the day of surgery, when the improvements produced by other modifications of the submental region can be evaluated.

Preoperative Preparations

All patients undergo a preoperative physical evaluation, and any with significant medical problems must be cleared by their internist or personal physician before their procedure is performed. Patients are required to avoid agents known to cause platelet dysfunction for 2 weeks before surgery; they are given a list of products such as aspirin, ibuprofen, ketoprofen, naproxen, nonsteroidal antiinflammatory drugs, vitamin E, and other prohibited products.

Patients who smoke are asked to quit 4 weeks before their procedure and are required to avoid smoking and all secondhand smoke for 2 weeks after surgery. Patients who smoke or have a significant history of smoking but have quit are advised in writing that their risk of serious complications, including poor healing, flap necrosis, skin slough, and thromboembolic phenomena, is significantly higher than in non-smokers. It is generally assumed, however, that most patients will not cease smoking, and extra care should be taken to ensure that informed consent is complete in this regard. Fortunately, flap viability depends on a variety of factors other than smoking that are under the surgeon's control or are minimized by the high SMAS procedure design. These factors include tissue trauma, the extent of skin undermin-

ing, and the amount of skin tension. Because the high SMAS technique limits skin undermining, preserves important cheek perforators, and avoids tension on delicate cervicofacial skin flaps, a careful surgeon employing proper technique can operate safely on smokers. Indeed, some surgeons allow patients who smoke to do so in the perioperative period and have observed no increase in complications. *Smokers should always be approached with caution, however, and every surgeon should recognize that these patients are at high risk for serious local and systemic complications.*

All patients are instructed not to color their hair, have a permanent, or otherwise chemically treat their hair during the 2-week period before and after surgery, because this may result in hair breakage and loss. Patients are instructed to shower and shampoo with antiseptic soaps the night before surgery, paying careful attention to the periauricular areas.

It is important that adequate operating room time be allotted for contemporary face-lift procedures, since they are deceptively time consuming compared with traditional or more limited techniques. A high SMAS face lift, when performed in conjunction with a foreheadplasty, eyelid surgery, fat injections, dermabrasion, and other procedures, may often encompass 6 to 8 hours or more, even when performed by a “fast” surgeon working with a well-organized and experienced operating room team. Most surgeons I know who regularly perform these complicated combined procedures have resigned themselves to this fact and have made appropriate adjustments in their surgery schedules. Usually this means allotting an entire day for the procedure. For difficult procedures, or when additional surgery is requested (such as rhinoplasty), it is recommended that the procedures be staged over two separate (consecutive or nonconsecutive) days.

It is strongly recommended that any surgeon new to these techniques consider staging a full-face rejuvenation over 2 days. This worked well for me early in my practice and is still recommended for certain patients with difficult or unusual problems and those who request multiple ancillary procedures. Typically, face and neck lifts are performed the first day. The patient is then usually returned to the operating room the following day or a few days later for foreheadplasty, blepharoplasty, and other procedures. Patient acceptance of this recommendation will be high if it is presented to them as being in their best interest and that it is part of the surgeon’s efforts to ensure their safety and provide high-quality care.

Anesthesia

The majority of face lifts I perform are now done with the patient under deep sedation administered by an anesthesiologist using a laryngeal mask airway (LMA). A laryngeal mask technique allows the patient to be heavily sedated without com-

promise of their airway, but the patient need not be given muscle relaxants and can be allowed to breathe spontaneously. A laryngeal mask is also less likely to become dislodged during the procedure than an endotracheal tube, and it is less likely to trigger coughing and bucking when the patient emerges from the anesthetic. However, any skillfully administered anesthetic is adequate for performing the procedure.

Most modern, comprehensive face-lift techniques, including the high SMAS procedure, are time consuming, technically demanding, and will test the patience and composure of the surgeon. It is highly recommended that any surgeon new to these techniques enlist the services of an anesthesiologist or competent CRNA. This is particularly important when the procedure is to be performed on a patient who is apprehensive, has a history of difficulties with anesthesia, hypertension, or other significant medical problems. This will avert the frustration and stress of trying to master a technically demanding procedure while bearing the responsibility of supervising the administration of an anesthetic, monitoring the patient, and managing intraoperative problems.

Most patients receive preoperative medication tailored and adjusted to their age, weight, height, personality, specific circumstances, and general health; this regimen is modified depending on the type of anesthetic used. *Oral narcotics should not be given as part of the premedication, because they commonly result in nausea and vomiting.* Cocaine, anticholinergics, and parasympathomimetics are also avoided.

We administer antiemetics preemptively at the beginning of each procedure, and patients with a history of perioperative nausea are usually given several agents to block the emetic reflex at multiple levels. All patients are fully monitored with electrocardiography, automatic sphygmomanometry, transcutaneous pulse oximetry, and mainstream capnography. Perioperative blood pressure is closely monitored and fluctuations are aggressively treated, especially in patients with existing hypertension or a borderline condition. The latter group of patients should be watched closely and treated preemptively, because they typically become hypertensive once the surgery and anesthesia is begun.

Surgical Technique

The patient is placed supine on a well-padded operating table, with a special effort to ensure that the elbows, heels, and other potential pressure points are well protected. The patient's lower extremities are elevated and antiembolic pedal compression devices applied. An indwelling balloon-tipped urinary catheter is placed after sedation is begun or general anesthesia administered. A temperature probe is taped in the axilla or groin, and the patient is sufficiently covered or a patient-warming

device is applied to allow the room to be cooled for the comfort of the scrubbed team members.

Each patient receives a full surgical scrub of the entire scalp, face, ears, nose, neck, shoulders, and upper chest with full-strength (1:750) benzalkonium chloride (Zephiran) solution the day of surgery after a bland ophthalmic ointment is instilled in each eye. The patient's head is then placed through the opening of an adhesive-backed disposable transverse laparotomy sheet, leaving the entire head and neck region unobscured from the clavicles up. This allows unimpaired examination of the cervical profile in its entirety throughout the procedure and provides complete access to all areas of the scalp. No head drapes are used, because they will limit scalp access and make it difficult to determine hair shaft inclination and make incisions properly.

The breathing circuit is draped separately from the patient by wrapping it with a sterile sheet or covering it with a sterile stockinette. This allows it to move during the procedure as the patient's head is turned from side to side. When set up in this manner, it is not necessary to secure the LMA with tape or by other means, as long as its position is watched by the anesthesiologist and/or other members of the operating room team present. If an endotracheal tube is used, it can be conveniently secured to the perioral skin with Tegaderm or similar sterile, adhesive-backed dressing.

After the general preparation of the face is complete and drapes have been applied, the posterior surface of the tragus and the auditory canals are prepared with full-strength povidone-iodine (Betadine) using cotton-tipped swabs by a scrubbed member of the surgical team. Each nasal vestibule, the perioral area, and the gingivolabial sulci are prepared with povidone-iodine as well. Peanut sponges are placed in each auditory meatus, and these are changed as necessary during the procedure to prevent the accumulation of blood in the auditory canals.

No hair is cut or shaved along any proposed site of incision. Shaving or trimming hair will prevent accurate assessment of hair shaft inclination relative to the scalp and can result in incisions that injure hair follicles. Tightly applied rubber bands, adhesive tape, surgical lubricants, antibiotic ointment, and hair clips produce similar problems and should also be avoided. It is always an error to pre shave any area of the scalp before the procedure, because this commits the surgeon to excision of these areas, even if this is determined to be inappropriate intraoperatively. As a practical matter, in a well-planned face lift, little if any scalp tissue should actually be excised.

Administering Local Anesthesia

A local anesthetic is administered, even if deep sedation or general anesthesia is used. This limits stimulation of the patient and the overall amount of anesthetic needed. A significant hemostatic effect is also obtained when solutions containing epinephrine are used.

Sensory nerve blocks are performed using 0.25% bupivacaine (Marcaine) with epinephrine 1:200,000. This allows the rest of the face to be injected with a reduced degree of stimulation. Skin marked for incision is then infiltrated with the same solution. Areas of subcutaneous dissection are infiltrated with 0.1% lidocaine (Xylocaine) with epinephrine 1:1,000,000 using a 22-gauge spinal needle in the cheek and postauricular areas and a blunt infiltrator in the neck and submental regions. Care is taken to ensure that the total dose of bupivacaine does not exceed 3 mg/kg of body weight and lidocaine does not exceed 7 mg/kg of body weight per 4 hours. *No direct infiltration of the SMAS or platysma is necessary if the overlying subcutaneous tissues are infiltrated generously at the beginning of the procedure, as described.* It is not necessary to inject local anesthetic in a tumescent fashion.

The local block is maintained by systematically reinfusing the key areas (preauricular and postauricular) during the procedure and readministering nerve blocks *before the local anesthetic effect wears off.* This prevents loss of continuity of the local anesthetic effect and stimulation of the patient that would otherwise occur if reinjection were delayed until after sensation returned.

Making Incisions



All incisions on the scalp must be made precisely parallel to the hair follicles to avoid injury to them, and it is important to confirm by direct observation that this is true as the incision is made.

Incising the skin and scalp is a key step in which the surgeon exercises direct control over the quality of the resultant scar, and incisions should not be made casually or carelessly. All incisions on the scalp or along scalp-skin interfaces must be made precisely parallel to the hair follicles to avoid injury to them, which can result in perincisional alopecia. Frequently this is mistakenly attributed to the patient's own poor healing characteristics and is erroneously regarded as "a wide scar."

In most cases, follicles and hair shafts will be similarly inclined, but this may not be true in a kinky-haired or curly-haired individual or when the patient's hair is wet, saturated with surgical lubricants, or restrained with drapes, tape, or rubber bands. For this reason *it is important to confirm by direct observation that the incision is precisely parallel to the hair follicles as it is made.* One must also recognize that hair

follicle inclination is not uniform over the scalp: follicles will be inclined differently at different areas along the planned incision. Because of this, the angle of the scalpel blade with the scalp must change correspondingly as the incision is made, and the completed incision will be beveled to varying degrees and in different directions, if properly performed.

Skin Flap Elevation

After incisions are made, skin flaps are elevated according to the preoperative plan over the cheek and neck. *Partial separation of the skin flap from the SMAS (lamellar dissection) is necessary because skin and SMAS flaps need to be advanced in different direction to achieve an optimal outcome.* This “bidirectional” tissue shift is not possible if a “composite” type of dissection (elevation of a combined skin-SMAS flap) is done.

Correct positioning of the operating room lights and proper retraction by the assistant is essential for proper dissection, and unnecessary trauma to the flaps must be avoided. Light should be placed on both sides of any flap being dissected to provide simultaneous direct and transmitted illumination; blind dissection must be avoided. Shining a light on the skin surface (transillumination) will help define flap thickness, while lighting the site of dissection (direct illumination) allows identification of important structures. However, too much direct illumination can obscure the transillumination effect and must be avoided. This is particularly true of the bright direct light emitted from fiberoptic headlights and retractors. If they are used, their intensity should be reduced to produce proper, balanced illumination.

The circulating nurse or other unscrubbed team member should be assigned the task of adjusting the overhead lights as needed and the importance of this assignment emphasized. In time, a perceptive nurse need only watch the operative field to know when adjustment is needed. If the circulating nurse is required to monitor the patient, administer medication, or frequently leave the operating room, it is recommended that an additional staff member be present for adjusting lighting.

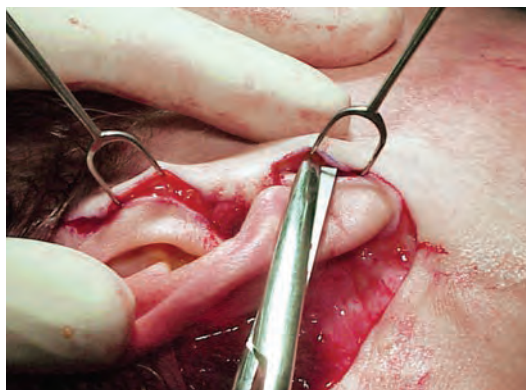
The surgeon and assistant should refrain from adjusting the overhead lights, because each will need both hands free for proper retraction and dissection. *Adjusting the lights with one hand while retracting with the other is a common error that invariably results in excessive traction on the flap and unnecessary trauma to delicate cervicofacial tissue.*

Proper care of the patient and effective functioning of the operating room team requires that two team members be scrubbed with the surgeon throughout most of the procedure. One scrubbed team member will be necessary to act as a full-time surgical assistant. This is a key role that generally precludes passing instruments, loading sutures into needle holders, tracking sharps, and maintaining the instrument

stand. A second scrubbed team member should be present to oversee and carry out these important secondary functions. Regardless of experience or claims to the contrary, it is not possible for one person to effectively assume both roles without compromising her or his role as an assistant and otherwise slowing down the surgical procedure.

Cheek flap dissection is begun using an Adson forceps and a small Kaye scissors or scalpel, grasping only tissue edges that will later be excised. Once the flap edge has been elevated, the forceps are set aside and gentle traction is applied by the assistant with double-pronged skin hooks. A standard patterned medium curved Metzenbaum scissors is then used to establish the proper plane.

Flap dissection is most effectively performed when the surgeon and assistant work together as a carefully coordinated team using a *four-handed technique* in which the assistant applies gentle traction on the skin flap directed toward the surgeon with two large double-pronged skin hooks. One skin hook retractor should be held in each hand, because it is not possible for the assistant to provide proper retraction using a one-handed technique (holding both retractors in one hand). The surgeon then dissects while providing gentle countertraction toward the assistant with the fingertips of the opposite hand.



Four-handed technique. The assistant applies gentle traction on the skin flap toward the surgeon with two large double-pronged skin hooks with one retractor held in each hand. The surgeon then dissects while providing gentle countertraction toward the assistant with the fingertips of the opposite hand.

As the dissection advances, one skin hook is exchanged for a small Deaver, malleable, or similar retractor. The remaining skin hook is used to drape the flap over the retractor and keep it properly positioned on it. This eliminates the need for excessive traction and minimizes trauma to the flap.

The surgeon should not retract for herself or himself, because this invariably leads to rough handling of the flap, especially when exposure is limited or dissection becomes difficult. Retracting should instead always be performed by a conscientious assistant capable of focusing his or her attention on providing proper exposure and protecting delicate facial flaps. This assistant must ignore his or her natural urge to “help” the surgeon by applying excessive force when retracting. It must also be kept in mind that most hospital and surgery center personnel are accustomed to assisting surgeons in other specialties and have not been trained in proper tissue-handling techniques. They are usually not aware that improper retracting, excessive traction, and rough handling of the flap are harmful and can lead to flap compromise, tissue necrosis, and skin slough, and time taken to teach them proper retracting techniques is well spent.

Tissue trauma to skin flaps can be significantly reduced by periodically moving the dissection from one area to another and completing flap elevation in stages. This allows the tissue to “breathe” and avoids prolonged compromise of any one area. Traction should also be released before retractors are moved. If traction is not released, the flap’s microcirculation will be compromised as the retractor is moved from side to side.

All operating room team members should be responsible for ensuring that flaps are handled carefully and that they are not subjected to excessive traction, pinching, folding beneath retractors, or other potentially harmful actions. It is not possible for the surgeon, who is usually preoccupied with other aspects of the procedure, to always be diligent in this regard.

Skin flaps should be elevated sharply under direct vision, avoiding blind dissection. This is especially important in the preauricular region and over the cheek, where a deep dissection can injure and compromise the underlying SMAS or render it useless as a flap. *I have observed that many surgeons using non-SMAS face-lift techniques dissect deeper than they realize*, and inspection of their flaps after dissection often reveals that SMAS fibers have been elevated as part of the “skin” flap. It is also an error to dissect too close to the posterior surface of the skin flap, because this can result in injury to the subdermal microcirculation.

Although subtle, some visual clues are helpful in avoiding these problems and determining when the proper plane has been established. If skin flap dissection is made too deep and SMAS fibers are elevated, the flap’s undersurface will appear relatively smooth and covered by streaks of fine white tissue. When transilluminated, flaps dissected in this manner will appear cloudy and relatively thick. If dissection is made in the proper plane, however, the undersurface of the flap will have a characteristic

rough pebbled or cobblestone appearance and will be more yellow. Transillumination of a flap dissected in the correct plane enhances this appearance.

Blind dissection done by pushing scissors or blunt dissection using a scissors-spreading technique is unacceptably traumatic to the subdermal microcirculation of the skin and can result in flap compromise, damage to subdermal fat, and unintended injury to the SMAS and platysma. This is particularly likely when aggressively patterned, doubled-edged, serrated, and extra-sharp scissors are used. After experimenting with many scissors patterns, I have found none as good as the standard Metzenbaum type.

Postauricular skin flap undermining is most easily begun inferiorly if the occipital incision has been made along the occipital hairline, or posteriorly if the incision has been made over the occipital scalp, because more subcutaneous fat is usually present in these areas. Beginning dissection in these areas helps the surgeon identify the proper plane more superiorly and anteriorly in the postauricular area, where less subcutaneous fat is present and the skin and fascia lie in close proximity. Careful infiltration of dilute local anesthetic into the plane of dissection also facilitates dissection in these areas, but large-volume tumescent injections should be avoided, because these can injure delicate postauricular skin.

Once the correct plane of dissection has been established in the postauricular area, two 10 mm double-pronged skin hook retractors are placed and held by the assistant, and Metzenbaum scissors are used to elevate the postauricular skin flap. Postauricular flap elevation should be done under direct vision aided by transillumination. Dissection is most easily performed in a posterior-to-anterior direction rather than in a superior-to-inferior one.

As dissection progresses anteriorly and inferiorly from the postauricular region to the upper lateral neck, the surgeon must be careful to avoid injury to the great auricular nerve. This nerve provides sensation to the lower two thirds of the ear and travels superficially superiorly in the upper lateral neck over the sternocleidomastoid muscle fascia. The most superficial portion of the nerve is anatomically constant, lying approximately 6.5 cm inferior to the auditory meatus midway between the anterior and posterior borders of the sternocleidomastoid muscle. In most patients, however, it will lie deep to the plane of skin flap dissection and is covered by a thin layer of subcutaneous fat. In these cases, it is neither necessary nor advisable to attempt to specifically identify or isolate this nerve through additional dissection.

Patients with thin faces or those undergoing secondary face lifts will not uncommonly have little subcutaneous fat between the superficially situated portion of the great auricular nerve and the skin. For this reason, extra caution must be taken in these patients when elevating the skin flap in this area, and a clear knowledge of nerve anatomy is required.

As dissection continues anteriorly into the cervical region, subcutaneous fat generally becomes more abundant, and the flap is easier to dissect. The surgeon must be careful to remain in a subcutaneous plane and to leave the majority of the preplatysmal fat on the platysmal surface. This makes fat excision and sculpting easier later in the procedure, if required, and precludes the need for tedious excision of fat from the undersurface of the cervical skin flap. Unlike dissection of a cheek skin flap, in which a conscious effort must be made to prevent the flap from becoming too thick, a slightly deeper dissection should be made in the neck to preserve a slightly thicker layer of subcutaneous fat. Preserving a thicker layer of fat helps to avoid a hard or overresected appearance in the cervicosubmental area and objectionable overexposure of underlying neck anatomy.

If a submental incision is planned, completing subcutaneous dissection of the anterior neck skin flap will be more easily performed through it, rather than through the postauricular incisions. Undermining the submental crease and releasing the submental and mandibular ligaments will also be easier when performed through the submental incision.

The submental incision should be made 1 cm or more posterior to the submental crease, approximately halfway between the mentum and hyoid. Placing the incision in this location helps conceal it in the shadow of the mandible and avoids surgical reinforcement of the crease and accentuation of a double-chin and witch's-chin deformity. The surgeon should stand at the head of the table during dissection of the submental region while the assistant retracts the edges of the submental incision with a pair of 10 mm double-pronged skin hooks. The skin is undermined using Metzenbaum scissors, and the dissection should be made subcutaneously, leaving the majority of the preplatysmal fat on the platysma surface. Submental dissection is continued inferiorly and laterally until it is joined with the dissection made previously in the lateral neck.

On completion of subcutaneous undermining of the anterior neck and submental regions, the submental restraining ligaments should be divided and the submental crease released from its bony attachments. Some bleeding is usually encountered during this maneuver, but this should not prevent the surgeon from completing this important step.

Although in most patients' necks subcutaneous undermining is necessary, this should not arbitrarily include the entire face. If a SMAS dissection is planned, preservation of the anterior platysma-cutaneous ligaments will allow attractive, youthful-appearing elevation of perioral tissue that cannot be obtained with a skin-only technique or when wide skin undermining is performed.



Extent of subcutaneous undermining. The shading indicates the area of subcutaneous undermining. Note that the platysma-cutaneous ligaments (*red dots*) are not undermined and are preserved. Preservation of platysma-cutaneous ligaments and proper elevation and fixation of the SMAS provides support of lateral perioral tissues and prevents the "lateral sweep" deformity.

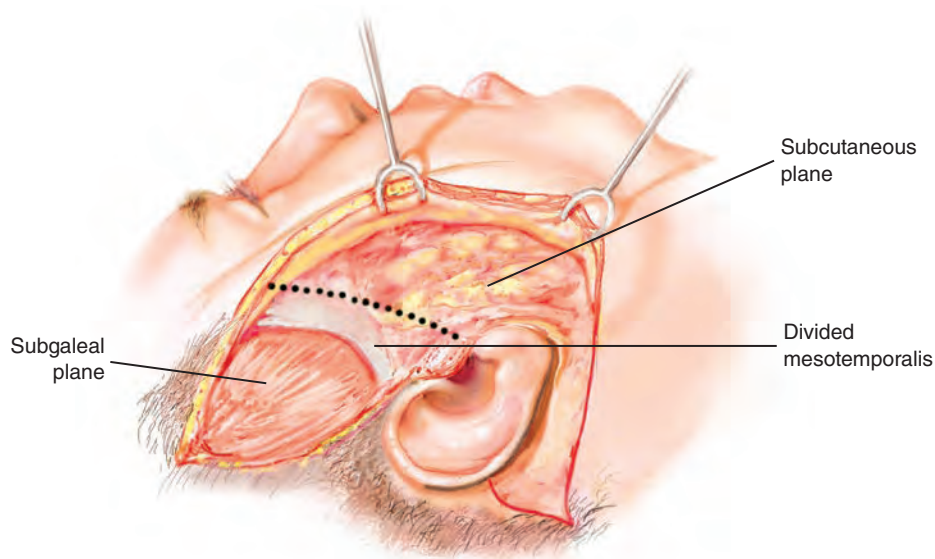
These ligaments anchor the dermis of the perioral cheek to the SMAS and upper platysma and provide a means of lifting and supporting the lateral perioral area without overtightening the skin of the upper-lateral face. Preservation of the platysma cutaneous ligaments also preserves important accompanying perforating vessels to the cheek flap. This reduces the likelihood of flap slough, swelling, and compromise.

If subcutaneous dissection is extended too far anteriorly and the platysma-cutaneous ligaments are divided, the SMAS effect on the superficial tissues of the perioral cheek and jowl will be negated, and a significant portion of the benefit of SMAS elevation and advancement will be lost. Wide cheek flap undermining and division of the platysma-cutaneous ligaments is also the underlying cause of the lateral sweep deformity, since SMAS support of sagging perioral tissues is lost when dissection is performed in this manner.

Temple Dissection

The temple incision is made according to the preoperative plan based on the redundancy present over the upper cheek and the predicted degree of displacement of the sideburn and temporal hairline (see the preceding section).

When a traditional incision on the temporal scalp is indicated, it is made precisely parallel to hair follicles. This will generally require that the incision be beveled to varying degrees and in different directions along its length. The dissection is then deepened and carried down through the galea (superficial temporal fascia) to the fascia of the temporalis muscle and the temporal hair-bearing fasciocutaneous flap anterior to the incision undermined. This dissection is usually easy to perform bluntly with closed Metzenbaum scissors anteriorly to the lateral brow, inferiorly to the mid-temple, and superiorly to the temporal crest. The bridge of fascia lying inferiorly between the deep dissection in the temple and the subcutaneous dissection in the cheek can be safely and conveniently partially divided posterior to the temporal hairline.



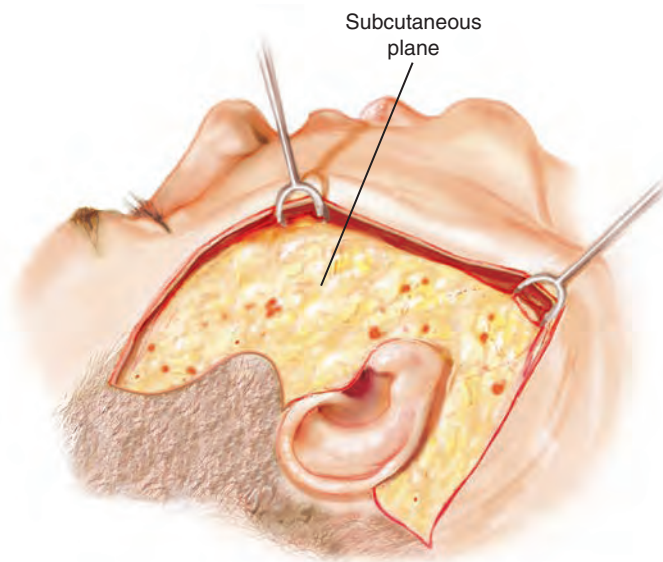
Dividing the mesotemporalis. The bridge of tissue situated between the subfascial (subgaleal) dissection in the temple and the subcutaneous dissection in the cheek can safely be divided posterior to the course of the frontal branch of the facial nerve (*black dotted line*).

Usually this bridge of tissue contains the anterior branch of the superficial temporal artery and it must be divided and ligated when encountered, or thoroughly cauterized. This is of no clinical consequence in a nonsmoking patient who has no vascular disease and is a routine part of the dissection of this area. The frontal branch of the facial nerve lies well anterior and inferior to this chosen point of transition between planes, and this dissection, when executed as described, is anatomically sound and clinically safe. Frontal branch anatomy can be confusing, however, and *a surgeon who is uncertain of the exact relationships in this region should review them carefully before undertaking this dissection.*

Partially dividing the bridge of tissue between the deep plane of the temple and the subcutaneous plane of the cheek allows the two planes of dissection to be joined laterally; this in turn facilitates exposure in the upper cheek and lateral orbit, dissection of the SMAS, and redraping of the temporal portion of the face-lift flap. This method of dissection also protects hair follicles on the undermined temporal scalp by moving the plane of dissection deep to them. Temporal skin can then be undermined subcutaneously up to the lateral orbit, bringing the dissections in the cheek and temple into wide continuity.

When an incision along the temporal portion of the anterior hairline is indicated, it is made a few millimeters within it with a slight bevel, or parallel to the hair follicles. This incision should be made no higher than the junction of the temporal hairline with the frontotemporal hairline; if it is carried more superiorly, the resulting scar will usually be visible, since hair tends to grow posteriorly in this area.

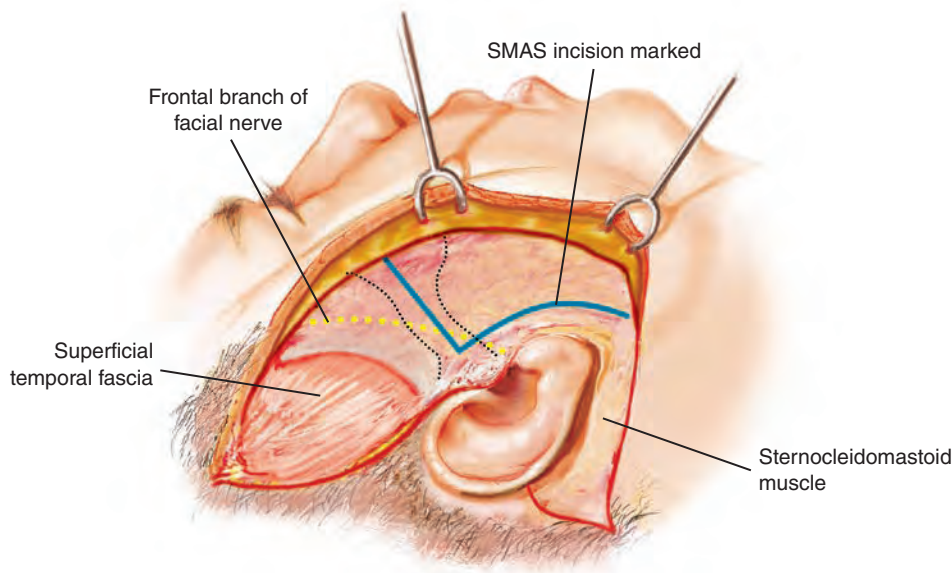
After the incision is made along the hairline, the temporal skin flap is carefully undermined subcutaneously and joined with the subcutaneous dissection in the cheek. No transition between planes is necessary under these circumstances, and no hair-bearing flaps are raised; the superficial temporal vessels and frontal branch of the facial nerve are left undisturbed beneath the superficial temporal fascia.



Flap dissection with a hairline incision. When an incision along the temporal hairline is used, all dissection will be in a subcutaneous plane and no transition between planes will be necessary, no hair-bearing flaps are raised, and the superficial temporal vessels are left undisturbed beneath the superficial temporal fascia.

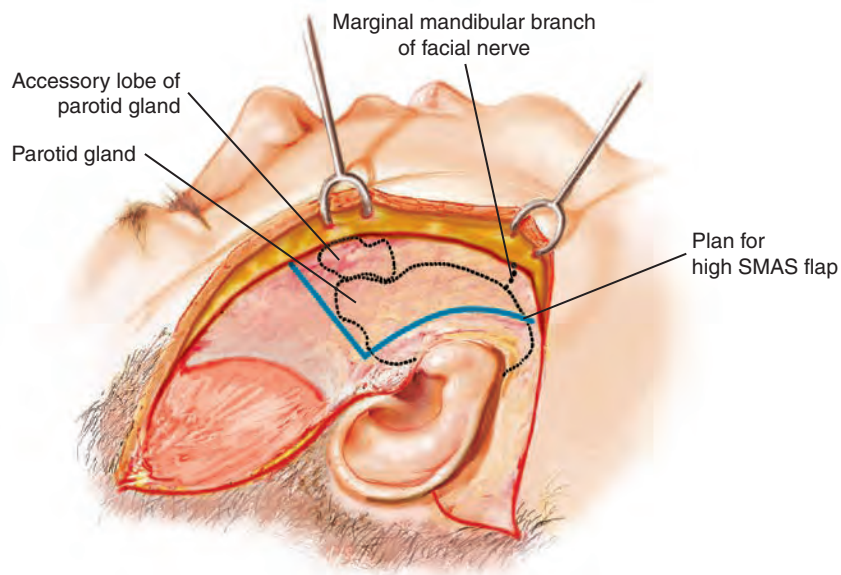
SMAS Dissection

Once the skin flaps have been elevated, they are retracted and the zygomatic arch is palpated. A line is then traced high over its midportion with water-soluble surgical ink (methylene blue) from the infraorbital rim to a point approximately 1 cm anterior to the superior portion of the tragus. This line lies higher than the dissection made in most other techniques, and well above the malar origin of the zygomaticus major muscle. The mark is then turned inferiorly and carried over the preauricular portion of the parotid 1 to 2 cm anterior to the ear. Inferior to the lobule, it is carried inferiorly and posteriorly to the anterior border of the sternocleidomastoid muscle.



Plan for high SMAS flap. The superior margin of flap is planned over the zygomatic arch and not below it. The frontal branch of the facial nerve (*yellow dotted line*) lies safely posterior and deep to the majority of the dissection.

A basic high flap of this type is used on most patients. There are several important advantages in its design worth considering. First, *planning the superior margin of the flap over and along the zygomatic arch, rather than inferior to it, expands the effect of the flap to include the upper midface and allows a better vector to be applied to it.* Carrying the incision posteriorly and inferiorly over the tail of the parotid to the anterior border of the sternocleidomastoid muscle in the upper-lateral neck also maintains a safety zone between the incision and the mandibular margin and moves the dissection away from the marginal mandibular nerve. Placing the remaining portion of the incision along the anterior border of the sternocleidomastoid muscle places the dissection in a relatively thin and avascular area of platysma and along a line where the cut edge, if visible through the skin after surgery, would appear to be the muscle border.

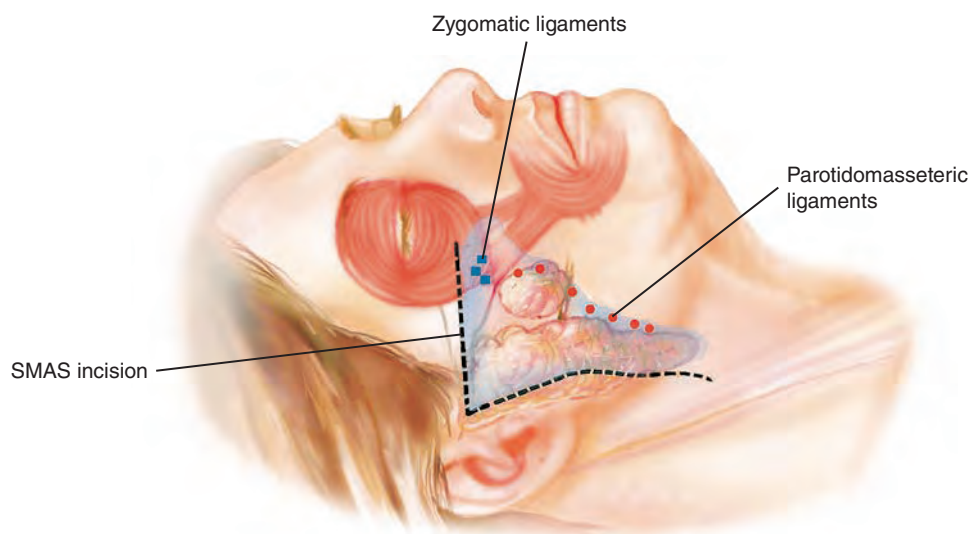


Plan for high SMAS flap. The marginal mandibular branch of the facial nerve (*black dotted line*) emerges from the anterior border of the parotid gland well anterior to the SMAS incision in the preauricular region. The mark for the posterior incision curves posteriorly to the anterior border of the sternocleidomastoid muscle.

Flap elevation is begun by incising the SMAS over the zygomatic arch. This is accomplished by grasping the preauricular tissue overlying the lateral arch with an Allis clamp on each side of the marked line and having the surgical assistant apply gentle posterior traction on them to tense the SMAS layer. The surgeon then makes an incision with Metzenbaum scissors and continues it medially 1 to 2 cm along the marked line in the tensed plane. Allis clamps are then released and reapplied incrementally as the dissection proceeds farther medially along the marked line in the tensed plane in 1 to 2 cm segments in a similar fashion. A considerable amount of tissue lies over the arch, and the frontal branch will be safely concealed beneath several millimeters of fibrous fat. *The margin for error may be reduced in a thin, aged patient with advanced facial atrophy and less soft tissue cover over the arch or in a secondary procedure; therefore extra caution must be exercised under such circumstances.*

The preauricular limb of the SMAS incision is then made using a similar technique over the posterior parotid along the marked line in the preauricular region. It is continued inferiorly and posteriorly to the anterior border of the sternocleidomastoid muscle. These two incisions define the high SMAS flap to be elevated.

After initial SMAS incisions have been completed, preauricular tissue comprising the posterior-superior corner of the SMAS flap is grasped with Allis clamps and flap elevation is then begun using careful scissors technique. Undermining should be limited in the preparotid cheek, more extensive over the zygoma and upper midface.



Approximate extent of SMAS undermining. Complete release of the SMAS flap will require that both the zygomatic ligaments (*blue squares*) and the parotidomasseteric ligaments (*red dots*) be released.

The SMAS, although substantial, is thinner than many surgeons imagine it to be, and it is decidedly thinner and less substantial than other tissue layers that are typically dissected in plastic surgery procedures. SMAS flap elevation also entails dissection in the plane of the facial nerve, in close proximity to important motor branches. Although flap elevation over the parotid is safe, great care must be taken when dissecting more medially and over the zygomatic arch.

Sharp scissors dissection of the high SMAS flap is usually required posteriorly over the parotid, where the plane between parotid fascia and SMAS is often indistinct. In some instances a portion of the parotid fascia may be incidentally and/or unavoidably raised with the SMAS flap, and part of the lobular surface of the gland may be exposed. This is of no clinical consequence and should be used by the surgeon as an aid in identifying the proper plane of dissection, situated slightly more superficially.

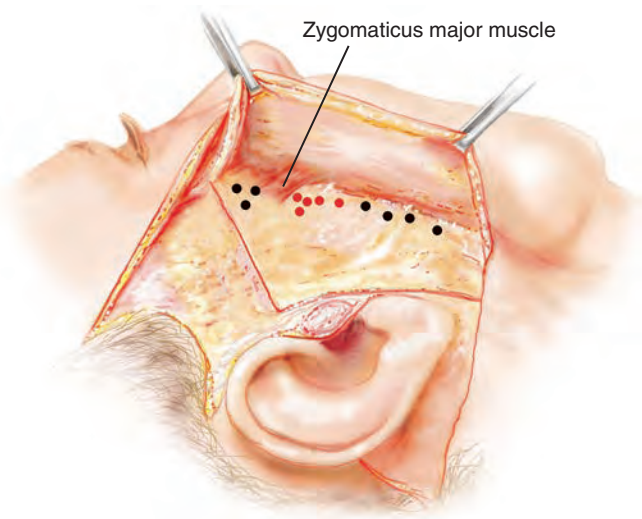
A separate and distinct plane does exist medial to the parotid between the SMAS-platysma and the parotidomasseteric fascia. This plane is most easily identified and established in the lower cheek, where it can usually be entered by gentle blunt dissection with scissors tips, a fingertip, or with a Kitner (peanut) sponge. The parotidomasseteric fascia will be seen as a thin, shiny, transparent layer covering the masseter muscle, parotid duct, buccal fat, and the branches of the facial nerve. Blunt dissection on top of this layer is safe and will not result in nerve injury, but great caution must be exercised when dissecting sharply or when clamping or coagulating in this area. *Frequently motor nerve branches accompany perforating vessels,*

and each bleeding point must be carefully identified when ensuring hemostasis. Blind clamping should not be performed, and a low coagulation current should always be used. The patient's face should also be carefully watched during cauterization and the current discontinued immediately if facial twitching is noted.

Sub-SMAS dissection must generally be carried over the anterior border of the parotid in the lower cheek to ensure that *parotidomasseteric ligaments* tethering the SMAS are released. These are most easily identified by fingertip palpation along the front of dissection. If these restraining attachments are not released, the SMAS effect in the lower cheek and jawl will not be optimal, and the overall benefit will be minimal.

As SMAS flap dissection is made anteriorly and medially in the upper cheek over the superior portion of the parotid and its accessory lobe, the SMAS will be seen to thin and invest the lip elevators. *At this point the dissection must be taken superficial to the superior portion of the zygomaticus major muscle* and its upper 1 to 2 cm carefully exposed. The zygomatic ligaments will be encountered just at the malar origin of the zygomaticus major muscle. These fibrous connections between the periosteum, SMAS, and skin must be divided and when completely released, produce a dramatic liberation of the flap. The lateralmost ligaments are typically more substantial and generally require sharp dissection and formal transection. The ligaments lying more medially are generally softer and can often be disrupted bluntly with open scissors tips.

Directly inferomedial to the origin of the zygomaticus major muscle and superomedial to the accessory lobe of the parotid and the parotid duct lies the zone of transition between the zygomatic and parotidomasseteric ligaments—and potentially the most dangerous part of the SMAS dissection. Proper liberation and release of the SMAS flap usually requires at least partial division of restraining attachments in this area, but this moves the dissection into very close proximity to the zygomatic branch of the facial nerve.



Completed SMAS flap dissection. Inferior to the origin of the zygomaticus major muscle and superomedial to the accessory lobe of the parotid lies the zone of transition between the zygomatic and masseteric-cutaneous ligaments (*red dots*)—potentially the most dangerous part of the SMAS dissection. Proper liberation and release of the SMAS flap usually requires at least partial division of restraining attachments in this area, but this moves the dissection into very close proximity to the zygomatic branch of the facial nerve.

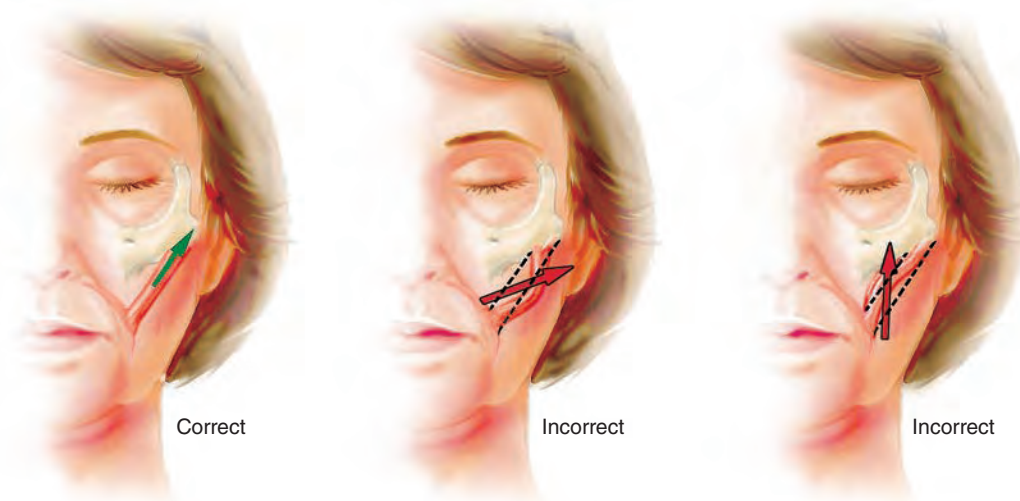
Although experienced surgeons make this dissection appear easy and often seem to minimize the risk involved, it can be difficult for a less-experienced surgeon to distinguish between nerve branches and ligamentous attachments in this area. Anatomic variations are common in this area, and in some cases nerves will penetrate the deep fascia early and travel directly in a sub-SMAS plane or send a branch over the zygomaticus major to the orbicularis oculi. In these situations, traction on the SMAS flap during dissection can tent up these branches, placing them at even greater risk. *It is highly recommended that any surgeon uncertain of the anatomy of the facial nerve and its variations or the exact relationships in this area review them carefully before undertaking this dissection.*

A safe dissection of the submalar SMAS and proper release of the zygomatic ligaments requires adequate light, an attentive assistant, a well-organized surgical team, a dry field, and patience, caution, and composure on the part of the surgeon. Loupes are very helpful in identifying important anatomic structures, and inexperienced surgeons should consider the use of a disposable battery-operated nerve stimulator to aid in initial dissections. *If the neophyte surgeon is confused or the anatomy seems unclear, it is better to limit dissection until he or she gains additional experience and familiarity with this anatomic region, because no amount of improvement in facial appearance is worth an injury to the facial nerve.*

Dissection of the SMAS flap and release of restraining ligaments is continued until gentle traction on the flap produces motion at the nasal ala, philtrum, and stomal angle, and elevation and compression of infraorbital and lower eyelid tissue. *This traction test clinically confirms adequate flap release and is a more important indicator of a complete dissection than any arbitrary anatomic endpoint.* If flap release is incomplete, residual tethering fibers are identified are carefully divided, and the traction test is repeated. When dissection is complete, the midface and malar pad and attached skin will move freely as part of the high SMAS flap, and tissue advancement into the infraorbital area and compression of the lower eyelid skin will be evident. No separate suturing or dissection of the midface is required.

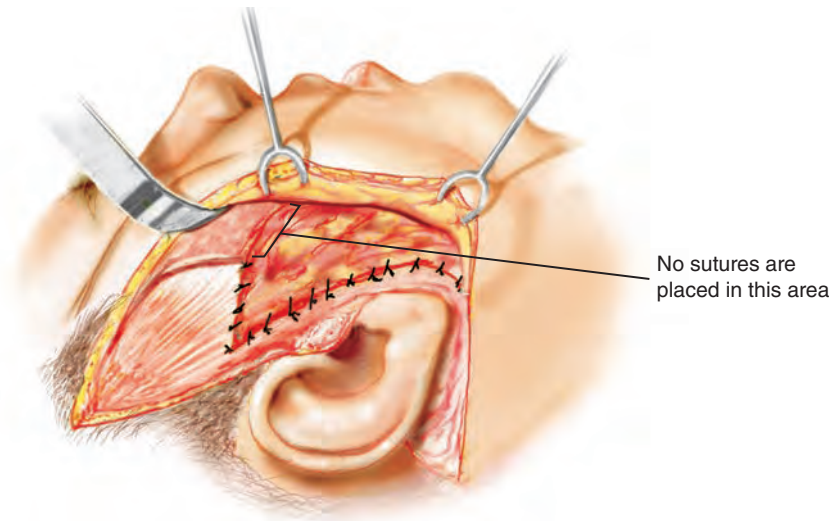
SMAS Suspension

Once the SMAS flap has been elevated and adequately released, the superior edge of the flap is grasped and shifted variously to determine which direction produces the best effect on the upper midface, cheek, and jawl. In all but the unusual case, this is along a posterior-superior vector parallel to the long axis of the zygomaticus major muscle. *If a vertical or posterior vector is used, the function of the zygomaticus major muscle will be corrupted, and an abnormal appearance during animation may result.*



Proper and improper vector of the SMAS shift. *Left*, The correct shift of the SMAS flap is along the long axis of the zygomaticus major muscle. This allows natural muscle function. If the SMAS is shifted along a posteriorly directed vector (*center*), not along the long axis of the zygomaticus major muscle, the muscle will be pulled off its axis and its function compromised. This can result in deepening of the nasolabial fold and abnormal appearances during animation. *Right*, An analogous problem occurs when a vertical vector is used in a “vertical face lift.”

Management of the superior margin of the SMAS flap and the technique of flap suspension will vary, depending on the problems present and considerations particular to the patient, including sex, race, and his or her overall facial morphology. In most cases no trimming of the superior margin of the flap is performed, because the overlapping tissue segments of the SMAS add volume to and restore lost projection over the zygomatic arch. In these situations the superior edge of the flap is anchored with multiple interrupted sutures of 3-0 Mersilene, well over the zygomatic arch, directly to the deep temporal fascia, superior to the mesotemporalis.



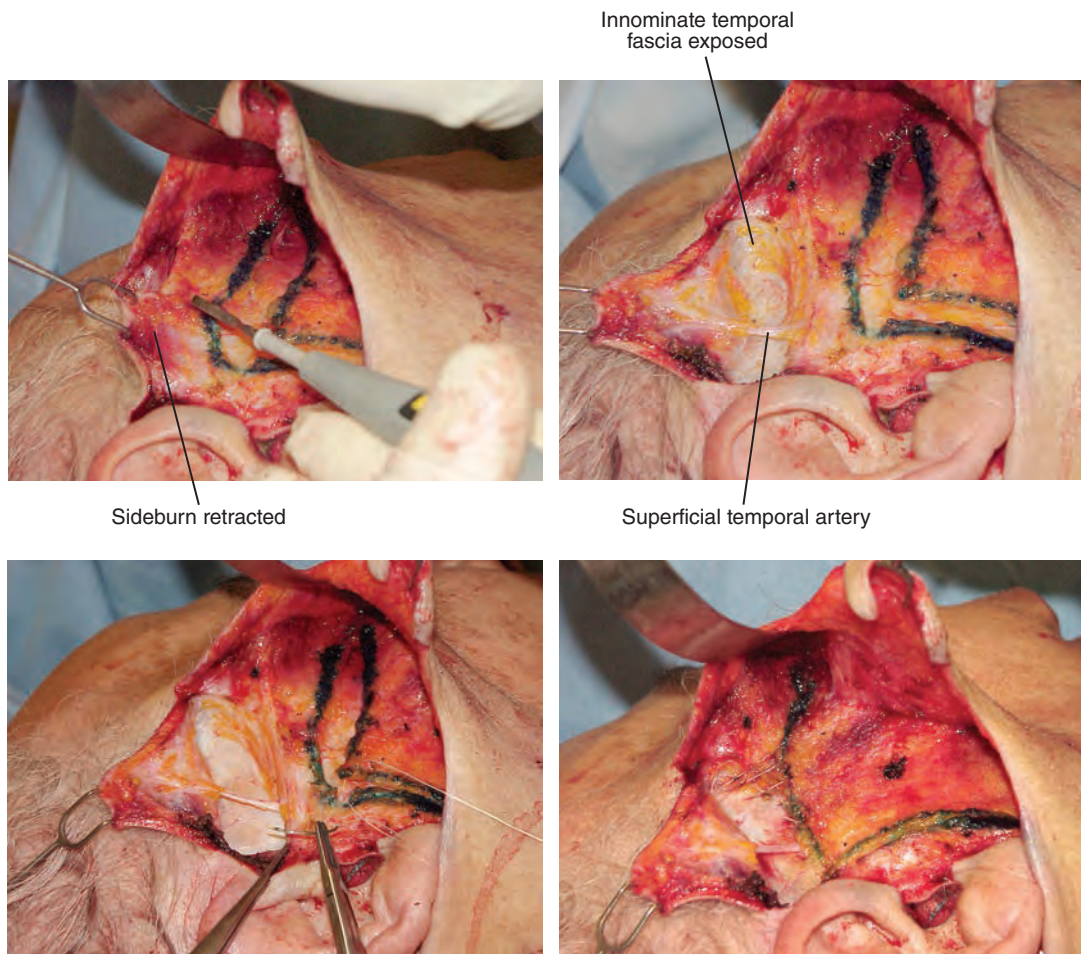
High SMAS flap suspension with a temporal scalp incision. The SMAS flap has been advanced superiorly, the mesotemporalis pushed inferiorly, and the flap secured to the temporalis muscle fascia.

Suspension in this manner is greatly facilitated if the mesotemporalis is gently pushed inferiorly as the sutures are placed. This solidly suspends the midface, upper cheek, and jowl with little if any risk of injury to the frontal branch of the facial nerve. No suturing is needed or should be performed more anteriorly over the zygoma or along the infraorbital rim. These parts of the face are mobile and need to move during animation and for natural expression. Directly suspending the midface along the zygoma or infraorbital rim, especially rigidly, can result in the tissue tethering and dimpling often referred to as a *smile block*. If direct anchoring of the flap to the temporal muscle fascia is not possible, even when the mesotemporalis is pushed inferiorly, suspension can still be made in this manner if the sutures are allowed to bridge the intervening gap.

In patients with wide faces and small mandibles, in many men, and in many patients of Asian or Slavic ancestry, enhancement of the upper cheek and arch obtained by overlapping the SMAS may not be artistically appropriate, necessary, or desired. In such cases the redundant tissue along the superior flap margin can be excised and discarded and the superior flap margin sutured edge to edge to the superior margin of the initial incision made in the SMAS over the zygomatic arch.

When an incision along the temporal hairline is used and temporal dissection is done in a subcutaneous plane, temporal muscle fascia will not be exposed and a mesotemporalis will not be present. The redundant tissue along the superior flap margin can

be excised and discarded, and the superior flap margin sutured edge to edge to the superior margin of the initial incision made in the SMAS over the zygomatic arch. Alternatively, the galea can be incised just inferior to the sideburn to expose the temporalis muscle fascia (*innominate fascia*). The SMAS can then be anchored in a manner analogous to the way in which the mesotemporalis has been divided.



High SMAS flap suspension with a temporal hairline incision. *Top left,* To gain access to the temporalis muscle fascia to suspend the SMAS, the sideburn is retracted and the galea incised. *Top right,* The completed incision of the galea under the sideburn exposes the temporalis muscle fascia. Once incised, a "mesotemporalis" (the transition from the subcutaneous plane of the cheek to the subgaleal plane in the temple) is created. If this is done carefully, the superficial temporal artery can be preserved, although it can be divided and ligated without consequence. This establishes a situation for suspension of the SMAS analogous to that shown on p. 1579. *Bottom left,* The suture has been placed through the corner of the SMAS flap. Note that the mesotemporalis is being pushed inferiorly as the suture is placed. *Bottom right,* Additional sutures have been placed between the superior margin of the SMAS flap and the temporalis muscle fascia, securely anchoring the flap. Although unnecessary, a few sutures have been placed and allowed to bridge anteriorly. Once suspension of the SMAS is complete the sideburn is placed back in a proper anatomic place and anchored down before the skin flap is trimmed and the incisions closed.

Regardless of how the superior margin of the flap is secured, invariably some trimming of the posterior margin of the cheek SMAS flap is subsequently required to allow an edge-to-edge approximation to the SMAS remnant in the preauricular region. Overlapping of the SMAS in the preauricular area is functionally unproductive and artistically inappropriate, because such an arrangement lends no additional support to the anterior face and obliterates the natural preauricular contours and the pretragal hollow.

The posterior margin of the cheek SMAS flap should be trimmed after the superior margin has been suspended over the zygomatic arch. Tissue is excised by placing gentle traction on it and tracing a line in marking ink over the cut edge lying beneath it. The amount of tissue excised will vary depending on the size of the patient's face, the degree of release of the flap, and the chosen vector of advancement. *It is unproductive and an error to place excessive traction on the SMAS in the preauricular region*, and the posterior margin of the flap should be trimmed carefully to avoid overexcision and a tight closure. Posterior traction on the SMAS will result in perioral distortion, a "pulled" look, or other abnormal appearances.

After trimming of the posterior margin of the SMAS flap, the cut edge is approximated to the preauricular remnant with multiple interrupted sutures of 4-0 Mersilene with the knots tied on the deep side. These sutures consolidate the cheek and help support the superior suture line but should not be used to put posterior traction on the SMAS flap.

When the cheek SMAS is sutured, the facial contour should be improved and a faint smile should be evident. Usually elevation of the lid-cheek junction and compression of lower eyelid tissue will also be noted.

To provide additional support in the anterior neck and along the submental region, the excess tissue along the posterior margin of the cheek SMAS flap can be left attached to the cervical-submental platysma and used as a *postauricular transposition flap* (see pp. 1556-1557). This flap improves neck contour by correcting horizontal platysma redundancy and increasing submental support. Frequently this cannot be accomplished by lateral platysmapexy (see p. 1556) alone because of the mobility of the tissues in the upper lateral neck. Suturing the transposed segment of cheek SMAS to the mastoid fascia while leaving it attached to the cervical platysma circumvents this problem and improves the result. In addition, a *dynamic* sling is created that tightens the submental region when the patient looks down. This tightening occurs because the mastoid moves superiorly during neck flexion and away from the anterior neck, pulling the transposed flap and attached tissue with it.

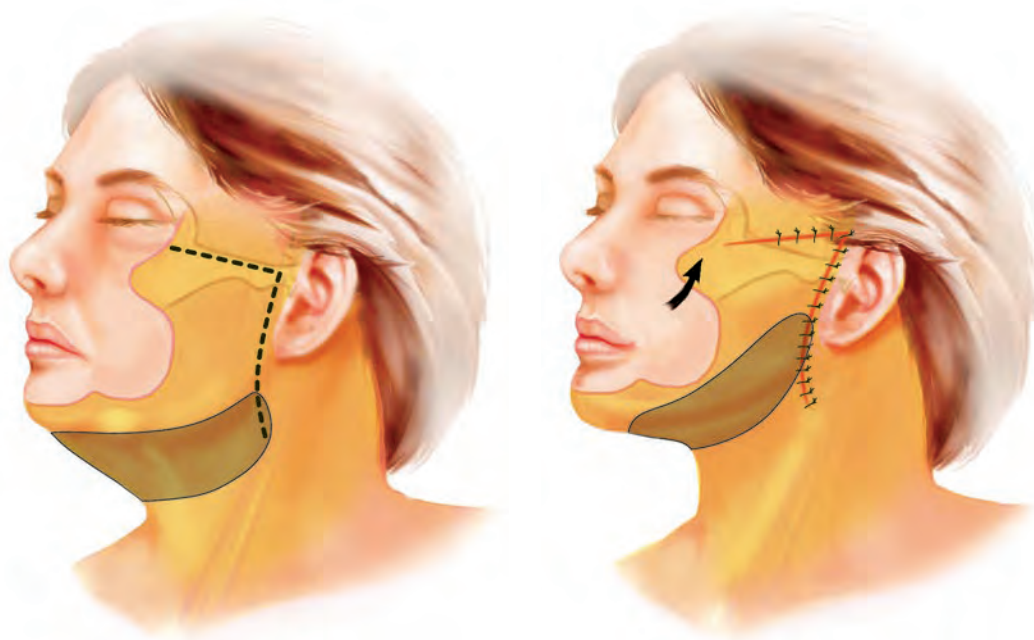
When a postauricular transposition flap is used, it must be carefully designed and its effect thoroughly tested intraoperatively. The SMAS must be incised in such a fashion that the transposition flap exerts its effect on the cervical platysma below the mandibular border, and not more superiorly on the SMAS in the cheek. Flap suspension is also best delayed until after the anterior platysmaplasty is completed (see the next section). A postauricular transposition flap, when used in conjunction with anterior platysmaplasty, creates a mastoid-to-mastoid sling of autologous tissue. This is a more natural and superior maneuver than any attempt to accentuate neck contour by the placement of suspension sutures, alloplastic straps or bands, and similar measures.

Cervical Lipectomy

A cervical lipectomy is a technically demanding and conceptually difficult maneuver that requires patience, perseverance, restraint, and artistic sensitivity. Success or failure in neck rejuvenation will be largely determined by the surgeon's proper or improper handling of neck fat. Other maneuvers commonly performed to improve neck contour, including platysmaplasty (a "corsetlike" tightening of the platysma), platysmapexy (Labbé sutures), placement of submental "hammock"-type suspension sutures, and removal and repositioning of cervical skin, are far less important. Accepting this fact is an essential point of transition in most surgeons' quest to provide their patients with the optimal neck contour they desire.

Cervical fat is present in three distinct anatomic layers: preplatysmal, subplatysmal, and deep cervicosubmuscular (*intradigastric*); understanding this distribution is the key to attractive and successful outcomes in the neck. In almost all cases cervical lipectomy should be limited to the two more superficially situated regions, and in a contemporary neck lift the focus is placed predominantly on fat in the subplatysmal layer. Lipectomy technique is not as important as the contours created, and *it should be the aim of the surgeon to produce a well-contoured and attractive neck, and not simply one devoid of fat.*

Contrary to what is traditionally practiced, preplatysmal cervicosubmental subcutaneous lipectomy should in most cases be performed after shifting and suturing of the SMAS and platysma and excision of subplatysmal fat when indicated, and not at the beginning of the procedure. If preplatysmal lipectomy is performed at the beginning of the procedure, fat will be mistakenly excised from regions of the neck that will be raised onto the face when SMAS flaps are advanced and suspended. This will result in inadvertent creation of harsh or irregular mandibular contours.



Sequencing excision of preplatysmal fat. If preplatysmal fat is excised before the SMAS is elevated, denuded areas that were formerly situated below the jawline will subsequently be advanced onto the lower face. This can result in a harsh mandibular contour. To avoid this problem, preplatysmal fat should be removed, if indicated, after the SMAS flap has been raised. *Left*, Incorrect plan for preplatysmal fat excision (*shaded area*). Fat is excised before the SMAS flap is raised. *Right*, After SMAS elevation, the denuded areas are moved up onto the lower face, resulting in contour irregularities and depressions.

Performing preplatysmal lipectomy at the beginning of the procedure also typically results in erroneous removal of the fat necessary to a soft, youthful, healthy appearance. Typically this overresection of subcutaneous fat will not be evident intraoperatively or for the first few months postoperatively because the error is masked by swelling. Once the swelling has resolved, however, the cervicosubmental region will have an unnatural, unhealthy, elderly, and overresected look.

Subcutaneous cervicosubmental fat should be thought of as the surgeon's "artistic clay"; it is my usual practice to leave this layer untouched in most necks until subplatysmal fat excision and deep-layer work have been performed (submandibular gland reduction, partial digastric muscle myectomy), and all other maneuvers (platysmaplasty and platysmamyotomy) have been completed. Once all other work in the neck is complete and the optimal shape of the foundation of the face has been established, only then is final contouring of the subcutaneous fat carefully and conservatively performed. Contouring preplatysmal cervicofacial fat as the last in the sequence of steps used to improve the neck provides one important last opportunity to optimize facial contour and finesse facial appearance that is lost if this fat is arbitrarily sacrificed at an initial stage of the procedure.

In full necks in which excessive subcutaneous fat deposits can be detected, preplatysmal lipectomy can be performed judiciously with a small suction cannula before needed deep-layer maneuvers are performed if care is taken to avoid injury to the platysma muscles and to leave enough fat behind for final fat contouring later in the procedure. This is an unusual circumstance, however; careful preoperative assessment of the subcutaneous fat layer in the neck of most face-lift patients will show that a paucity of fat is present.

In most cases cervicosubmental subcutaneous fat is removed after all other necessary neck maneuvers have been performed. Fat can be removed in such circumstances using an open suction technique with a one-holed cannula turned toward the platysma. In thinner necks, simple excision is done with a scissors technique, or no fat is removed. Preplatysmal lipectomy is usually easiest in the anterior and lateral neck, where it is needed least, and is more difficult in the submental area and near the mandibular border and chin, where it is needed most. Fat in the latter regions is often firmly adherent to the platysma and is usually difficult to remove with a cannula alone. If preplatysmal lipectomy is performed with a suction cannula, fat should be removed in a medial-to-lateral and inferior-to-superior direction, working through both submental and postauricular incisions to prevent disruption of previously placed sutures suspending the SMAS.

Although proper shift of the cheek SMAS often repositions ptotic jowl fat, partial excision and contouring of this area may be necessary in some patients, particularly those with round, full faces. It is also usually productive to examine the mandibular contour while gently pushing inferiorly on the cheek. This simulates the effect of gravity on the upright face and may reveal the need for additional fat excision from this area.

Once skin and SMAS flaps have been elevated, but before the SMAS has been sutured and preplatysmal lipectomy is complete, the surgeon should examine the neck intraoperatively to decide whether the subplatysmal space needs be explored. Exploration may be indicated if a significant collection of *subplatysmal* fat was identified preoperatively or if large digastric muscles or submandibular glands are present. Significant accumulations of subplatysmal fat can be demonstrated intraoperatively by placing gentle superior traction on the cheek flaps and flexing the neck. If the neck appears full with this maneuver, the surgeon should consider exploring the subplatysmal space and removing redundant subplatysmal fat.

The subplatysmal region is explored through the submental skin incision, and the subplatysmal space is entered by incising the superficially situated fascia between the medial platysma muscle borders. A combination of blunt and sharp scissors tech-

nique is used to isolate each muscle edge. The muscle edge is then grasped and the dissection carried laterally over the anterior belly of the anterior belly of the digastric muscle hugging the underside of the platysma. If this dissection is carefully done, a well-defined, relatively avascular plane can usually be identified. Small communicating vessels are not infrequently encountered, especially near the medial muscle borders; these should be carefully fulgurated and divided.

Subplatysmal fat should be left on the deep surface of the neck and not raised with the platysma flap. This will facilitate fat removal, since it is technically difficult to resect fat from the undersurface of the muscle.

The plane tangent to the anterior bellies of the digastric muscles should be used as a landmark for the limit of subplatysmal fat removal. All fat lying superficial to this plane should theoretically be removed to achieve an optimal contour. As a practical matter, the overall neck contour must be considered, because it is the curvilinear plane across the submental region tangent to the borders of the mandible and the anterior bellies of the digastric muscles that ultimately determines an attractive neck contour. If large submandibular glands and/or anterior bellies of the digastric muscles are present but are not addressed, subplatysmal fat removal should be more conservative if accentuation of these problems is to be avoided. Fibrous fat in the prehyoid region should not be arbitrarily removed, especially in women, to prevent accentuation and masculinization of the larynx. If prominent submandibular glands and digastric muscles are appropriately treated, however, subplatysmal fat can be resected more aggressively, allowing optimal neck improvement.

Once the platysma muscles have been undermined, subplatysmal fat will be evident as a triangular fat pad with its base lying at the hyoid and the tip near the mentum. It should be removed incrementally, as appropriate, and as determined by the position and size of the digastric muscles and the size of the submandibular glands. Fat removal should not be arbitrary, and the surgeon must pay close attention to the new contours created. Subplatysmal fat excision often results in the division of tributaries of small pretracheal vessels, and a long, shielded cautery forceps and good suction should be available to obtain adequate hemostasis when required.

Fat situated deep to the plane tangent to the anterior bellies of the digastric muscles and beneath the deep cervical fascia (deep cervical or intradigastric fat) should rarely be removed, and *the overwhelming temptation to “clean out” the deep cervical space must be resisted. Platysmaplasty and other maneuvers cannot compensate for overzealous excision of deep fat, and in time, an objectionable submental depression will appear in the neck of a patient treated in this way.*

Submandibular Gland Reduction

If a large submandibular gland is present, it can usually be seen and palpated lateral to the ipsilateral belly of the anterior digastric muscle within its respective submandibular triangle, protruding inferiorly to a plane tangent to the digastric and the mandibular border. The protruding portion can be incrementally resected through the submental incision before the submental platysmaplasty is performed to improve neck contour, if indicated.

Prominent submandibular glands will be encountered as subplatysmal dissection is carried over the anterior belly of the digastric muscle. The prominent gland will appear as a smooth pink to tan mass covered by a smooth capsule. Reduction is begun by incising the capsule overlying the gland inferomedially just lateral to the anterior belly of the digastric muscle with Metzenbaum scissors. The submandibular gland will be evident once exposed in this manner because of its distinctive lobulated appearance. Its inferior portion can be grasped and easily separated from adjacent tissue inside its capsule with a gentle blunt scissors-spreading technique. Although all vital structures are outside the glandular capsule, care should be taken when mobilizing the gland superolaterally, because both the retromandibular vein and the marginal mandibular branch of the facial nerve are in close proximity in that area.

An examination of the gland, once separated from its capsule, will reveal it to be large, not merely ptotic; this observation forms the basis of the recommendation that partial resection be performed. In addition, examination of the exposed gland will clearly demonstrate that attempts to reposition it more superiorly will ultimately be fruitless.

The key to safe performing the procedure is adequate mobilization of the gland; modest overmobilization will make both gland resection and the control of any intraglandular bleeding much easier. Once adequately mobilized inside its capsule, the redundant, protruding portion of the submandibular gland is excised with an extended blade-tipped cautery and a long pair of insulated forceps. As in all surgery of the neck and the submental region, a fiberoptic headlight or retractor is essential, as is a competent assistant and a second scrubbed person to pass instruments and sutures as needed. One person cannot safely perform both these roles. A suction cannula or smoke-evacuating retractor should also be placed, and the position of the cautery tip relative to vital adjacent structures must be known at all times during the resection. If a smoke-evacuating retractor is used, a second Y-anchor suction setup should be available in the event that bleeding is encountered during the resection.

The inferior portion of the gland is firmly grasped and pulled gently inferiorly and medially out of its fossa, away from adjacent structures. The redundant portion is

subsequently incised incrementally under direct vision in a medial-to-lateral direction along the planned line of resection with coagulating current cautery. Gland excision should be performed so that the portion protruding inferior to the plane tangent to the ipsilateral anterior belly of the digastric muscle and the ipsilateral mandibular border will be resected. Usually the initial resection should be conservative, and the gland is incrementally reduced thereafter, as required. It should never be necessary and is not appropriate to remove an entire gland. This would most likely result in a depression or other contour abnormality and could precipitate dry-mouth symptoms.

Submandibular gland reduction must not be performed without good light, proper instruments, suction, adequate exposure, sufficient personnel, and proper caution, since intraglandular vessels may be encountered. These vessels are more commonly encountered when larger resections are necessary and are most easily managed by immediate, thorough fulguration before further dissection is done. Typically bleeding will occur from both the gland and the specimen side, and this is usually best controlled by quickly moving the cautery back and forth between each end of the cut vessel. If only the gland side is cauterized, bleeding will frequently continue from the specimen side, obscuring the surgical field. If bleeding is brisk, the cut edge of the gland should be compressed with forceps and the vessel isolated. It may then be grasped with a second instrument and cautery applied. In these situations, the surgeon should consider placing a hemostatic suture of 3-0 chromic gut at the cauterized site to prevent postoperative bleeding. In the unlikely event that bleeding cannot be controlled by these means, the submandibular fossa should be packed with a gauze sponge and digital pressure applied against the cut gland edge for several minutes. In most cases, when the sponge is carefully removed, the bleeding will have stopped; the bleeding point can be sought and any suspicious areas cauterized.

Once initial excision of the protruding portion of the gland is complete, the submental region is reconstructed, as indicated. It is not necessary or productive to attempt to oversew the cut edge of the gland or close the glandular capsule. These maneuvers are technically difficult and could precipitate intraglandular bleeding or result in injury to nearby neurovascular structures. It is also not necessary or productive to cauterize the cut edge of the gland in an attempt to shrink or seal it. This typically results in more postoperative pain and swelling and prolonged submental induration.

When submandibular gland reduction is performed, a drain should be placed in the subplatysmal space and left in place for several days after the procedure. It is safest to perform the platysmaplasty before the drain is placed and then to perforate the platysma and thread the drain into place. If the drain is placed before the platysmaplasty, the drain could be caught in one of the sutures, making its removal difficult.

Submandibular gland reduction, although important in the rejuvenation of many necks, will not in and of itself result in attractive neck contour. Other problems must be identified and addressed to achieve optimal results.

Submandibular reduction should be regarded as an advanced technique. It should be undertaken by surgeons well versed in cervical anatomy and experienced in more basic maneuvers used to rejuvenate the neck. It is highly recommended that any surgeon uncertain of the anatomy of the submental triangle or the exact relationships of important structures in this area review them carefully before undertaking this dissection.

Partial Digastric Myectomy

The surgeon will encounter a small subset of patients who have objectionably large anterior digastric muscle bellies. Usually these are most easily identified after subplatysmal lipectomy and submandibular gland reduction has been performed, but they may sometimes be evident preoperatively in patients seeking secondary surgery. In these situations additional improvement in neck contour may be obtained by performing superficial subtotal anterior *digastric myectomy*.

Superficial subtotal anterior digastric myectomy is performed under direct vision, through the submental incision after the subplatysmal space has been opened, the platysma muscle mobilized, and subplatysmal fat and protruding portions of the submandibular gland resected, if indicated. The redundant portion of muscle is visually gauged and then simply picked up with forceps and tangentially resected with Metzenbaum scissors. The neck is reexamined and the maneuver repeated until an improved contour is obtained. Usually this entails the excision of 10% to 25% of the total muscle mass. Occasionally 50% to 75% or more of each muscle will need to be removed. Tangential muscle myotomy will typically result in variable amounts of superficial oozing, which is easily controlled by grasping the bleeding areas and applying cautery.

Superficial digastric myectomy, although important in the rejuvenation of many necks, will not in and of itself result in attractive neck contour. Other problems must be identified and addressed if optimal results are to be obtained.

Superficial digastric myectomy, although important in achieving attractive contour in some necks, should be regarded as an advanced technique. It should be undertaken by surgeons well versed in cervical anatomy and experienced in more basic maneuvers used to rejuvenate the neck. It is highly recommended that any surgeon uncertain of the anatomy of the submental region or the exact relationships of important structures in this area review them carefully before undertaking this dissection.

Anterior Platysmaplasty

Anterior platysmaplasty (see p. 1555, *bottom*) is performed in most patients and provides an improved result in most necks, especially when the patient looks down and flexes her or his neck. The purpose of platysmaplasty is to consolidate the neck. It cannot create contour in and of itself, and it is not adequate treatment for platysma bands in most patients. Typically platysmaplasty consists of suturing the medial muscle borders together from the mentum to the thyroid cartilage in one or two layers in conjunction with varying degrees of platysma transection (platysma myotomy) low in the neck. If redundant muscle is present medially, it is excised and discarded so that a smooth edge-to-edge approximation of the medial muscle borders can be made. Experience has shown that this produces a better result and reduces the likelihood that objectionable midline fullness or bands will result after the tissues have healed and relaxed than when excess muscle is invaginated and a multilayer “plication” is performed.

Platysmaplasty should be performed after checking the SMAS flap dissection and suspension to prevent general accentuation of the effects of aging and gravity and compromising rejuvenation of the face. Although this makes suture placement during the platysmaplasty more difficult, it allows optimal repositioning of the cheek and jawl. *If platysmaplasty is performed first, the cheek SMAS and lower facial fat will be pulled inferiorly and the improvements will be compromised.*

Platysmaplasty is usually performed using a combination of multiple simple interrupted and continuous sutures of 3-0 braided polyester sutures (or the surgeon's suture of choice) on a medium tapered needle beginning at the menton and working inferiorly to the cricoid. Long instruments are needed and patience is required. Optimal improvement generally cannot be obtained if the repair is done in one layer or if a running suture is initially used. If the first layer is performed using a running suture, some gathering and a purse-string effect can occur. This will result in shortening along the line of repair and can cause bow-stringing and the formation of midline bands. If the initial approximation is made with interrupted sutures, this problem is averted.

Next, the line of repair can be oversewn and reinforced with a simple running suture without a purse-string and shortening effect. The repair need only be snug, not tight. If a permanent suture is used, each should be immersed in antibiotic solution before placement, and care should be taken to bury all knots.

Platysmaplasty should be performed with the neck in a neutral position. If the closure is done with the neck extended, there may be excessive tightness when the patient looks down. This is particularly true if the platysmaplasty is performed in conjunction with a postauricular transposition flap of cheek SMAS.

If postauricular transposition flaps are planned, suspension to the mastoid should be performed after the anterior platysmaplasty is complete. If the transposition flaps are suspended first, the platysma muscles can be shifted laterally, and it may be difficult or impossible to adequately join them in the midline. Suspension to the mastoid is performed with interrupted sutures of 4-0 Mersilene (or another suture of choice). Usually the more proximal portions of the flap are secured with a simple running suture of 4-0 Vicryl. This consolidates the deep-layer repair in the perilobular area and prevents the flap from rolling on itself.

Transverse Platysma Myotomy

Although anterior platysmaplasty will often result in an attractive neck at rest and on the operating table, objectionable platysma bands and muscle striations will often still be evident in conversation and during animation if additional steps are not taken. These problems can be avoided by performing a *transverse platysma myotomy* (see pp. 1553-1555). The extent of platysma transection will depend on the deformities present and thus will vary from patient to patient.

Platysma myotomy should be performed after anterior platysmaplasty has been completed, when the platysma muscle is uniformly distributed over the anterior neck. Myotomy should be performed low in the neck at the level of the cricoid cartilage. At this level the muscle is thin and will bleed less, and the cut edges are less likely to be visible postoperatively. In addition, a smooth transition across the cervicomental angle is maintained. If transection is done higher, these benefits are lost and the larynx will be masculinized. This is particularly true when a myotomy is performed along the cervicomental angle or when wedges of platysma muscle are removed there.

An anterior platysma myotomy is best begun through the submental incision. The medial platysma border is identified over the cricoid cartilage and grasped and lifted away from the deep cervical fascia with a long DeBakey or similar type of forceps. Myotomy is then done by nibbling through the muscle in small increments with long Metzenbaum scissors. As the muscle is divided it usually separates a centimeter or more, exposing the fascia beneath it. Serrated and supersharp scissors should not be used, because they tend to pick up and cut adjacent tissue, and this can result in injury to the anterior jugular vein, which usually leads to copious bleeding that can be difficult to control. Gentle spreading with scissors tips before each cut helps separate the platysma from the underlying cervical fascia and facilitates dissection. The myotomy is continued laterally according to the preoperative plan. If a full-width division of the platysma is planned, the lateralmost portion of the transection is completed through postauricular incisions by identifying the lateral muscle border, incising it, and extending the incision to bring it into continuity with that made through the submental incision.

Final Contouring of Cervicofacial Fat

Once SMAS suspension, platysmaplasty, platysma myotomy, and other modifications of deep-layer tissues have been completed, final contouring of superficial cervicofacial fat can be performed. This should be done under direct vision using Metzenbaum scissors or a fine suction cannula. Final fat sculpting should be continued until all contours are smooth and regular, but *it is essential that not all fat be removed to produce an attractive, natural appearance*. Particular attention should be paid to the jawline and jowl areas. In addition, if the patient has a double chin or witch's chin, extended dissection of the perimental area and chin pad should be done, with fat contributing to these problems excised. Mental and submental fat should then be sculpted and blended to ensure a smooth transition from the mentum to the submental area.

Drain Placement

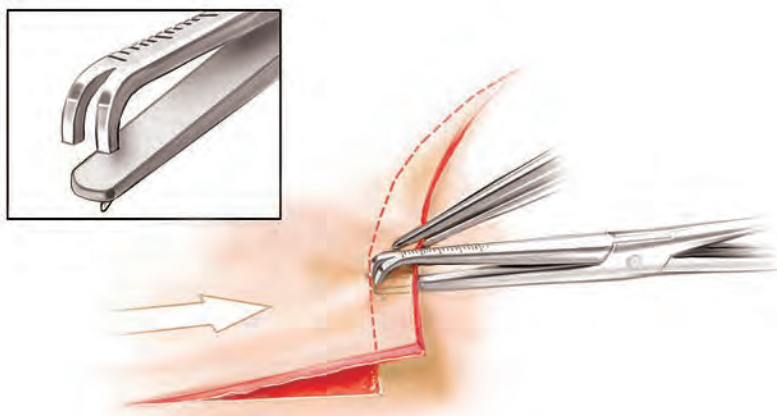
Drains are used routinely; experience has shown that they reduce postoperative ecchymosis and seromas and allow patients an earlier return to work and social activities. However, drains will not substitute for poor hemostasis and will not prevent hematoma formation. Drain placement should be performed before skin flap suspension and incision closure. A 10 Fr round, end-perforated Jackson-Pratt style closed-circuit suction drain is typically used in the neck. The drain is placed through a small stab incision on the occipital scalp 1 to 2 cm superior to the apex of the occipito-mastoid incision and anchored at its exit site with 4-0 nylon or a similar suture. The perforated portion of the drain is then passed beneath the cervical skin across the anterior neck to the opposite side of the face. When extensive modifications have been made to the anterior cervical and submental regions, or when diffuse oozing is encountered, one drain is placed on each side. This provides overlapping drainage of the anterior cervical area. Two drains are generally placed in most male patients as well. As mentioned earlier, if submandibular gland resection is performed, a separate drain is placed in the subplatysmal space.

Skin Flap Repositioning and Suspension Suture Placement

Skin flap repositioning and suspension suture placement should be performed with the patient's head in a neutral position, since flexion and extension of the neck will influence the amount of skin excised in the postauricular region. *To avoid an unnatural appearance, skin flaps must be shifted in a slightly more posterior, less superior direction than with the SMAS. It must also be remembered the goal of skin excision is to remove redundancy, not to tighten the skin flap.* Shifting skin along an overly superior vector or suspending skin flaps under tension will result in hairline displacement, poor scars, and other secondary deformities and objectionable problems.

Cheek skin flaps should be shifted along a vector roughly perpendicular to the nasolabial fold. When this is done sideburn elevation and displacement will be minimized, and skin will lie more naturally over the tragal region once healing is complete. An improved effect will also be obtained on the nasolabial area. In the neck area, skin should be shifted along a vector parallel to the mandibular border. This provides optimal improvement in the anterior neck and allows maximum excision of skin flap redundancy without compromising the skin flap's covering function. If the postauricular skin flap is shifted along a more superiorly directed vector, improvement in the anterior neck will be compromised, skin will be erroneously excised over the apex of the occipitomastoid incision, and a wide scar will be present once healing is complete.

There are two points of skin flap suspension that set the stage for the remainder of the closure. The first point is located in the supraauricular area, where the anterior-superiormost part of the ear joins the scalp. The cheek skin flap it is shifted along a vector roughly perpendicular to the nasolabial fold and skin redundancy is then gauged with a face-lift marker or similar implement. The skin flap should be held under just greater than normal skin tension for marking, and a small T-shaped incision is made into the flap at the marked point. Making the incision in a T shape facilitates suture placement and simplifies subsequent trimming of the flap. The flap is then anchored at this point with a half-buried vertical mattress suture of 4-0 nylon with the knot tied on the scalp side. No deep sutures are necessary.



The face-lift marker. The use of a flap marker provides a reliable means for appropriate excision of skin. The pin on the lower jaw of the marker is designed to be placed near the edge of the incision. The skin flap is then pulled over the lower jaw of the instrument, and when proper tension is set, the instrument is closed. Then the upper jaw of the instrument marks the precise position of the edge of the scalp flap beneath it. This serves as a valuable guide to the degree of redundancy present and is particularly useful in gauging the depth of "pilot" incisions initially made into the flap at points of initial flap suspension. The marker is shown in use. *Inset*, Close-up view of the tip design.

The second point of suspension is located in the postauricular area at the anterior-superior aspect of the occipitomastoid incision. The postauricular flap is shifted posteriorly and somewhat superiorly, roughly parallel to transverse neck creases and the mandibular border so that skin is suspended under minimal or no tension and that *little or no skin need be trimmed from the anterior (postauricular) flap border*. Excessive trimming of skin from the anterior border of the postauricular skin flap will require the flap to be shifted along an incorrect vector, and will compromise the result. The flap is then secured with a simple interrupted 4-0 nylon suture. No incision into the flap is necessary, and no deep suture is used.

Once the two key suspension sutures have been placed, the flap overlying the inferior portion of the ear should be carefully divided and the lobule exteriorized. *This is a key step in the procedure that must be performed incrementally and with great care to avoid a visible scar, lobular malposition, and objectionable secondary deformities*. If the incision to exteriorize the lobule is properly made, the apex of the incision should rest snugly against the inferiormost portion of the conchal cartilage. If the incision into the cheek flap is made too far anteriorly or inferiorly, however, artistically appropriate resetting of the lobule will not be possible, and the outcome of the overall procedure will be significantly compromised.

Skin Flap Trimming and Closure

Trimming of the skin flap and incision closure are conveniently begun in the postauricular area after initial suspension sutures have been placed and the lobule exteriorized. Postauricular closure along the auriculomastoid sulcus should be completed before trimming and closure of the occipital portion of the incision and resetting of the lobule. It is begun by conservatively trimming the anterior border of the postauricular skin flap into a soft curve to match the curve of the incision in the auriculomastoid sulcus. The incision is then closed with several interrupted 4-0 nylon sutures. No deep suture is used, and a watertight closure is not needed.

A small amount of skin only should be trimmed from the anterior margin of the postauricular flap along the auriculomastoid sulcus. If it appears that a large amount of skin needs to be excised from this area, the postauricular flap has been shifted incorrectly, both too far anteriorly and superiorly. If this occurs, the previously placed suspension sutures should be removed and the flap readvanced along a more appropriate and more posteriorly directed vector.

It is also an error to excise any skin over (superior to) the apex of the occipitomastoid incision and to shorten the postauricular flap along the long axis of the sternocleidomastoid muscle, as is commonly done. Despite an apparent redundancy in this area when the patient is supine on the operating table, there is never any true skin excess at this location. This pseudoexcess of skin is present only because of the patient's high shoulder position in the supine position; it will vanish when she or he sits up and the shoulders drop to a normal position. Skin along the axis of the sternocleidomastoid muscle is also needed for side-to-side head tilt. Inappropriate excision of skin over the apex of the occipitomastoid defect is the ultimate underlying cause of hypertrophic healing in the postauricular region and a wide postauricular scar (see p. 1596, *top*).

Trimming and closure of the occipital portion of the incision should be performed after closure of the postauricular area. If the occipital incision was made into the occipital scalp (see p. 1543), it should be closed without the excision of skin or scalp in one layer with multiple simple interrupted 4-0 nylon sutures. This incision plan is used to provide access to the lateral neck only and cannot by design accommodate skin excision in this area without producing displacement and notching of the occipital hairline. Because this incision is usually beveled when properly done, staples will not usually provide precise wound edge approximation. Sutures are generally required to avoid malalignment and step-offs.

If the occipital incision has been made along the occipital hairline (see p. 1545), skin only will be excised along the posterior border of the postauricular skin flap. A face-lift marker should be used to gauge skin flap redundancy, and all points along the flap should be intentionally trimmed with two to three millimeters of redundancy. It must be remembered that the goal of skin excision is to remove redundancy, not to tighten the cervical skin flap. *If trimming is performed correctly, the wound edges should abut one another and no gaps should be present before sutures are placed.* The incision is then closed in one layer with multiple half-buried vertical mattress sutures of 4-0 nylon with the knots tied on the scalp side and simple interrupted sutures of 6-0 nylon (see p. 1596, *bottom*).

No deep sutures are required, and staples should not be used. This will provide precise wound edge alignment and prevent crosshatched scars (suture marks). In addition, if the incision is closed under no tension, as described, the scar will be an inconspicuous scar.

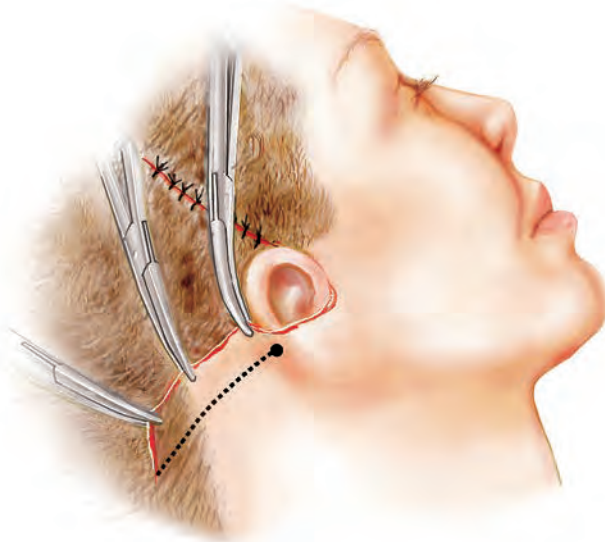
If the postauricular skin flap has been shifted along a proper vector and tissue distributed appropriately under no tension over the occipital area, a precise fit should be obtained. If neck skin redundancy is large, or if the postauricular flap has been suspended under tension, a dog-ear will often be present at the inferiormost portion of the occipital incision. This should not be chased down the occipital hairline, because an obvious scar will result in the fine hair at the nape of the neck. A better result is obtained if the dog-ear is inset *posteriorly* into the occipital scalp, above the junction of thick and fine hair, and secured with simple interrupted sutures of 4-0 nylon. This requires that a small ellipse of scalp be excised from the *scalp side of the incision* but moves the end of the incision into dense hair where it is well concealed.

Skin flap redundancy should be carefully gauged using a face-lift marker while the pretragal portion of the skin flap is held down into the pretragal hollow with an instrument by the assistant. This ensures that enough skin will be present to fill the pretragal sulcus and to provide natural and attractive preauricular contours once healing is complete. This is also a key step in avoiding a “retracted tragus” deformity.

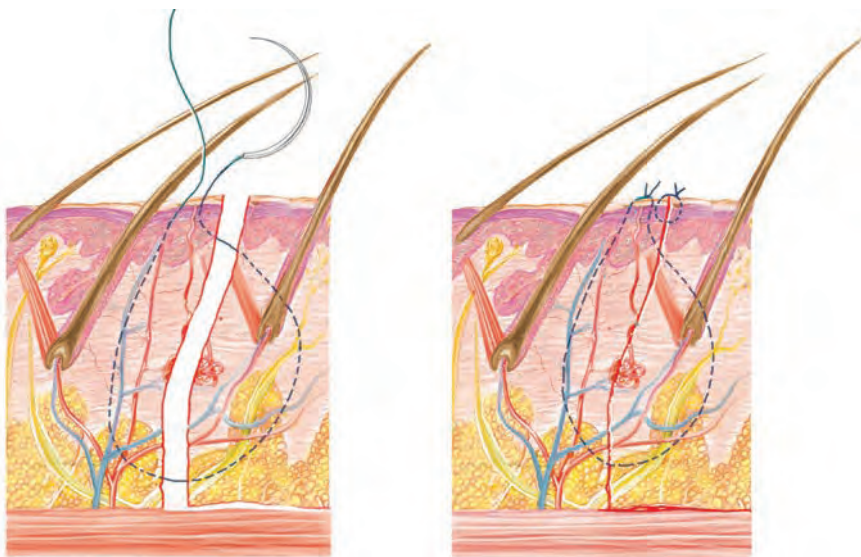
Preauricular closure is performed next. Using marks made by the face-lift marker as points of reference, the prehelical portion of the cheek skin flap is trimmed to form a soft curve that matches the prehelical incision. *If trimming is performed correctly, wound edges that abut one another and no gaps should be present before sutures are placed.* The incision is then closed in one layer with multiple simple interrupted sutures of 6-0 nylon or a simple running suture of 6-0 Prolene. No deep sutures are necessary.

The prelobular (subtragal) portion of the cheek skin flap is trimmed next, guided by marks made previously with the face-lift marker. If trimming is performed correctly, wound edges will abut one another, and no gaps should be present before sutures are placed. The incision is then closed in one layer with several simple interrupted sutures of 6-0 nylon. No deep sutures are necessary.

Once the prehelical and prelobular areas have been closed, the tragal flap is trimmed. This must be performed with great care while the assistant holds the pretragal portion of the skin flap into the pretragal hollow. As elsewhere in the periauricular closure, the tragal flap should be trimmed with 2 to 3 mm of redundancy. Closure is then made with simple interrupted 6-0 nylon sutures or a simple running suture of 6-0 Prolene. The tragal flap usually does not need to be thinned or defatted except along its posterior margin, and no deep sutures are necessary. Trimming the tragal skin flap too short is a serious artistic error that will result in tragal retraction and an unnatural chopped-off tragal appearance.



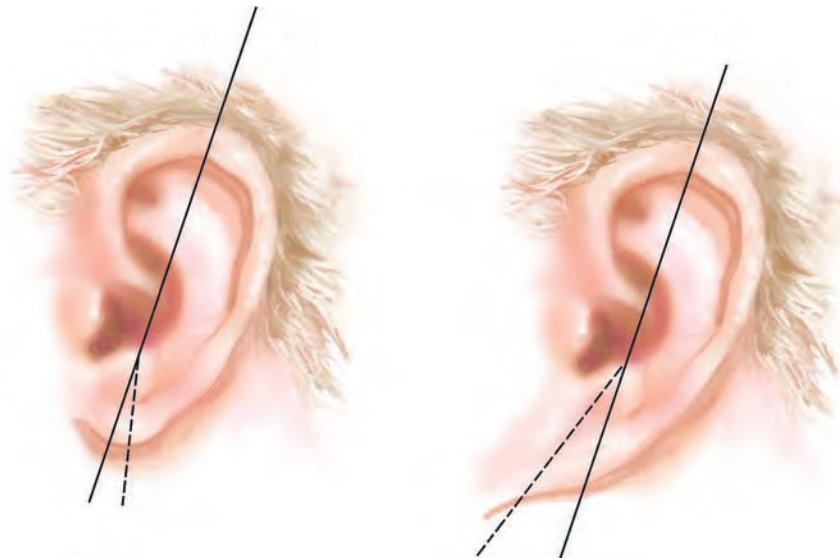
Incorrect trimming of the postauricular skin flap. It is an error to excise any skin over (superior to) the apex of the occipitotomastoid incision and shorten the postauricular flap along the long axis of the sternocleidomastoid muscle. There is no true excess of skin along this vector, nor any aesthetic benefit from shifting skin in this direction. Excision of skin in this fashion is the underlying cause of hypertrophic healing in the postauricular area and of a wide postauricular scar.



Suturing incisions along hairlines. *Left,* Wound edges are approximated with interrupted half-buried vertical mattress sutures of 4-0 nylon with the knots tied on the scalp side. *Right,* Final approximation with simple interrupted 6-0 nylon sutures.

Insetting the Lobule

There is nothing as telltale and aesthetically objectionable as an abnormal position of the earlobe. For this reason, *the lobule should be inset into the cheek flap as the last step in the closure of the periauricular area*. Trimming the cheek flap to inset the lobule must be performed with great care and should always be performed incrementally in stages to prevent overexcision. The cheek flap should be trimmed and the earlobe inset in such a manner that the lobule ends up situated in a natural and aesthetic appearing posterior and somewhat superior position, even if it was in a more anterior or inferior position before surgery. This is because the long axis of the earlobe of an artistically ideal, nonsurgical-appearing ear sits approximately 15 degrees posterior to the long axis of the ear itself in the lateral view. As this angle is reduced or shifted anteriorly, or if the lobule is mistakenly placed too far inferiorly, an elderly, unnatural, face-lift look is produced.



Proper insetting of the earlobe. In an artistically ideal, nonsurgical-appearing ear (*left*), the long axis of the earlobe (*dashed line*) sits approximately 15 degrees posterior to the long axis of the ear itself (*solid line*) in the lateral view. As this angle is reduced, or the axis of the lobule shifted anterior to the long axis of the ear, an elderly, unnatural, face-lift look is produced (*right*).

Insetting the lobule into the cheek so that its long axis sits posterior to the long axis of the rest of the ear often requires that the lobule be released from tethering tissue. It is then secured in two layers. The first layer consists of several deep dermal sutures of 4-0 Monocryl. These sutures provide initial alignment and protect the incision from disruption in the first few weeks after surgery when the patient pulls clothing, jewelry, and other items off over the head. Final approximation is then made with a simple running suture of 6-0 Prolene. A running polypropylene suture is usually eas-

ier to remove than a running or interrupted suture of 6-0 nylon, although either method of suturing will suffice.

If the lobule has been inset correctly, there will often be redundant skin on the posterior surface of the ear at the lobular-conchal junction. This is easily and conveniently managed by excising a triangle of skin corresponding to the tissue redundancy in this area. Closure is done in one layer with several simple interrupted sutures of 4-0 nylon or another suture of choice.

If foreheadplasty is to be performed as part of the procedure, closure of the temporal portion of the face-lift incision is delayed until after it is complete. This preserves access to the upper lateral face and affords precise realignment of tissue in this area.

If the temporal portion of the face-lift incision has been made on temporal scalp (see p. 1537), the incision is closed in one layer *without excision of any hair-bearing temporal tissue* with multiple simple interrupted sutures of 4-0 nylon. A small amount of cheek skin and scalp only will be excised immediately above the ear at the completion of the closure. Because a properly made incision on the temporal scalp is usually beveled, sutures, not staples, are generally required to avoid malalignment and step-offs. *It is clinically unproductive, a conceptual error, and a serious technical mistake to excise scalp over the temple region in attempt to improve the forehead or upper lateral face.*

If the temporal portion of the face-lift incision has been made along the temporal hairline (see p. 1538), skin only will be trimmed when it is closed. A face-lift marker should be used to gauge temporal skin excess and the flap intentionally trimmed with 2 to 3 mm of redundancy. *If trimming is performed correctly, wound edges should abut one another and no gaps should be present before sutures are placed.* The incision is then closed in one layer with a combination of half-buried vertical mattress sutures of 4-0 nylon, with the knots on the scalp side, and simple interrupted 6-0 nylon sutures (see p. 1596). Staples should not be used. This scheme will provide precise wound edge alignment and will prevent crosshatched scars (suture marks).

Once all other incisions have been sutured and all concomitantly performed procedures have been completed, the submental incision is closed. Closure of the submental incision is usually delayed in this manner so that a final check for hemostasis can be made. If closure is done earlier in the sequence of the procedure, subsequent oozing in the neck can require that the incision be reopened to control it. The incision is closed in two layers to ensure precise approximation of subcutaneous fat and skin. If a more casual closure is done, irregularities may result that will draw attention to the scar. The first layer of closure is accomplished using several deep dermal sutures of 4-0 Monocryl. Final approximation is made with a simple running suture of 6-0 Prolene.

Instrument Tray for a Face Lift

	Number	Instrumentation
Scalpels	2	Scalpel handle (round) (Padgett P-650)
Skin Hooks	2	Double-pronged skin hook (10 mm) (P-5379)
Needle Holders	4	Needle holder long (7") (narrow carbide jaw, gold handled) (V. Mueller CH2492)
	4	Needle holder medium (carbide jaw, gold handled) (Padgett P-2410)
	3	Needle holder large (carbide jaw, gold handled) (Jarit 121-135)
	4	Needle holder, Webster (smooth jaws) (Storz N5712)
Scissors	1	Tenotomy scissors (V. Mueller OP 5675) (forehead)
	1	Kaye scissors (carbide jaw-gold handled) (P29065)
	1	Metzenbaum scissors (med) (Padgett P-6468)
	1	Suture scissors (small "baby Metz")
	1	Utility scissors (large straight Mayo) (Pilling LL3)
Forceps	1	Adson (carbide with fine w teeth) (P 2511)
	1	Adson (carbide with medium w teeth)
	1	DeBakey (8" fine-toothed jaws) (Codman 37-1011)
	1	Coagulating forceps (black insulation) (SP 0531)
	5	Allis forceps (Storz N-5600)
	12	Mosquito hemostat (Storz)
	2	Curved Kelly hemostat (for peanut sponges)
	4	Straight Kelly hemostat
	2	Snitz forceps (long)
	1	Right-angle forceps (long)
Retractors	1	Malleable (small) (Padgett 4206)
	1	Malleable (large) (Padgett P-4341)
	1	Army (Codman 50-4071)
	1	Freeman (Padgett P-491)
	1	Freeman rake (four pronged) (Padgett P-509)
	1	"Wound protector" (modified Des Marres retractor)
	1	Ragnell retractor (double ended)
Miscellaneous	4	Towel clip (small)
	4	Towel clip (large)
	1	Obwegeser periosteal elevator (Padgett 7710)
	1	Metal ruler
	1	Metal comb
	1	Marten flap marker
	1	Yankauer suction (metal) (N7550)
	1	Frazer suction and stylet (2 pieces)
	2	Hair clip
	1	Ring/sponge forceps
	2	Zimmer blue plastic clip
	1	Headlight joystick
	1	Instrument retainer
	1	Needle tip cautery
	1	Cautery, long tip
	1	Cautery, short tip

Completion of Concurrently Planned Procedures

When the face, neck, and forehead lifts are completed, attention is turned to upper blepharoplasty, lower blepharoplasty, perioral dermabrasion, and other planned procedures, as indicated.

Dressings

After all planned procedures have been completed and all incisions closed, the patient's hair is shampooed and rinsed with warm tap water that has been allowed to stand for a few minutes with a few drops of povidone-iodine added. The sutured incisions are given a final inspection. If poor alignment is found in any area, it is locally reprepared and sutures are removed and replaced, as required.

Once the patient's hair has been shampooed and rinsed, conditioner is applied and the hair is carefully detangled with a wide-toothed comb. Failure to adequately wash, condition, and detangle the patient's hair after completion of the procedure can result in matting and tangling that can be problematic in the postoperative period.

No dressings are required or applied. Dressings traditionally applied over the face and neck after face-lift surgery create a tourniquet effect and accentuate swelling in the face, regardless of how carefully they are applied. These dressings were needed for two reasons. First, traditional face-lifts were usually closed over large Penrose-type drains that were typically left protruding from a loosely closed postauricular incision. A large, bulky, helmet type of dressing of mineral oil-soaked cotton secured with a shell of rolled gauze was required to catch blood and serous fluid and prevent it from soiling the patient's clothing, belongings, and carpets. Second, a pressure dressing was needed to hold undermined facial flaps against the underlying face and to close down subcutaneous dead space. The use of closed suction drains has simplified the management of these problems and eliminated the need for a dressing.

Every surgeon seeking the best result and the fewest complications should give careful consideration to the need for a traditional face-lift dressing and its possible drawbacks. Although those who use a face-lift dressing claim it prevents seromas and hematomas and provides increased patient comfort, experience, simple logic, and common sense all indicate otherwise. There are many compelling arguments against the use of a face-lift dressing—perhaps the most compelling of which is the very real danger of compromising circulation in delicate, widely undermined cervicofacial skin flaps. Dressings also limit the ability to directly observe the face and neck and may conceal an evolving or established problem. In addition, little about a face-lift dressing is comfortable. Most are tight and confining; they obstruct hearing, complicate facial hygiene, and needlessly attract unwanted attention. In my experience, patients, when given the choice, almost always prefer to do without them. If the sur-

geon chooses to use a dressing, there should be a good reason for doing so, and it should be confirmed that it does the patient no harm.

Patients are typically discharged with a hat, scarf, and sunglasses. If dermabrasion or lip augmentation has been performed, a rigid disposable surgical mask that rests off of the perioral area is also usually applied.

Postoperative Care

Performing the procedure itself fulfills only part of our obligation to the patient, and the care they receive postoperatively is arguably as important as the surgery itself. Diligent postoperative care will also ensure the best result and limit the likelihood that problems and complications will occur.

All patients are discharged to an aftercare specialist with specific written instructions as to how they are to care for the patient. I am always available to answer questions and see any patient, if needed. Patients are asked to rest quietly and apply iced compresses to their eyes for 15 to 20 minutes of every hour they are awake for the first 3 days after surgery, even if they have not had eyelid surgery as part of the procedure. For most patients, edema peaks at about this time. It is not necessary or productive to apply ice compresses continually throughout the day or at night. It has not proved necessary, and it is generally not well tolerated by the patient, to apply iced compresses to the cheeks, neck, or forehead. If the patient has had lip augmentation, ice compresses are applied to the perioral area in a similar manner and on a similar schedule. Recently we have found that a commercially available water-cooled face mask simplifies and improves the experience for many patients. Unlike traditional wet compresses, these masks apply continuous dry cooling that is well tolerated even when sleeping.

All patients are provided oral analgesics, sleep medications, antiemetic suppositories, bland ophthalmic ointment, and preservative-free artificial tears solution with specific instructions for their use. Patients are required to use ophthalmic ointment each night for the first 3 weeks after surgery or until all signs of eye irritation have abated. Artificial tears are used throughout the day, as needed. Patients are also informed that eyedrops are not sufficient for night use.

All patients are instructed to sleep flat on their backs without a pillow. A small cylindrical neck roll is permitted if the patient requests it and/or requires it. This posture ensures an open cervicomentral angle and averts dangerous folding of the neck skin flap and obstruction of regional lymphatic vessels that inevitably occurs if the patient is allowed to elevate the head on pillows, as is commonly recommended. In ad-

dition, swelling will drain to the back of the head instead of the neck in this position, where it is not harmful and is less noticeable and more rapidly transmitted away from the head and neck area when the patient sits upright.

All patients are shown an elbows-on-knees position that ensures an open cervicomental angle while sitting. This posture places the patient's book, magazine, paperwork, notebook computer, or meal in a position that allows reading, writing, eating, and TV watching in comfort and safety, with the patient's chin up and the neck extended. Other sitting postures typically result in unavoidable neck flexion and related problems.

All patients should be examined the morning after surgery, if possible. This visit, although sometimes inconvenient, is important to identify incipient problems in an early, treatable stage. All sutures should be checked and any appearing too tight should be cut but left in place. Releasing potentially overtight sutures prevents necrosis and alopecia. Leaving the cut suture in place, rather than removing it, averts the annoying bleeding from the suture site that inevitably occurs if the suture is completely removed at that time. All flaps should be carefully inspected. *Whenever incipient compromise is noted, one must be suspicious that a tight closure has resulted in excessive tension over that area.* If compromise is suspected, the offending sutures should be removed, even if wound separation may result. Secondary healing of the incision is always superior and easier to revise than is a large area of more anteriorly situated full-thickness skin slough.

Patients are allowed to take a soft diet as tolerated after surgery but are encouraged to avoid salty, sour, dry, and difficult to chew foods. Patients are asked to abstain from drinking alcoholic beverages for 2 weeks after surgery and until they are no longer taking pain pills (acetaminophen included) or sleep medications.

Patients begin a daily routine of showering and shampooing no later than 3 days after their procedures. This helps remove crusting about the suture lines, keeps incisions clean and bacteria counts down, and usually improves the patient's general overall sense of well-being. It also facilitates suture removal. Patients are instructed that they need not be as thorough as usual when washing their hair after their procedure and that they need not attempt to remove all dried blood and crusts. They are also assured that shower water, shampoo, and conditioners are not harmful and will not cause infection. Showering and shampooing are permitted even when drains are still in place.

Forehead drains are generally removed the morning after surgery by the aftercare nurse or when the physician checks the patient. At least one drain is usually left in the neck until the first suture removal visit however. This is because drain output often quickly falls on the second or third day during the time the patient is mostly supine and resting but then picks up again when the patient begins to spend more

time upright and starts to move her or his head about more. Leaving the neck drain in for 4 to 5 days will reduce the likelihood that small collections will form and will speed the overall resolution of edema and ecchymosis in the neck area.

Sutures are removed in two visits over 7 days. Fine sutures are removed on the first visit 4 to 5 days after surgery. Half-buried vertical mattress sutures and scalp sutures are removed on the second visit 7 days after surgery. It is usually not productive to try to remove sutures hidden under dried blood or crusts along suture lines; these are usually removed at a third visit approximately 2 weeks after surgery, at which time crusts are gone and sutures are readily identified.

Patients should be warned that their scalp and parts of their face may be partially numb after surgery and that they must be careful when bathing that shower water is not too hot and that hairdryers are not used on high heat settings. Patients are also instructed not to get a permanent or tint, dye, highlight, color, or otherwise chemically treat their hair for 2 weeks after surgery, because these treatments can result in hair breakage or hair loss. Hot rollers and curling irons must be used with care for several months, because the patient can unknowingly burn her forehead and scalp.

Determining when patients can return to work and their social lives depends on their tolerance for surgery, their capacity for healing, the type of work they do, the activities they enjoy, and how they feel overall about their appearance. Patients are asked to set aside 2 to 3 weeks to recover from surgery. Additional time off is recommended before an important business presentation, family gathering, vacation, or other important event. If the patient is doing well and not experiencing problems, she or he is allowed to return to light office work and casual social activity 9 to 10 days after surgery. It is often wise to begin with a limited workday at first and to adjust their schedules thereafter. If a patient's job entails more strenuous activity or physical labor, a longer period of convalescence may be required. Patients are advised not to drive for the first 10 days after surgery until they are feeling well, their vision is clear, and they have stopped taking pain medications.

Patients are advised to avoid all strenuous activity during the first few weeks after surgery, including heavy lifting, stooping, straining, and bending forward, and are informed that aerobic activities and exercise can result in internal bleeding and hematoma formation. Two weeks after surgery, patients are allowed to begin light exercise and gradually work up to their presurgical level of activity; 4 to 6 weeks after surgery, they are allowed to engage in more vigorous activities, including most sports, as tolerated.

Patients are informed that it may take 2 to 3 months for them to look good in a photograph or to be seen at an important function. They are also advised to expect some numbness and firmness in the face and submental areas for 6 to 9 months or more.

Results

Face Lift: Obtaining a Soft, Natural Appearance

Whenever prospective patients and the lay public discuss face-lift surgery, they will inevitably express the most concern and dismay over the tight faces of various celebrities and their friends and acquaintances that have undergone the procedure. Many will unhesitatingly demonstrate what they see to be the problem by pulling forcefully on their cheeks, eyes, and eyebrows, asking either not to look that way after their surgery, or stating they will never undergo surgery for fear of ending up with a similar appearance. This is reinforced by the numerous jokes and references in the popular press to “masks,” “wind tunnels,” and “faces so tight they will crack” if the individual smiles. Despite these expressed concerns and the frequent popular ridicule of the typical outcome of skin-only face lifts, procedures based predominantly on skin tightening continue to be performed.

The fundamental problem with the traditional skin-only face lift performed by many surgeons is that skin is meant to serve as a covering function, not a structural, supporting one. Most of the changes seen in the aging face are the result of an attenuation of support and subsequent descent of deep layer facial tissues however, and not sagging of skin. Any attempt to lift significant sagging of deep facial tissue with skin will be short lived and destined to produce an overly tight appearance and other telltale and objectionable problems.

The following patient example shows that when modern two-layer SMAS face-lift techniques are used and tension is diverted to deeper layers of the face, a soft, natural appearance with few telltale signs that surgery has been performed can be obtained.



This 42-year-old woman had a suboptimal eyebrow position and configuration, cheek and jawline laxity, and hollowness in the cheeks and under-eye area. Even when smiling, she had a somewhat sad and melancholic appearance. She had had no prior plastic surgery. The same patient is shown 13 months after a face lift, neck lift, a limited-incision forehead lift, conservative upper and lower blepharoplasties, correction of ptosis, fat injections, and an upper lip lift. A small nevus on her neck was also removed. No skin resurfacing, facial implants, or other ancillary procedures were performed. She now has soft, natural facial contours, with no tight, pulled, or face-lifted appearance. Her improved eyebrow position gives her a more youthful, feminine, alert appearance. The cheeks and jawline have been lifted and redundant skin removed. Hollowness in the upper cheek and under-eye area has been filled by lifting sagging cheek tissue to a youthful position and by fat injections. She also had her teeth whitened and straightened after the surgery was performed.



After surgery, improved eyebrow position and restoration of cheek fullness are evident, as well as an improved transition from the lower lid to the cheek, elevation of the corners of the mouth, a smooth jawline, and improved neck contour. The lip lift has shortened the distance from the bottom of her nose to the upper lip border and improved the appearance of her mouth. The patient's face has a lighter, fresher, more alluring appearance.



In the preoperative lateral view, eyebrow ptosis, lower lid fullness, a tear trough, sagging cheek and jowl, a “drool line,” and neck laxity can be seen. The patient appeared tired and unfit, even though she was trim and in excellent overall health. Postoperatively, her results are as described above. No scars are visible, there is no distortion of the ear, and the earlobe is in normal position. In the down-tilted view, her neck laxity and poor neckline could be seen preoperatively, presenting an elderly, unfit appearance. Postoperatively, she now appears young, fit, and attractive.

Face Lift for Ethnic Patients

Hispanic patients, like Asian and black patients, often have elastic skin that stands up comparatively well to the sun and as a result, typically ages well. Because these patients often develop skin wrinkles comparatively late in life, they are thought by many surgeons performing traditional skin-only face lifts to benefit minimally from such procedures. In addition, people of ethnic ancestry with darker complexions are also thought to form poor scars and are typically deemed to be poor candidates for surgery on this basis.

A careful examination of the next patient's face before surgery shows that although minimal skin wrinkling and redundancy are present, there has been a loss of youthful facial contour. This loss of shape and contour results from sagging tissues under the skin; the improvement shown in the postoperative photo demonstrates the effectiveness of repositioning it by tightening the underlying SMAS layer. It is also evident that when tension is diverted away from the skin to deeper structural layers of the face, healing will be excellent and scarring minimal. This patient demonstrates the importance of addressing deep-layer aging, the effectiveness of the SMAS procedure, and that patients with good skin and minimal wrinkling can still benefit significantly from a properly performed procedure. In addition, if tension is diverted off the skin and transferred to deeper layers, healing of incisions will generally be excellent and inconspicuous scars will result.



This 55-year-old Hispanic woman had sagging cheeks, heavy jowls, lower eyelid fullness, deep nasolabial lines, and thin lips. The patient has a somewhat stern and disapproving appearance. She has had no prior plastic surgery. The same patient is shown 18 months after a face lift, neck lift, limited-incision forehead lift, upper and lower blepharoplasties, chin augmentation, and fat transfer to the lips and cheeks. No skin resurfacing or other ancillary procedures were performed. Postoperatively, smooth facial contours and a more youthful facial shape are evident, with an absence of a pulled or a face-lifted appearance. There is a smooth transition between the lower eyelid and cheek, and her lips and cheeks are fuller as a result of the fat injections.

In the preoperative scowling view, it can be seen that the patient had strong corrugator muscles that produced deep creases and an intense, angry appearance. The patient is seen after surgery trying to frown; she is no longer able to do so because of muscle modification performed as part of the forehead lift procedure.



In the oblique view her sagging cheeks and jowl and the hollow undereye areas are evident. Postoperatively cheek fullness has been restored, the transition from the lower eyelid to cheek is improved, the corners of her mouth have been elevated, and she has a smooth jawline and an improved neck contour. The lateral and down-tilted views show that her lower eye bag, tear trough, sagging cheek and jowl, thin lips, drool line, poor neckline, and weak chin have been restored to a more attractive and youthful appearance. The chin implant has produced a natural-looking profile that is in better balance with the rest of her face. No scars are visible, there is no distortion of the ear, and the earlobe is in normal position.

Face Lifts: Then and Now

Although skin tightening has been a traditional part of face-lift surgery since the inception of such procedures, the assumption that it is logical and productive has come under question in recent years. The reasons for this are numerous and are becoming increasingly hard for less-experienced surgeons, and patients themselves, to ignore.

Contrary to past assumptions, facial aging is in reality predominantly a process of loss of contour, rather than one of loosening and wrinkling of the skin. The skin, in large part, merely descends with the sagging tissue beneath it and sags to a lesser degree on its own. Skin is intended to serve a covering function, not a structural or supporting one. It is inherently elastic and evolved to accommodate tissue shifting and displacement associated with facial movement and expression. As such, skin cannot reasonably be expected to provide sustained support for sagging deeper facial tissues.

It is now recognized by many surgeons performing procedures to rejuvenate the face that skin tightening flattens facial contour rather than restoring it. Pulling on the skin flattens the contours that make the face appear youthful and distinctive, much in the way that stretching a rubber sheet or nylon stocking over it would. Skin tightness looks unnatural; not even infants and children have tight skin. Instead, they have an appropriate amount of skin to cover their youthfully contoured faces.

If skin is used as a vehicle for repositioning sagging deeper facial tissue, secondary deformities including poor scars and earlobe malposition will occur. In addition, using skin to reposition sagging tissue requires it to shift unnaturally in an upward direction. This can result in hairline and sideburn elevation, objectionable shifting of neck wrinkles onto the face, and other unnatural appearances.

When the face is lifted using the deeper SMAS layer instead of skin, skin can be re-draped under normal tension and in a more natural direction. When treated in such a manner, skin appears to be capable of undergoing some degree of self-repair and contraction, and this adds further to the improvement obtained. This concept forms the basis of the lamellar (two-layer) and bidirectional (two-directional) maneuvers used in modern face-lift techniques.



This 65-year-old woman had a high forehead, asymmetrical eyebrows, cheek and jawline laxity, neck bands, deflated lips, and hollowness in the undereye area. Despite a bright smile, she had a somewhat tired and melancholic appearance. She had previously undergone upper and lower blepharoplasties by another surgeon. She is shown 13 months after a face lift, neck lift, forehead lift, upper and lower blepharoplasties, perioral dermabrasion, and fat transfer to the cheeks and lips. No skin resurfacing, facial implants, or other ancillary procedures were performed. Note her soft, natural, facial contours and the absence of a tight, pulled, face-lifted appearance. Eyebrow asymmetry has been improved. The cheeks and jawline have been lifted and redundant skin removed.



The patient had a large submandibular salivary gland, seen as fullness in the upper neck area. Postoperatively the salivary gland has been reduced in size to obtain optimal neck contour. In the down-tilted view her neck laxity and poor neckline gave her an elderly, unfit appearance. After surgery, her well-defined jawline and create a more attractive, fit appearance.

The Concealed-Incision Face Lift

Considerable focus has recently been placed on shortening face-lift incisions as less-experienced surgeons have begun performing procedures to rejuvenate the face. More often than not, these short scars end up being wide, irregular, poorly positioned, or otherwise visible, and the procedure is of questionable benefit to the patient. The real goal in incision planning is to design incisions that provide the surgeon adequate access to the deep layers of the face that are simultaneously *well concealed* and do not result in hairline displacement. In properly performed face lifts, patients should be free to wear their hair any way they wish afterward, and they should not need to wear large earrings and heavy makeup to conceal the fact that they have had surgery. It is evident that many surgeons are still struggling with concealing face-lift scars when one notices that the area in front of the ear is typically hidden by hair or large earrings or is cropped out of the picture in postoperative photos of face-lift patients shown in informational brochures, books, magazine articles, and websites.

The irony of misguided attempts to conceal face-lift incisions by shortening them is that a well-trained surgeon employing proper technique can obtain inconspicuous scars using a long-incision plan. The issue is not how long the scar is—it is whether the scar can be seen and will be noticed by others, and this is the philosophy that underlies the concealed-incision face-lift technique.

A fundamental principle of the concealed-incision face lift is that inconspicuous healing cannot occur if there is skin tension; that tension must be diverted to deeper structural layers of the face, such as the SMAS and platysma. This cannot be achieved if the incision plan is too short, even if barbed suspension sutures are placed. It is equally important that incisions be placed along natural anatomic interfaces where the eye expects to see a natural line or a transition of skin color and texture. Scars placed in these locations appear to be part of the patient's natural anatomy or mimic naturally reflected highlights.

Finally, the eye will not be looking for scars if the outcome of the face lift is soft and natural appearing and there are no other telltale signs that surgery has been performed. In many cases a patient's friends and coworkers have refused to believe the patient has had a face lift, even if she or he admits it, if the patient's face is not tight and a concealed-incision plan is used.

The following patient is a case in point. It is evident that a marked improvement in the patient's appearance has been obtained, but there are no telltale signs indicating that surgery was performed. Her face has a soft, natural appearance, scars are concealed, and no hairline displacement or other irregularities are present.



This 48-year-old woman had a heavy jowl, overall facial laxity, and deflation in her cheek and undereye areas. She had had no previous plastic surgery. The same patient is shown 2 years and 11 months after a face lift, neck lift, limited-incision forehead lift, upper and lower blepharoplasties, fat transfer, and a shave excision of an unwanted nevus on her right upper lip. No skin resurfacing, facial implants, or other ancillary procedures were performed. Note the soft, natural facial contours and the absence of a tight, pulled, or face-lifted appearance. The cheeks and jawline have been lifted and redundant skin removed. Deflation in the upper cheek and undereye areas has been corrected with fat transfer. An existing scar on the left anterior neck has been released and fat grafted.



After surgery the patient's neck and jawline have been lifted and redundant skin removed. Note also that no distortion of the ear is present and the earlobe is in normal position. The patient appears fit, decisive, and more attractive.

Concluding Thoughts

The traditional “low” cheek SMAS flap elevated below the zygomatic arch suffers the drawback that it cannot by design have an impact on tissues of the midface and infraorbital areas. Low designs target the lower cheek and jowl only and produce little if any improvement in the upper anterior cheek region. Planning the flap “higher,” along the zygomatic arch, and extending the dissection medially to mobilize midface tissue overcomes this problem and results in a simultaneous lift of the face and midface together. A separate midface lift procedure is not required, and more comprehensive and natural-appearing improvement is obtained.

Clinical Caveats

It is not possible to design a universal face-lift technique. Each patient will have a unique set of problems that require precise anatomic diagnosis and an appropriately planned and individualized surgical repair.

Attractive, natural-appearing rejuvenation of the face is not possible without diverting tension away from the skin to the SMAS and platysma and unless other deep-layer structures and the aging midface are addressed.

Skin was meant to serve a covering function, not a structural or supporting one. Using skin as the vehicle to support sagging deep-layer tissue corrupts its function and results in abnormal tension and related secondary problems, including poor scars, tragal retraction, earlobe malposition, and a tight, unnatural appearance.

Using the SMAS to lift sagging facial tissues and restore facial contour circumvents the problems associated with skin-only face lifts, because it is an inelastic structural layer capable of providing meaningful and sustained support. Although skin must be excised in SMAS procedures, only redundant tissue is sacrificed, and closure can be done under normal skin tension.

Careful evaluation of most patients who need a midface lift will show that they also need a face lift. It is rare to encounter a patient with significant midface aging who does not also have sagging in the cheek and jowl, and a midface lift is arguably more logically performed in conjunction with a formal face lift than as an isolated, stand-alone procedure.

A drawback of the conventional low cheek SMAS flap elevated below the zygomatic arch is that it does not by design have an effect on tissues of the midface, perioral, and infraorbital regions. Planning the flap higher, along the superior border of the zygomatic arch, overcomes this problem and produces an improved result.

Continued

Clinical Caveats—cont'd

Lamellar dissections in which the skin and SMAS are dissected as two separate layers offer the advantage that skin and SMAS can be advanced different amounts, along separate vectors, and suspended under differential tension. This allows each layer to be addressed individually as indicated and in turn results in a more comprehensive and natural-appearing improvement.

Rarely does isolated aging occur in the lower face and neck, and nearly all patients requesting face-lift surgery are also candidates for forehead and eyelid surgery. Patients do not always recognize this fact, however, and must be carefully counseled in this regard.

Proper analysis, careful planning, and the use of an incision along the hairline, when indicated, can avert hairline notching and displacement without compromising the overall outcome of the procedure. This is particularly true of patients with marked skin redundancy and those undergoing secondary procedures.

Anterior platysmaplasty helps consolidate the neck but is *not* adequate or effective for the treatment of platysma bands. Effective treatment of platysma bands requires that a platysma myotomy be performed.

It is not enough in most situations to limit treatment of the neck to preplatysmal lipectomy and postauricular skin excision. For many patients, subplatysmal fat accumulation, submandibular salivary gland ptosis, and digastric muscle hypertrophy will contribute significantly to their neck deformity and necessitate additional treatment.

Although subcutaneous undermining is usually necessary in most necks, it should not arbitrarily include the entire face. If a SMAS dissection is planned, preservation of the anterior platysma-cutaneous ligaments will allow attractive and youthful appearing elevation of perioral tissue that cannot be obtained with a skin-only technique, or when wide skin undermining is performed.

SMAS flaps should be advanced along a posterior-superior vector parallel to the long axis of the zygomaticus major muscle. If a vertical or posterior vector is used, the function of the zygomaticus major muscle will be corrupted and abnormal appearances during animation may result.

Inappropriate excision of skin over the apex of the occipitomastoid defect is the underlying cause of hypertrophic healing in the postauricular region and ultimately of a wide postauricular scar. Although an apparent excess of skin will be present in this area when the patient is supine on the operating table, this skin is necessary once the patient's shoulders drop in the upright position, and for side-to-side head tilt.

Rejuvenation of the face is a considerable undertaking, and its difficulty should not be underestimated. The procedure must be carefully planned, meticulously carried out, and the patient's safety and well-being unfailingly ensured.

Performing the procedure itself fulfills only part of our obligation to the patient, and the care they receive perioperatively is arguably as important as the surgery itself. Diligent perioperative care will ensure the best result and reduce the likelihood that problems and complications will occur.

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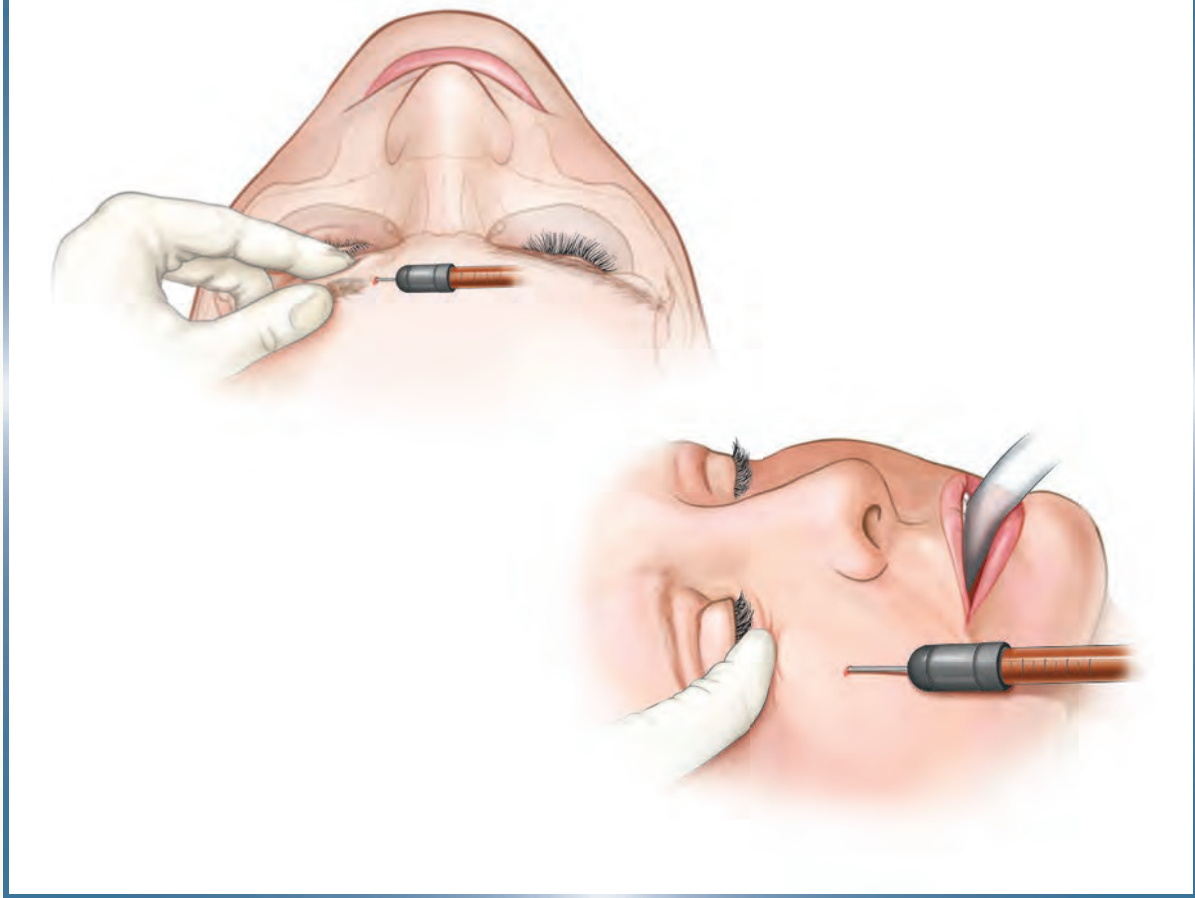
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CHAPTER 47



Combined Face Lift and Facial Fat Grafting

TIMOTHY J. MARTEN

Recognizing the components of the aging deformity of the face and appreciating the underlying anatomic abnormalities are essential to selecting the appropriate treatment and planning surgical procedures. Careful analysis will reveal that most patient problems fall into three broad categories:

1. Aging and breakdown of the skin surface
2. Facial sagging, skin redundancy, and loss of youthful facial contour
3. Hollowing, wasting, atrophy, and/or age-related lipodystrophy of the face

Selecting the appropriate treatment will depend on the types of problems present, the patient's priorities, and the time, trouble, and expense she or he is willing to expend to obtain the improvement desired.

Patients primarily concerned with *surface aging* of their faces may not require formal open surgery; they may be able to achieve the improvement they desire through salon care and dermatologic surface treatments of the skin. These treatments include skin peels, skin resurfacing, intense pulsed light (IPL), chemodenervation (*botulinum* injections), injection therapy (with tissue fillers such as Restylane, Juvéderm, and Radiesse), and various forms of cutaneous laser and other treatments designed to remove or reduce age spots, spider veins, wrinkles, and other age-related skin surface imperfections.

Patients primarily concerned with facial sagging, skin excess, and *loss of facial contour* will achieve marginal, if any, improvement if only surface treatments are employed. They will require formal surgical lifts in which sagging tissue is repositioned and redundant tissue excised if these problems are to be properly corrected and an attractive and natural-appearing improvement is to be obtained. The misapplication of surface treatments of the skin to a sagging face with excess tissue will produce little more than a smooth, saggy face with no improvement in contour. This sort of "smooth-saggy" look, typically seen in an older patient who has undergone laser resurfacing, is unnatural looking, because patients with a loss of facial contour generally have concomitant skin surface aging. It is arguably more attractive and natural appearing to have a well-contoured face with a few wrinkles and surface imperfections than a smooth but saggy one.

In patients with significant *facial atrophy*, age-related hollowing, and loss of facial fat, improvement from both surface treatments of facial skin and surgical lifts will generally be suboptimal. Smoothing the skin will not hide a drawn appearance caused by loss of facial volume, and it is difficult to create aesthetically pleasing, natural, and attractive contours by lifting and repositioning tissues that have abnormally thinned and involuted with age. Using fat injections to restore lost facial volume is a powerful technique that is now acknowledged by most plastic surgeons and other physicians who treat the aging face to be the most important advance in aesthetic surgery in several decades or more. Properly performed, the addition of fat to areas

of the face that have atrophied from age or disease can produce a significant and sustained improvement in appearance that is unobtainable by other means.

Why Perform a Face Lift and Fat Injections?

Why not perform just a face lift? The answer to these questions lies in the multifactorial origin of facial aging, and the fact that fat is predictably lost from the face, which develops hollows as a person ages, in addition to sagging, drooping, and other gravitational effects. An isolated face-lift procedure, even when aggressively and comprehensively performed, only addresses tissue ptosis and redundancy and often produces a lifted but telltale hollow and an underrejuvenated look, sometimes referred to as a “cougar” appearance. Fat injections, however, allow the loss of facial fat to be treated concurrent with the face lift, and these appearances to be avoided.



All things being otherwise equal, a concurrent face lift and fat injections will produce a better result than either technique performed alone, and when a face lift is performed in conjunction with fat injections, both loss of contour and facial atrophy can be corrected, and optimal improvement can be attained. This 75-year-old patient, seen preoperatively on the left, had tissue ptosis and redundancy, and significant facial atrophy. On the right, she is shown 1 year and 17 months after a high SMAS face lift, a neck lift, a closed forehead lift, upper and lower blepharoplasties, and panfacial fat injections. Combined lifting and filling of her face has produced a better outcome than either technique could have alone. The patient has had hyaluronic acid filler placed in her lips.

Volumetric Rejuvenation

Fat injections have other advantages for the face lift surgeon: they provide *volumetric rejuvenation*, a new means by which to improve facial appearance and a new dimension for plastic surgeons to work in. Unlike injectable fillers, fat is autologous and produces a sustained and long-lasting improvement. In addition, fat injections may actually induce an improvement in facial tissue *quality* through an as yet not clearly defined “stem cell effect,” and when performed with a face lift may constitute, for the first time, rejuvenation in the true sense of the word.

Nomenclature

The nomenclature for autologous fat transplantation can be confusing, since surgeons and others who inject fat into the face have used various terms to describe the procedure. In addition, in an effort to market the procedure, many proprietary marketing names and catch phrases have been created, and these can be especially confusing to patients. In essence, the commonly used terms *fat transfer*, *fat grafting*, *autologous fat grafting*, *autologous fat transplantation*, *fat injections*, *lipofilling*, and *lipoinjection* all refer to the same basic procedure. We typically use the terms *fat injections* or *fat transfer* in our discussions with patients, because these are straightforward descriptive terms that do not include medical jargon and are most easily understood and remembered.

Additional confusion has been created by the term *stem cell face lift*, a procedure in which fat is variously injected into the face with the purported but as yet unproven benefit of tissue rejuvenation mediated through a “stem cell effect.” In most cases fat only is injected, but in some cases limited traditional face lifts are performed concurrently. At present it is a stretch of the available scientific data to make such a claim, and it is medically more correct to refer to the two procedures simply as combined but separate and distinct surgeries.

Drawbacks of Fat Injections

Performing fat injections in conjunction with a face lift has certain disadvantages that must be acknowledged, including the learning curve associated with any new procedure, the increase in operating room time, increased postoperative edema, a longer period of recovery, and the uncertainty of graft take. Certain patient misconceptions must also be overcome, including misguided notions held by many that injected fat can migrate or fall, or that fat injections will make the face “look fat.”

Personal Evolution in Fat Grafting in the Face

I performed my first fat grafting procedures almost two decades ago; these were usually limited in scope, targeting specific areas such as the lips and nasolabial creases, as is the case for most beginning injectors. Over time, I began to address bigger problems that were otherwise difficult to treat, including overexcision of buccal fat by other surgeons, HIV-associated facial wasting, and the hollow upper orbit.



Buccal fat excision is often erroneously recommended as a way of creating a “high cheekbone” and a more angular facial appearance. In reality, it often produces an ill, haggard, gaunt appearance and an unfeminine look in women, especially when performed aggressively. This patient had buccal hollowing following buccal fat excision by an unknown surgeon. The patient is shown 11 months after fat injections to the buccal area. Fat was also placed in the infraorbital, midface, cheek, preoral, and jawline areas.

Still later, I expanded my use of fat injections to the treatment of thin-faced patients with significant atrophy but minimal sagging and redundancy who mistakenly believed a face lift alone would help them, and secondary and tertiary face-lift patients who had cervicofacial fat that had been erroneously removed by other surgeons during the primary procedures. For these secondary and tertiary face-lift patients, the fat injections quickly became more important than the face lift itself, and this remains true to this day.



This thin-faced man with marked facial atrophy but minimal tissue sagging and redundancy had had no prior surgery when he presented requesting a face lift. He is shown 16 months after fat injections to the infraorbital, midface, cheek, and jawline areas. No implants were placed, and a face lift was *not* performed. Improvement is evident in all areas, and the patient appears healthier, more fit, athletic, and masculine. A face lift alone could not have produced this kind of improvement and arguably might have accentuated his facial hollowness.



This woman had a previous face lift and related procedures performed by an unknown surgeon. She is shown 13 months after a combined secondary face lift and panfacial fat injections. She has also undergone foreheadplasty, eyelid surgery, ptosis correction, a neck lift, and perioral dermabrasion. Although the face lift allowed scars to be moved to more concealed locations and corrected her earlobe malposition, the replenishment of lost facial volume with fat injections was more important to the overall outcome of the procedure. Significant improvement of facial atrophy can be seen in the temples, upper and lower orbits, cheeks, midface, lips and perioral area, over the buccal recess, and along the jawline.

In time, however, I came to recognize that I was not obtaining full correction in many of my own primary face-lift patients, no matter how careful and technically proficient I was at lifting their ptotic tissue and removing excess skin. In most cases, regardless of how skillfully the procedures were performed, the patient still lacked the healthy, fit, and sensual appearance that younger faces with more facial fat had.

Other facts confirmed for me the concept that the volume addition to the aging face had artistic merit, including patients' and surgeons' preoccupation with the swollen face. I observed that patients overwhelmingly liked the appearance of their faces the first few weeks and months after traditional face-lift procedures, because the swelling present at that time gave them an almost surreally youthful appearance. Plastic surgeons also seem to like the swollen face for the very same reason, as is evident in the early face-lift results typically shown in advertisements, on the Internet, and even at scientific meetings and symposia. Although showing early results in these ways is deceptive and without scientific merit, it nevertheless affirms the importance of volume to an attractive and youthful appearance.

As groundbreaking as the idea of volume addition to the face was, at some point I came to realize that fat injections may offer something far more profound than just added volume, but I was slow to recognize this. My first realization that something above and beyond simple volume addition might result from fat injections was at an instructional course I was giving on face-lift surgery at a plastic surgery conference. After showing a large series of well-matched high-resolution before-and-after photographs of face-lift patients, a member of the audience raised his hand and inquired, "What type of laser and what energy settings are you using to resurface your patients?" I answered that other than limited perioral dermabrasion in some cases, none had had resurfacing of any kind. Confused by my response, he followed up by asking, "*Then why do they all look so smooth?*" Missing the significance of his question at that moment and the importance of his observation, my answer was simply that "they had had face lifts." I could not make any connection to the fat injections they had also received as part of their face-lift procedure. But he was seeing something in my patients that I had overlooked, or erroneously assumed to be solely the result of traditional surgery, that he was not seeing in his own face-lift patients. This difference is now known to very likely be the result of the much talked about but as yet not clearly scientifically defined "stem cell effect" obtained with fat injections. Simply put, fat contains "adult stem cells" that are thought to elaborate "growth factors" and other yet to be defined cellular "mediators" that appear to have a beneficial and regenerating effect on tissues adjacent to where the fat is injected, and it is likely that injecting fat into the face as part of a face-lift procedure has a rejuvenating and regenerative effect of this sort on the facial skin. Numerous anecdotal accounts and a growing number of scientific reports now support this idea, and fat

is currently being used to successfully treat atrophic scars, radiation necrosis, and other problem wounds that were previously deemed untreatable. It is my opinion, and that of other surgeons, that the combination of fat injections and dermabrasion is arguably the most effective treatment we currently have for perioral wrinkles, but this may be the result not only of restoring lost volume and the traditional improvement gained from dermabrasion, but also may reflect a direct regenerative stem cell effect. Only further research can conclusively answer the question as to whether fat injections can actually improve skin quality and facilitate healing through an adult adipocyte-mediated stem cell effect, but this is now a widely held belief by many clinicians.

Over time, I began to look beyond the lines and grooves on the face that had previously held my attention and that typically gain the notice of the traditionally trained eye, and I came to see the loss of facial fat as an undeniable and important *panfacial* occurrence requiring comprehensive replenishment. I have also since come to recognize the face as an incredibly nuanced sculptural form, and fat injections as an astonishingly powerful tool to improve the outcome of my face-lift procedures.

My initial attempts to discuss the importance of fat injections in rejuvenating the aging face with patients was met with confusion and skepticism by many of them. The initial reaction by most patients was that they were “already too fat,” and that fat injections would just make them “look fatter.” They could not see atrophy and loss of facial fat as part of the aging deformity of their face. As a result, my initial use of fat in my face-lift patients was to tell them that we would do their face lift first, move sagging tissues to a more youthful position, remove excess skin, then reevaluate them 6 months after the procedure and perform fat injections at that time, if indicated. In some instances patients would submit to a second-stage fat injection procedure, but for quite a while it was an uphill battle. Over time, however, the concept of adding volume to the face and the beneficial effects of doing so became known to prospective patients through the educational efforts of a handful of early adopters of the fat injection technique, through the resulting increased exposure of the procedure in the lay press, and through patients’ growing experience with nonautologous injected fillers. As patients came to understand the procedure and its benefits, they began to reject my suggestion that fat injections be performed as a second stage. Many patients began to arrive in my clinic knowing that fat injections were needed and did not feel they could take the time off from their personal and professional lives to undergo a second-stage procedure. These patients asked if I could do both their face lift and fat injections at the same time. I responded that I felt I could, and I was

stunned by the results when we did so. Today I feel as if I have “one hand tied behind my back” when I must perform a face lift without fat injections, and fat injections are now performed as part of most of my face-lift procedures.

Why Not Just Inject Fat?

Age-related loss of facial fat rarely exists as an isolated event in a healthy patient, and thus patients who are troubled by it are rarely logically or appropriately treated by fat injections alone. Isolated fat injections are also arguably of questionable benefit to a patient with significant facial sagging and skin redundancy. Although aggressive filling of the sagging face with fat can improve contours and produce a smoother skin surface, it generally results in an unusually large, overfilled, “filler face” that looks both unnatural and unfeminine. Such an overfilled face is hard to correct in an attractive manner at a later date, and it is both more logical and practical to perform fat injections in conjunction with formal surgical lifts if needed, or sometime *after* ptotic tissue has been repositioned and redundant tissue has been removed.

Where Should the Fat Be Injected?

Areas in need of treatment will vary among patients, and planning fat injections requires looking at the face in a different way—more as a sculptor—and less as a tailor as we have done in the past. Any area that can be successfully treated with nonautologous injectable fillers is potentially treatable with fat injections, including, but not limited to, the temples, brow, radix, upper orbit (upper eyelid), lower orbit (lower eyelid), cheeks, midface, lips and the perioral area, the nasolabial folds, genio-mandibular grooves, jawline, and chin—and experience with fillers is a useful point of reference for planning fat additions to the face. Perhaps the best way to decide where fat is needed is for the surgeon to study his or her face-lift outcomes carefully and identify areas where the procedure has fallen short. In most cases the biggest shortcoming for an experienced surgeon will be evident as a failure to replenish lost volume, and the areas in need of treatment will be obvious. In time, and after engaging thoughtfully in such study, one will gain a deeper appreciation of facial atrophy and an increasing desire to correct it.



This 45-year-old patient is shown before and 2 years and 4 months after a high SMAS face lift, neck lift, lower blepharoplasty, and fat injections. She had had no prior surgery. The shaded areas (*center*) show where fat was placed: 3 cc was placed in each upper orbit, 4 cc in each temple, 1 cc in each tear trough, 3 cc in each infraorbital area, 4 cc in each cheek, 2 cc in each nasolabial crease, 1 cc in each stomal angle, 2 cc in each geniomandibular groove, 3 cc in each lip, and 2 cc in the glabella, for a total of 50 cc of injected fat.

Sequencing Fat Injections With Other Procedures

When fat grafting is best performed during face-lift surgery has not yet been answered scientifically, but as a practical matter, it is most expedient to inject fat at the beginning of the procedure before the face lift itself has been started. The reasons for this include the fact that it is easier to harvest the fat at the beginning of the procedure, before the face has been prepared or draped, and when the patient is typically in a deeper plane of anesthesia. In the beginning of the procedure, the tissue planes of the face have also not been opened, the face is not swollen, and preoperatively made pen marks and facial landmarks are easier to identify. Finally, surgical principles suggest that it is also probably best to inject the fat before the start of the face-lift procedure to limit the time the harvested fat is out of the body.

Fat Injection Technique

The technique for facial fat grafting has been described in detail by Coleman, and we adhere to Coleman's principles when performing fat injections (see Chapter 13).

Logistics of Concurrent Face Lift and Fat Injections

Fat injections are viewed by many surgeons as a simple procedure that can be performed in a few minutes' time. However, this is rarely the case, and such an attitude will lead to frustration, disruption of the workflow, and poor outcomes. Fat must be harvested in a specific, atraumatic, and time-consuming manner if viable tissue is to be obtained that will survive and "take" at the facial recipient site. It must then be processed and injected in a technically demanding and time-consuming process that cannot be rushed. Fat grafting is also an *artistically* demanding activity that requires a considerable amount of the surgeon's intellectual, creative, and physical energy. When anything other than small amounts are being injected, the entire procedure can encompass an hour or more, something that can significantly tax an already overburdened surgical team engaged in a demanding operation entailing multiple procedures. Therefore time must be planned appropriately.

Equipment



Special blunt-tipped cannulas are required for injection, in addition to other specialized equipment for harvesting and processing the fat. Poor outcomes are typically obtained if sharp hypodermic needles are used to harvest or inject fat, or if fat is injected using a technique similar to that used to inject nonautologous facial fillers. Sharp-needle injection can also result in fat embolization and serious related problems and thus is not recommended.

Choosing a Donor Site

Currently there is no scientific unanimity as to where the “best” fat for grafting should be obtained. Donor sites are typically chosen and marked with the patient in a way that the fat harvest procedure will improve her or his silhouette, although the ideal locations are arguably the areas of diet- and exercise-resistant fat deposits where the fat is biologically programmed to be stubbornly persistent throughout the patient’s life. For women this is typically the hips, outer thighs, or abdomen, and for men the love handle and spare tire areas.

Although the lower abdomen might appear on casual consideration to be the easiest and best place from which to harvest fat, my experience has shown otherwise, and I prefer to take fat from the hip and lateral thigh when possible, if the patient agrees. There are several reasons for this. First, although using the abdomen as a donor site means that the patient does not need to be turned and that only one site is prepared and draped, abdominal fat is usually harder to extract, and the fat obtained seems to be more fragile and have a higher “oil” content. In addition, when anything more than a small amount is needed, the abdominal area is far less forgiving than the hip or the outer thigh because of the thinner, less elastic skin that is typically present, and postoperative irregularities and contour problems are far more likely to occur. For that reason, consideration should be given to placing the patient in a liposuction garment or abdominal binder if anything more than a small amount of fat is harvested from the abdomen. Harvesting fat from the hips and outer thighs requires that the patient be turned and that two areas be prepared and draped, but the fat in these areas is much easier to extract and the tissue obtained is usually more durable and nearly free of blood and oil. The hips and thighs also have thicker, more elastic skin, and I find that postoperative problems and contour irregularities almost never occur in these regions. Overall, patients are typically more pleased with the improvement in their figures when fat is harvested from their hips and outer thighs than when it is removed from their abdomen.

In thin patients, small harvests from multiple areas may be required, including the inner thighs, inner knees, upper buttocks, and anterior axilla, and this will add additional time to the procedure. It is recommended that the donor sites and site markings be photographed preoperatively to document what harvest sites were agreed on and to avoid any dispute over the patient’s preoperative condition after surgery.

Marking the Face

Fat injections cannot be placed arbitrarily; a careful plan must be marked preoperatively with the patient seated in an upright position. Marking will consume a significant amount time and is best carried out in a private area that is free from distractions. Creating an initial plan on a life-sized laser print of a photograph of the patient’s face is helpful in organizing one’s thoughts and facilitates the discussion with the patient as to which areas will be treated. In most cases marks are made in

conjunction with the patient while she or he holds a hand mirror so the plan can be discussed and clarified during this stage. The goal is to create a topographical map of the deficient and atrophic areas of the face to guide the surgeon during the procedure—essentially a reverse plan of that used when liposuction is performed.

Because an aging face is undergoing a process of *lipodystrophy*—that is, fat is becoming deficient in some areas and excessive in others—marks are also made where fat needs to be removed, when indicated. These areas can be marked in a different color or designated by some other means.

Once the markings are complete, additional photographs are taken of the patient's marked face and printed for use during the procedure. Some surgeons go so far as to have patients sign and date a laser print copy of the marked plan to avert any postoperative questions about what the patient's preoperative requests were and what was agreed on and consented to.

Anesthesia

Most modern face lifts are time consuming and technically demanding, and the addition of fat injections will test the patience and composure of most surgeons. It is highly recommended that the services of an anesthesiologist or experienced CRNA be enlisted when combined procedures are performed. This is particularly important when the procedure is to be performed on a patient who is apprehensive or has a history of anesthetic difficulties, hypertension, or other significant medical problems.

The majority of face lifts I now perform are done with the patient under deep sedation, administered by an anesthesiologist using a laryngeal mask airway. This allows the patient to be heavily sedated without compromise of the airway, but the patient need not receive muscle relaxants and can be allowed to breathe spontaneously. It is also easier to harvest fat from a heavily sedated patient, especially when fat must be harvested from multiple sites, and comprehensive treatment of the face with fat is facilitated under these conditions. However, any skillfully administered anesthetic is adequate for performing the procedure.

Harvesting Fat

Fat is harvested the day it is needed; it is not frozen or stored. There are several reasons for this. First, it would be a questionable practice to store harvested fat in casually labeled syringes in a small, unmonitored refrigerator/freezer of the type intended for home or office use. These devices typically do not provide around-the-clock monitoring of internal temperatures or have backup power, and most surgeons do not have the means to properly log in tissue to be stored and guarantee that cross-contamination, inadvertent thawing and refreezing, or mislabeling has not occurred. In addition, storage of fat in this manner could be construed as “tissue banking,” a practice that only licensed tissue banks are legally allowed to do in certain states.

More to the point, the preponderance of scientific information currently indicates that to be viable, fat must be flash-frozen to very low temperatures, much in the way that a human egg cell would; it will not be viable if slow-frozen in a typical food freezer and later thawed. Research and development in fat banking is underway, and in the future it is likely that surgeons will be able to store viable patient fat at a regional blood bank or a center created specifically for this purpose.

Fat should be harvested in a thoughtful and artistic manner that improves the patient's figure; thus it must generally be removed bilaterally and symmetrically unless body contours dictate otherwise. Patients must be advised that fat harvest does not constitute a formal liposuction procedure, however, and that the small instruments used to harvest fat are not capable of making large improvements in body contour.

It is prudent to examine the patient at the first consultation, because thin patients with limited fat stores or patients who have undergone prior liposuction often present significant challenges, and considerable extra time and effort will be required to harvest fat from them. Anesthesia and operating times and the surgeon's fee must be calculated accordingly.

Fat is harvested after anesthesia is initiated, but before preparation of the face. In all but the unusual case, complete preparation of the torso is not necessary. Typically, a limited preparation of the marked area is made, and a sterile field is established about the prepared area with adhesive-edged blue paper drape towels (sticky blue towels). The surgeon and the surgical assistant need not gown for this part of the procedure, because sterile gloves are adequate for maintaining sterile technique.

If fat is to be harvested from the hip or lateral thigh, the patient is turned to a semi-lateral decubitus position; preparation, draping, and fat harvesting are performed, then the patient is turned to the opposite side, where the harvest procedure is repeated. If the patient is positioned carefully, this technique can be used to harvest fat from multiple additional sites, including the upper buttocks, inner thigh, and knees. Obtaining fat from multiple sites is particularly important in thin patients with minimal fat stores.



Areas from which fat is to be harvested are conservatively infiltrated with 0.1% lidocaine with 1:1,000,000 epinephrine solution using a specially designed multiholed local anesthetic infiltration cannula, and an adequate time is allowed for a proper anesthetic and hemostatic effect. It is not necessary or desirable to infiltrate in a tumescent fashion, since overwetting the donor site will result in an overdilute harvest and more time being spent in the harvesting process. Local anesthetic should be injected, even if deep sedation or a general anesthetic is used.



Fat is then harvested with special harvesting cannulas attached to 10 cc Luer-Lok syringes; the cannulas are used to atraumatically extract fat from donor sites using gentle hand-applied suction to avoid vacuum barotrauma to the tissue. If fat is harvested with too much applied suction, poor graft survival and compromised outcomes are likely. In general, a 30% to 50% overharvest is made to be sure that an adequate supply of processed fat will be available for use on the face. Fat harvested with these cannulas easily passes through injection cannulas as small as 0.7 mm. Shown from the top down: a 10 cc Luer-Lok syringe, a 1.6 mm by 15 cm local anesthetic infiltration cannula, a 2.4 mm by 15 cm Tulip “triport” harvesting cannula, and a 2.4 mm by 15 cm Coleman harvesting cannula. A closeup of instrument tips, shown from the top down, includes a 10 cc Luer-Lok syringe, an infiltration cannula, a Tulip harvesting cannula, and a Coleman harvesting cannula.

Once the fat harvest is complete, the stab incision used to obtain the fat is closed with a simple interrupted suture of 6-0 nylon. The harvest site is then washed free of prep solution, and the sutured site is dressed with a Tegaderm dressing.

Processing Harvested Fat

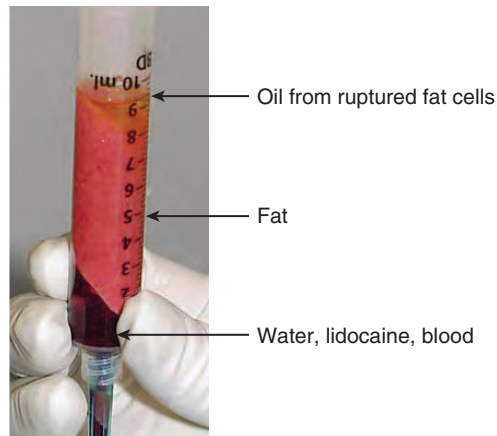
Harvested fat is generally not uniform in character and concentration as extracted from the donor sites: each syringe will contain a variable amount of fat, blood, local anesthetic, and ruptured fat cells (oil), and some type of processing is necessary to consistently obtain uniform, viable material for injection. Although fat can be separated simply and inexpensively from the oil and water fractions using a tea strainer type of sieve, the majority of the stem cells, growth factors, and “cellular messengers” are likely lost when this is done. Centrifugation, on the other hand is believed to allow separation of the oil and water fractions from the fat cells with minimal loss of these other potentially important components. In fact, currently efforts are underway to develop low-cost devices for use in clinical settings to process fat in a way that concentrates stem cells, or even allows them to be separated. As these devices become available, the outcomes of fat injection procedures could be significantly enhanced, and many new and beneficial uses of autologous fat will likely become possible.

Controversy exists as to whether the forces applied to the fat during centrifugation are harmful and decrease eventual graft take. Available evidence seems to indicate that the spin speeds and resultant applied forces in most countertop laboratory centrifuges typically sold and used for processing fat are at or below the cut-off value, but surgeons concerned with this can use commercially available rheostats to reduce the voltage and lower spin speeds, if desired. It is likely that once unanimity is reached regarding “safe” spin speeds and threshold G forces, centrifuges will be produced that operate below the appropriate cut-off levels.

Before centrifugation is begun, a sterile, disposable plastic Luer-Lok cap is placed on the end of the syringe to keep harvested fat inside it, and the syringe plunger is removed from the syringe barrel. Capped syringe barrels containing unprocessed fat are then loaded into the centrifuge rotor in a balanced fashion and spun for 1 to 3 minutes. Most small, portable centrifuges are inexpensive and have rotors that can be sterilized so that the syringes the fat are in remain sterile and can be handled by the scrubbed surgical team. Others centrifuges have sterilizable tubes that fit into the rotor for this purpose.



A small, portable, countertop centrifuge is shown, as well as a closeup view of the centrifuge rotor being loaded with unprocessed fat in 10 cc syringes. The syringe tip has been sealed with a disposable plastic cap. The removable and sterilizable metal sleeves shown fit into the rotor to keep syringe barrels sterile and allow them to be handled on the sterile field after spinning.



Harvested fat is shown after centrifugation. Three layers can be seen in the centrifuged material: an upper oil layer consisting of ruptured fat cells, a middle layer of intact fat cells, and a bottom layer of blood and local anesthetic.

The often blood-tinged water/local anesthetic component is separated by simply removing the syringe tip cap and allowing it to run out, and the cap is then replaced. The oil fraction is poured off out of the top of the syringe, and neurosurgical cottonoid sponges are placed inside the syringe barrel to wick up the small amount of residual oil.



A test tube rack to hold the syringes greatly facilitates fat processing activities. On the left, the syringes contain unprocessed fat; in the center, syringes contain centrifuged fat. The rack also conveniently holds 1 cc syringes, syringe components, and other equipment used in the fat grafting procedure.

Injecting Fat



After centrifugation and the oil and water fractions have been discarded, the fat tissue obtained is transferred into 1 cc Luer-Lok syringes using a transfer coupling, because proper injection in the very small aliquots needed in the face cannot be made with 3 cc, 10 cc, or larger syringes. A 10 cc Luer-Lok syringe, 1 cc Luer-Lok syringe, Luer-to-Luer transfer coupling, and transfer coupling in use are shown.

Nerve blocks are then performed with 0.25% bupivacaine with epinephrine 1:200,000 local anesthetic solution and adequate time is allowed for proper anesthetic and hemostatic effect. It is typically not necessary to directly infiltrate areas to

be treated with local anesthetic if nerve blocks are performed correctly and sedation is administered.

If patients state that they have had recent hyaluronic acid filler injections (such as Juvéderm or Restylane) in the areas that they want treated with fat injections, it is likely that the presence of the filler will compromise graft survival and the ultimate outcome of the procedure. In these patients, direct infiltration of areas containing filler can be made with hyaluronidase. In most cases, an immediate and almost instantaneous dissolution of the filler will be noted, and fat injections can then be performed.

Once nerve blocks have been administered, 1.2 mm, 0.9 mm, and 0.7 mm cannulas are used to infiltrate fat into the face through small stab incisions in the facial skin in multiple passes, in multiple planes, from at least two separate injection sites while feathering into adjacent areas depending on the area being treated. Injecting from at least two separate injection sites allows “crisscrossing” of cannula passes during graft placement, and helps avert a “row of corn” effect that might result if injection was made from only one site.

As the cannula is advanced, the surgeon feels for tissue resistance, and if resistance is felt, a small injection is made as the cannula is withdrawn. Approximately 0.5 cc or less is injected per pass. This corresponds to 20 passes or more for each 1 cc syringe of processed fat. If the injector does not feel tissue resistance as the injection cannula is advanced, this indicates that a pass has already been made in that area, and injection should *not* be made as the cannula is withdrawn.

The goal is to inject the fat in a way that optimizes its chance of developing a blood supply and surviving. The injector should have a mental model of scattering tiny particles of fat into the recipient site in multiple crisscrossing fine trails in multiple planes in such a way that each particle ideally sits in its own compartment and has maximal contact with perfused tissue. If fat is injected in the way in which a flu shot would be given or nonautologous fillers are typically administered, fat cells will be bunched together, and only those on the periphery of the injected area will have tissue contact and will be likely to survive. Most of the more centrally situated fat particles will only have contact with each other and will be less likely to survive.

At first the advancement and withdrawal of the injection cannula will necessarily be made slowly, but as familiarity with the technique is acquired, the movements can be made faster. Ultimately, all other things being equal, faster movements are desirable in that if the injection cannula is constantly in motion, intravascular injection is less likely, and an accidental large injection into one area is avoided.



How the syringe is held is also important in controlling the volume injected with each pass, and avoiding overinjection of any area. If the syringe is held in the manner one would typically use to give an injection with the thumb on the end of the syringe plunger, it is easy to inject too much fat if tissue resistance suddenly changes. More control can generally be maintained, and overinjection more easily avoided, if the syringe is held with the end of the plunger in the palm of the hand. Although a bit of practice is required at first, when held this way a slight closing of the hand results in only a small amount of fat being expressed from the cannula.

Although cannula obstruction will be very uncommon if fat is harvested and processed as described, *if a cannula becomes blocked, additional injection pressure should not be applied*, because this is the most common cause of a sudden and unintentional overinjection. It is better to simply withdraw the blocked cannula, pass it to the surgical assistant, and continue with a different one. The assistant can then clear the obstruction while the surgeon continues to work.

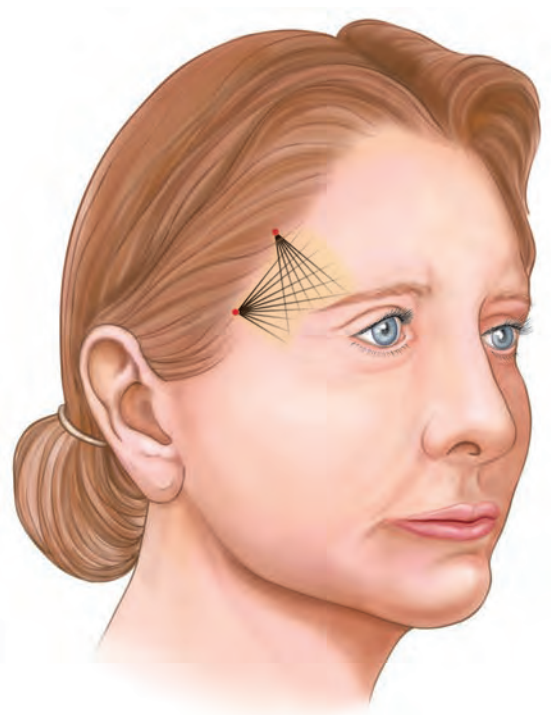
Injections will necessarily be made in different planes, depending on the areas being treated. In many areas where multiple tissue layers are present to inject and overlying skin is thick, injections can be made comprehensively at the treated site from the periosteum to the subdermal layer. These areas typically include the geniomandibular groove, piriform aperture, midface, cheek, and chin. These are the easiest areas for the beginning injector to treat. In other areas, injections must be placed with greater precision, skill, and care because of the anatomic characteristics of the treated sites and to avoid irregularities. These areas include the temples, upper and lower orbit, tear trough, lips, jawline, and the dorsum of the hand. In the beginning it is wise to “stay deep” and place the majority of the graft in a predominantly preperiosteal plane. Once the injector is familiar with the technique, areas in the second category can then cautiously be treated.

Fat Injection Instrument Set			
Number	Instrument	Diameter (mm)	Length (cm)
Harvesting			
2	Multihole local anesthetic infiltrator	1.6	15
2	Harvesting cannula	2.4	15
	10 cc Luer-Lok syringes		
	Luer-Lok disposable plastic syringe caps		
Fat Processing			
2	Luer-Lok anaerobic transfer coupling		
1	Syringe rack		
1	Centrifuge		
Injection: Face			
2	Injection cannula	0.7	4
2	Injection cannula	0.9	5
2	Injection cannula	1.2	6
1	V-dissector 1	1.4	6
	1 cc Luer-Lok syringes		
Injection: Breast and Body			
2	Injection cannula	1.2	8
2	Injection cannula	1.4	8
	3 cc Luer-Lok syringes		

Temple Area



Temporal hollowing is a consistent marker of the fourth decade of life that is readily improved with fat injections. This 45-year-old patient is shown before surgery and 2 years and 4 months after a high SMAS face lift and fat injection to the temples. Fat has also been injected in the upper and lower orbital areas.



Injections in the temples must be made in a predominantly subcutaneous plane, usually from small stab incisions just within the temporal hairline. Injection of the temples is performed with a 1.2 mm cannula, and typically 3 to 5 cc of fat is placed on each side, but occasionally more will be indicated.

In most cases a blunt 1.2 mm injection cannula is preferred to sharper and smaller types. This helps to avoid perforation of the tortuous veins often seen in the temporal area. These larger, blunter cannulas usually bounce off these veins and allow fat to be placed over and around them to conceal them, and this compression and concealment of veins is a significant part of the effect gained when treating the temples and the dorsum of the hand. If a temporal vein is accidentally penetrated during injection despite these precautions and swelling from the leakage of venous blood is noted, pressure is applied on the temporal area for a few moments with a surgical sponge. Typically, after applying uniform and continuous pressure for a few minutes, bleeding stops and treatment of the area can be completed.

Upper Orbit/Upper Eyelid Area

Whether a hollow upper orbit is the result of illness, aging, or an overzealous surgical procedure, it can be filled to produce a remarkable rejuvenation of the upper eyelid, eliminating an unnaturally hollow and elderly appearance sometimes referred to by patients as “nursing home eyes.”

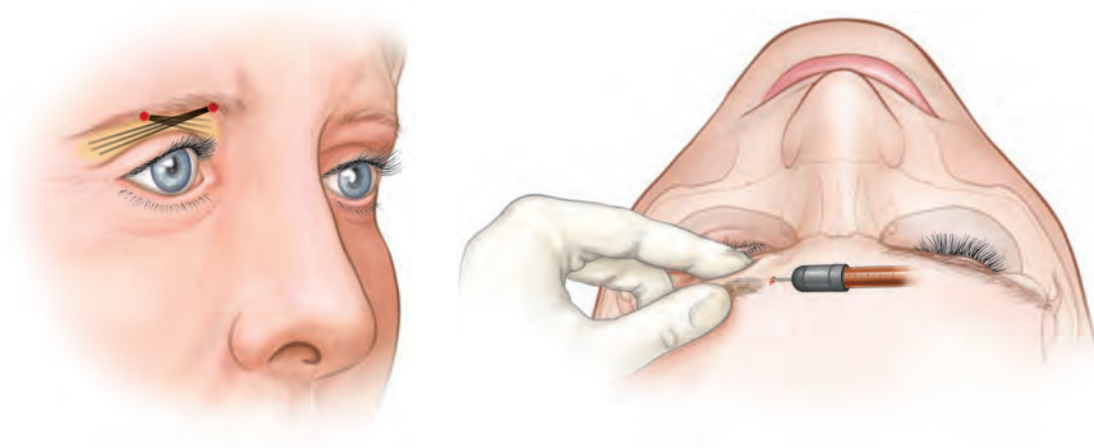


This patient had an unnaturally hollow and elderly ocular appearance after a blepharoplasty performed by an unknown surgeon. The patient is shown after fat injections to the upper orbit demonstrating a healthier, more youthful appearance.

What layers fat should be placed in in the upper orbit (upper eyelid) is a subject of some debate, however, and subcutaneous, suborbicularis oculi, and even subseptal (intraorbital) locations have all been safely and effectively used by various surgeons. For the beginning injector, it is safest to avoid the subseptal area because of the small but not insignificant risk of intraorbital and retrobulbar bleeding and other problems. It is also wise to avoid a purely subcutaneous injection in this area at first because of the extremely thin skin present, and to limit initial injections to a preperiosteal/suborbicularis oculi location. As the injector gains experience, injections can be extended to a subcutaneous plane to obtain a combined filling of the submuscular and subcutaneous areas.

A common misconception in treating the hollow upper orbit is that the fat is needed and should be injected in the preseptal portion of the eyelid itself. Not only would this be difficult and dangerous, it is unnecessary. Volume replacement is more properly and practically restored by placing fat in a preorbital position along the inferior margin of the supraorbital rim, and conceptually the process is best thought of as lowering the supraorbital rim and filling the upper orbital area to push skin that has retracted up into the orbit down onto the preseptal eyelid to create a full and creased upper eyelid. Once one accepts that improvement is obtained by injection of the orbit, and not the eyelid itself, it becomes apparent that larger volumes than might otherwise be expected are required, and in general 2 to 3 cc of fat must be placed in each upper orbit to achieve the improvement typically required. Smaller injection cannulas now available have made injecting the upper orbit easier and more predictable than in the past; they can be advanced more smoothly and accurately through tissues and allow deposition of very small aliquots of fat per pass. Currently a 0.7 or 0.9 mm cannula is preferred, but even smaller cannulas may become available and may provide even better results.

It should always be remembered that when injecting the upper orbit one is working in very close proximity to the eye, and although the injection cannulas are blunt tipped, they are small and easily capable of perforating the ocular globe. Thus two important technical considerations should be observed. First, injection sites should be placed in such a way that the injection cannula will be passed parallel to the globe and the supraorbital rim, not perpendicular to it.



Incision sites and a plan for injecting fat into the upper orbital (upper eyelid) area are shown. Injection of the upper orbital area is performed with a 0.7 or 0.9 mm cannula and fat is placed in a suborbicularis oculi/preperiosteal plane. Typically, 2 to 3 cc of fat is placed in each upper orbit. Directing the cannula toward the globe when injecting the upper orbit is dangerous and should be avoided.

Second, the surgeon should always have his or her index finger of the nondominant (noninjecting) hand held firmly on the inferior margin of the supraorbital rim as cannulas are passed into tissues and injection is made, and this finger should always be kept between the tip of the cannula and the globe. The idea is to position the finger so that the cannula would hit against it instead of penetrating the globe if the cannula is inadvertently misdirected. Having one's finger in this position also gives important feedback as to where the tip of the cannula is and helps the injector place fat as accurately as possible.

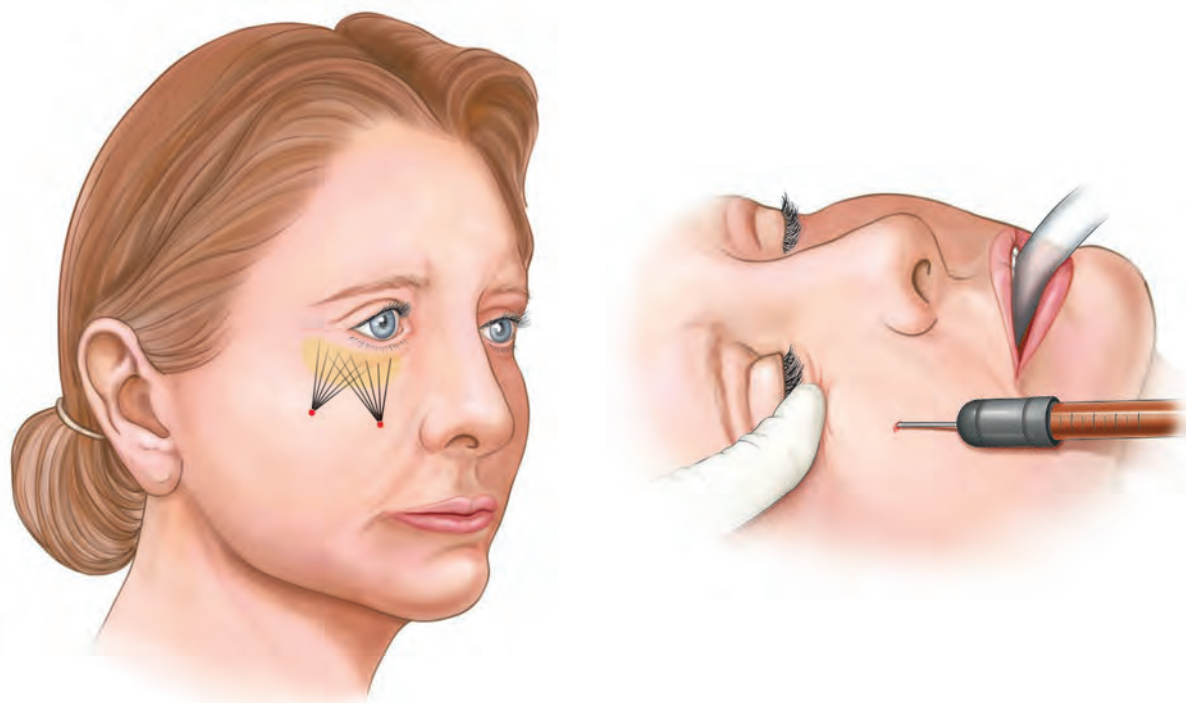
Lower Orbit/Lower Eyelid Area

Injecting the infraorbital (lower eyelid) area is in some ways analogous to injecting the upper orbit: there are similar misconceptions about where fat should be placed, similar technical considerations about which tissue layers fat should be injected into, and similar concerns regarding injury to the ocular globe. In addition, as with injecting the upper orbit, the artistic payoff is high if the procedure is carried out correctly.



This patient's lower eyelids had an unnaturally hollow and elderly infraorbital appearance. The lower eyelids appeared long, and there was a distinct line of demarcation between the lower eyelid and the cheek. The patient is shown after a face lift and fat injections to the infraorbital area. There is a smooth transition from the lower eyelid to the cheek, and the patient now has a healthier, more youthful and attractive appearance. The upper orbit, radix, cheek, and nasolabial fold have also been treated with fat injections, and the patient has undergone ptosis correction.

Injecting the infraorbital area corrects the age-related hollowness that lends the face an ill or haggard appearance and "shortens" the apparent length of the lower eyelid. Fat injections produce a youthful, attractive and highly desirable smooth transition from the lower eyelid to the cheek that is generally unobtainable by traditional lower eyelid surgery, fat transpositions, "septal resets," midface lifts, free fat grafts, and other means. As in the upper orbit, fat need not and should not be injected in the pretarsal lower eyelid. Fat should be injected deep in a submuscular/preperiosteal plane until experience is obtained. The technical goal of the procedure should be thought of as raising and building up the infraorbital rim rather than filling the lid itself. And, as in the upper orbit, the volumes required to obtain corrections in the lower orbit are typically more than one might initially expect: 3 to 4 cc is usually necessary to produce the desired effect. Experience has shown, however, that unlike the upper orbit, fat is best and most easily injected *perpendicular* to the infraorbital rim, and while I cannot speak from personal experience, it is my observation that surgeons injecting fat parallel to the infraorbital rim have more problems with irregularities, "lumps" and "bumps," and untoward results.



Injection of the infraorbital area is generally performed with a 0.7 or 0.9 mm injection cannula from injection sites in the midcheek or perioral area. Incision sites and plan for injecting fat into infraorbital (lower eyelid) area are shown. Fat is placed in a suborbicularis oculi/preperiosteal plane. Until experience is obtained, more superficial injections should be avoided. Typically, 3 to 4 cc of fat is placed on each side.

As with the upper orbit, when injecting the lower orbit the surgeon should place the index finger of the nondominant (noninjecting) hand firmly on the inferior margin of the infraorbital rim to protect the ocular globe as cannulas are passed into tissues and injections are made.

As the injection cannula is advanced perpendicular to the orbit and toward the fingertip through infraorbital tissues, the orbitomalar ligament can be felt along the infraorbital rim and the cannula tip is allowed to penetrate it slightly. This important landmark helps guide the injector as to exactly where most of the fat needs to be placed for an optimal result. Typically, after placement of 3 cc of fat in this manner, no resistance will be felt along the course of the ligament, and it is assumed that the multiple passes used to place the graft have effectively released it, further improving the overall outcome. Another guideline for the placement of fat in the infraorbital area is for the surgeon to imagine filling the area in which one might place an infraorbital implant, since the goal of treatment is essentially the same.

It is wise to avoid any subcutaneous injection in the infraorbital area until considerable experience has been obtained because of the extremely thin skin in the region,

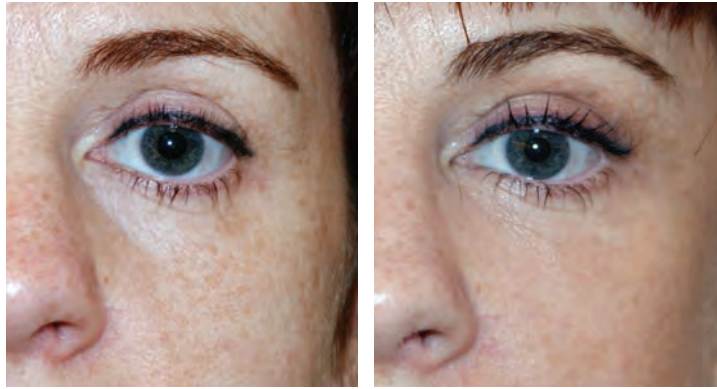
and to limit initial injections to a preperiosteal/suborbicularis oculi plane, as recommended previously. As experience is gained, injection can then be extended to a subcutaneous plane to obtain a combined filling of the submuscular and subcutaneous areas. This will produce improved outcomes and can help correct dark circles in the infraorbital area by improving the transmission of light through thin infraorbital skin and masking the darker-colored muscle underneath.

Tear Trough

Where the infraorbital area ends and the tear trough and cheek areas begin is hard to define. In reality, the infraorbital, cheek, and tear trough areas must be treated concurrently and the treated areas will overlap to a certain extent. In addition, it must always be remembered that the ultimate goal of the procedure is to create a youthful and attractive *contour*, not simply to fill a specific area.

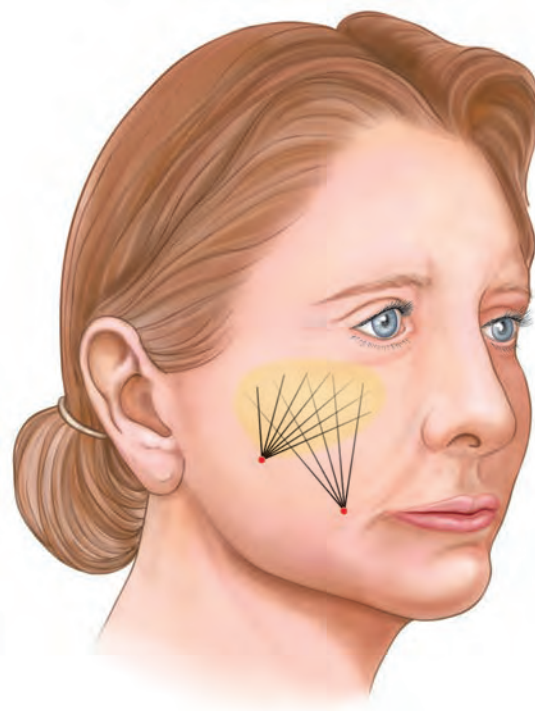


Treatment of the tear trough is most easily and best performed using the same incisions used to treat the infraorbital area. Incision sites and plan for injecting fat into the nasojugal (tear trough) areas are shown. Injection of the nasojugal area is typically performed with a 0.7 mm or 0.9 mm injection cannula and fat is placed in a preperiosteal/suborbicularis oculi plane. Until the injector gains experience, more superficial injections should be avoided. Fat can be safely placed subcutaneously despite the very thin skin in this area, and improved outcomes are obtained. Typically, 0.5 to 1.5 cc of fat is placed in the tear trough area on each side, depending on how far inferiorly and laterally the tear trough extends onto the cheek.



Another guideline for the placement of fat in the tear trough area is for the surgeon to imagine filling the area in which one might place a tear trough implant, since the goal of treatment is essentially the same. This patient is shown before and after fat injection to her hollow nasojugal groove (tear trough). Preoperatively it can be seen that she had an unnaturally hollow and elderly appearance. Postoperatively the defect has been filled and a healthier, more youthful appearance is evident.

Cheek



Treatment of the cheek is usually performed using access incisions on the cheek and the perioral areas. Injection of the cheeks is performed with a 0.9 mm or 1.2 mm injection cannula, and fat is placed in all tissue layers between the periosteum and skin. Typically, 3 to 7 cc of fat is placed in each cheek, depending on the degree of atrophy present, but occasionally more will be indicated.

Often an asymmetrical placement of fat will be required on the right and left sides, because malar asymmetry is seen in many patients. Another guideline for the placement of fat in the cheek area is for the surgeon to imagine filling the area in which one would place a cheek implant.



As the cheek atrophies, the lower eyelid “fat bags” become more exposed and prominent. Removing lower eyelid fat would create a hollow, elderly appearance. This patient presented with an atrophic cheek, and the lower lid fat was exposed. Seen after fat injections to the cheeks, the patient’s protruding lower eyelid fat has been disguised by building up the cheek; this has produced a more youthful, fit, and attractive appearance than removing lower lid fat would have. The upper orbit has been replenished with fat grafts as well.

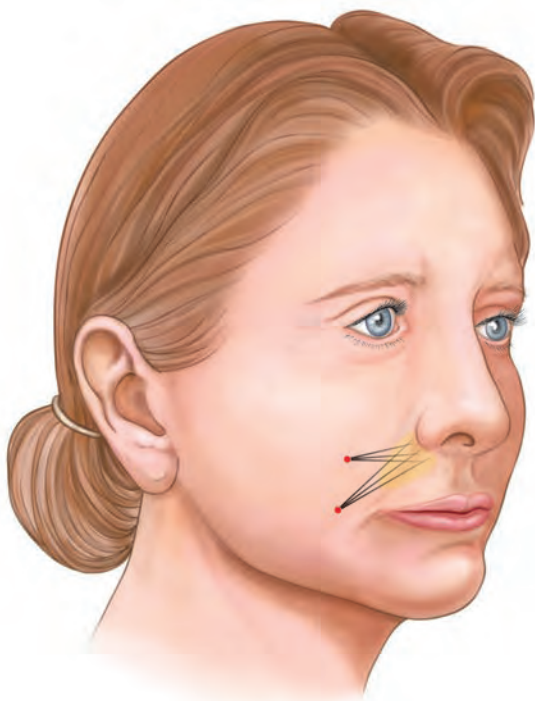
Nasolabial Injection

One of the first areas most patients inquire about when considering fat injections, and most surgeons are eager to treat, is the nasolabial folds. Nonetheless, one must be aware of certain misconceptions and several limitations of the fat injection technique in regard to the treatment of this area. The first is that treatment of the nasolabial folds with fat is generally not as effective as treatment with nonautologous fillers. Fat is softer and is typically placed deeper than nonautologous fillers, and fat is better used to treat a volume deficiency in a region of the face as opposed to a more discrete line, wrinkle, or fold that is subject to the repeated stress of facial muscle contraction and facial movement. Patients undergoing fat injections solely for treatment of their nasolabial folds will generally be disappointed with the outcome. However, this is not the case when a concurrent face lift is performed, with cheek and midface tissues repositioned and redundant cheek skin excised. In such instances, fat injection is an excellent adjunct in the treatment of the nasolabial fold (see the patient on p. 1650). It is also not intuitively obvious, but increasingly it is more widely appreciated by those injecting nonautologous fillers into the face that *filling the upper cheek produces a profoundly beneficial effect on the nasolabial fold*, and that treatment of the fold is more effective when filling of both these areas is combined. If the cheek is filled, less fat is needed to improve the nasolabial fold.



This patient had midface ptosis and heavy nasolabial folds; a high SMAS face lift was performed, with fat injections to the nasolabial creases. The combined lifting and filling provided a better correction than either procedure would have if performed alone.

Experience has shown that nasolabial folds result, at least in part, from age-related loss of maxillary projection, and the goal in injecting fat in the nasolabial areas should be thought of as more of an augmentation and restoration of maxillary/midface projection than as simple filling of the soft tissue crease. Thus the surgeon's efforts should be concentrated on the peripiriform areas, and injections should be placed predominantly along the rim of the piriform aperture in the upper nasolabial area.



Injection of the piriform and nasolabial crease is performed with a 0.9 mm or 1.2 mm injection cannula and fat is placed in all tissue layers between the periosteum and skin using access incisions in the perioral area. Typically, 2 to 3 cc of fat is placed in the piriform/nasolabial area, depending on the degree of the problem present, but occasionally more will be indicated.

Another guideline for the placement of fat in the piriform area is for the surgeon to imagine filling the area in which one would place a perinasal or piriform implant.

Overfilling the nasolabial area is a common eventual response when a surgeon feels frustrated upon treating the nasolabial crease with fat in the same manner in which nonautologous fillers would be injected. Higher and higher volumes may be tried in

a typically futile effort to efface the fold, but the crease will not be improved; instead, an abnormally heavy and unaesthetic fullness of the midface will be produced. In addition, overfilling the nasolabial area can produce changes in the position of the patient's mouth, the shape of the smile, and a change in the overall "look." For these reasons it is important to advise patients accordingly, for the surgeon to set reasonable goals, and to limit the amount of fat placed in the nasolabial area to a reasonable amount.

Lips

Treating the lips with fat grafts has distinct advantages and disadvantages that will both attract and repel surgeons and patients alike. Fat is autologous and is arguably like the tissue that was present at a younger age, and if the procedure is successful and graft take is good, patients will be spared the inconvenience and discomfort of having to undergo repeated painful and expensive treatments. Fat also produces a soft, natural-appearing improvement, and usually a slight undercorrection that I find to be most appropriate and even desirable for the typical face-lift patient who needs some enhanced volume in the mouth. In fact, overcorrection of the lips with fat injections, in my experience, is nearly impossible, unless patients undergo multiple treatments.

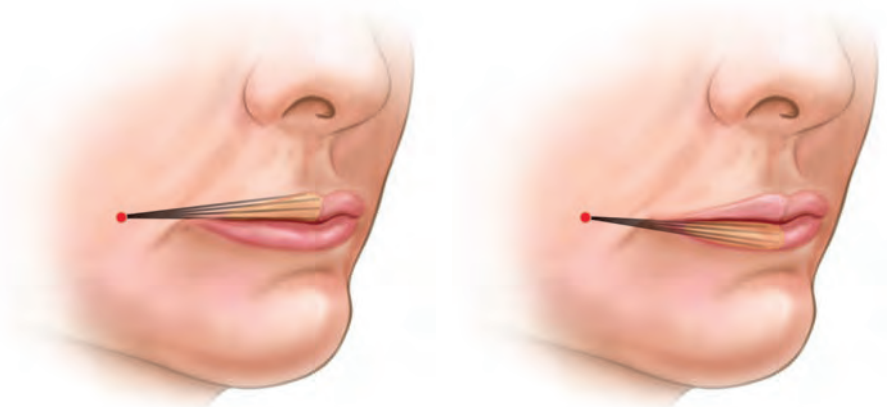


Fat injections produce soft, natural-appearing lips. Nonautologous fillers invite overcorrection and tend to produce a more stylized-appearing lip. The perioral area of this face-lift patient is shown before fat injections and after a face lift that included fat injections to the lips. The lips are fuller, but soft and natural appearing.

Fat injections to the lips have a distinct disadvantage in that they usually produce a "monstrous" amount of swelling that is slow to resolve; also, the take of the graft varies from patient to patient, and thus the eventual outcome is variable. Patients seeking a quick recovery, a specific lip size or shape, or nuanced changes are not good candidates for a fat injection procedure. In particular, patients must be warned that when using fat, it is generally not possible to create the highly stylized "stung by a bee" or "cover girl" lip appearance seen in fashion magazines. Such an appearance can only be obtained using nonautologous fillers, and patients seeking such appearances should be advised accordingly.

Patients seeking nuanced changes in their lip appearance are also not good candidates for fat injections. These include patients seeking corrections of small asymmetries, patients seeking accentuation of the vermilion-cutaneous junction, or who request specific parts of their lip be “lifted,” “rolled out” and the like. Although fat can be placed to achieve these appearances to some degree, it rarely is dramatic enough to satisfy most patients requesting these sorts of improvements, and patients making these kinds of requests are currently best treated with nonautologous fillers.

When the lips are to be treated, the preparation of the face should include the upper and lower gingivobuccal sulci, the buccal surface of the anterior teeth, and the tongue if it rests in the surgical field anterior to the incisors. A 0.7 or 0.9 mm cannula is usually used to infiltrate fat into the lips, but a slightly larger 1.2 mm cannula may be easier for the beginning injector, since it is harder to accidentally perforate the mucosa or vermilion with the larger instrument. Injection is made from access incisions in the perioral region, and fat is generally infiltrated through all layers of the lip.



Fat is usually placed in submucosal and intramuscular planes. Typically, a total of 1.5 to 2 cc is placed in each side of each lip, for a total of 3 to 4 cc per lip. Smaller amounts generally produce suboptimal outcomes after the initial swelling has abated. Larger amounts increase swelling but generally do not result in an improved outcome.

The first few passes of the cannula are used to place fat subcutaneously or submucosally directly under the vermilion-cutaneous junction. Fat is then infiltrated into the lip muscles, and then beneath the dry lip vermilion. If maximum lip protrusion is desired, fat is placed submucosally beneath the wet mucosa of the inner aspect of the lip.

A common error when injecting fat (or nonautologous filler) into the lips is to indiscriminately fill the lips in such a manner that a large but shapeless and unnatural-appearing “sausage lip” is produced. To some extent the fat injection technique is not prone to this, because lips treated with fat naturally tend to assume the shape of the patient’s existing lip envelope once the swelling abates and healing is complete. An attractive lip is generally one that is not just big, however, but one that has an aesthetically pleasing shape, and fat can and should be injected in a way that creates these appearances. An attractive lower lip typically has two tubercles; that is, two areas of fullness laterally, with a slight central depression between them. An attractive upper lip, on the other hand, has three aesthetic tubercles, a central one and one on each side laterally, with slight depressions between them. The time taken to inject fat to create a natural and aesthetic appearance in these tubercles is well spent. In addition, depressions between lip tubercles can be enhanced on completion of injections by placing a finger and thumb on the inside and outside of the lip and gently bidigitally compressing areas between tubercles to optimize fat position and lip shape.

The second common mistake when injecting the lips with either fat or nonautologous fillers is to make the upper and lower lips the same size. This is an unnatural situation and produces a “clown mouth” or “Halloween wax lips” appearance. In an aesthetic, natural-appearing mouth the lower lip is distinctly larger and fuller than the upper lip, and this should be the goal when augmenting the lips.

Perioral Area

Yet another important use of perioral fat injections is for the treatment of a patient with perioral wrinkles and “pucker lines.” Traditional resurfacing by peel, laser, or dermabrasion typically provides an incomplete solution for these patients in that these procedures only address the skin itself, and do nothing to replenish the age-associated loss of perioral subcutaneous fat. Patients have smoother-appearing skin in repose after these treatments, but when they speak or move their mouth, deep and objectionable lines appear and perioral deflation and subcutaneous atrophy becomes evident. This appearance spoils an otherwise excellent face-lift result and stands as telltale evidence that the patient is really older than she or he otherwise appears. With fat injections this can be avoided, and the fat previously situated between skin and orbicularis oris can be replaced. A second likely but as yet unproven benefit of perioral fat injections rests in the stem cell effect the procedure probably provides.

Experience with combined dermabrasion or laser resurfacing and perioral fat injections suggests that healing and the overall outcome are better when resurfacing procedures are combined with fat injections, beyond the improvement gained by simple added volume.



This woman had a wrinkled, atrophic perioral area that gave her an unhealthy, elderly appearance. She is shown 2 years and 7 months after a high SMAS face lift that included combined perioral fat injections and perioral dermabrasion. Both atrophy and wrinkling have been improved, and the mouth has a more youthful, vibrant, healthy appearance. The combined treatment produced a better appearance than either procedure would have if performed alone.

When injecting the perioral area, care must be taken to not simply overfill the white roll of the upper lip to reduce wrinkles, because the patient's upper lip can be lengthened, dental show can be reduced, and an abnormal, convex, simian contour in profile can result. A better strategy is to concentrate injections on and near the white roll, where the wrinkles are typically the deepest and most objectionable. Less fat is then placed more superiorly. Results are further enhanced by injecting additional fat at the columellar-labial angle, which helps to restore a youthful transition from the nose to the lip and helps to create a concave upper lip shape. Injection in the perioral area is necessarily made with small (0.7 to 0.9 mm) injection cannulas in a subcutaneous/premuscular plane. Placing the fat deeper and intramuscularly is not helpful in creating the type of improvement needed in this area.

Geniomandibular Groove

Injection of the prejowl/geniomandibular groove area with fat has a high aesthetic payoff and is a good area for the beginning injector to gain experience with the technique. Although not immediately intuitively obvious, filling the geniomandibular groove creates a strong, uninterrupted aesthetic line from chin to the posterior mandible, and is a highly desirable improvement on both the male and female face. The effect is similar to the placement of a Mittleman prejowl implant but is autologous and arguably simpler to perform.



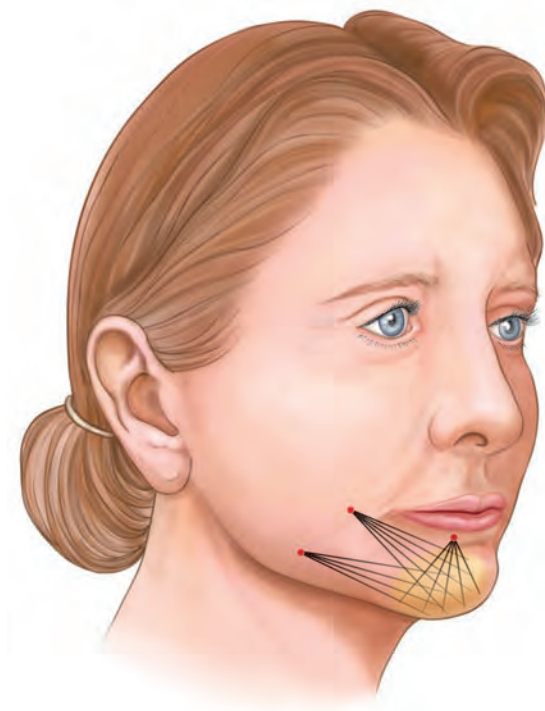
This patient had a deep geniomandibular groove. Her chin appeared narrow and pointed, and there was poor continuity between the chin and jawline. She underwent a face lift with injection of fat to fill the geniomandibular groove (prejowl sulcus) area. A chin implant was not placed. Postoperatively the chin appears broader and more aesthetically integrated with the jawline. Fat was also used to strengthen the posterior jawline and lower the mandibular angle, and to fill the lips, nasolabial crease, cheeks, and infraorbital areas.



Injection of the geniomandibular groove is typically performed with a 1.2 or 0.9 mm injection cannula from injection sites on the mandibular border and the perioral area and fat is placed in all tissue layers between the periosteum and skin. Typically, 1 to 3 cc of fat is placed in the geniomandibular groove, depending on the size of the depression present, but occasionally more will be indicated. Another guideline for the placement of fat in the geniomandibular groove area is for the surgeon to imagine filling the area in which one would place a prejowl implant.

Chin

Injecting the chin with fat can enhance a patient's profile and approach the kind of improvements obtained when small chin implants are placed. This patient had an underprojected chin that was also atrophic and feeble looking from the shrinkage that occurs with age. She is shown after a secondary face lift, with fat injections to the chin and geniomandibular groove (prejowl sulcus). A chin implant was not placed. Fat was also injected in the upper and lower orbits, cheeks, lips, and jawline. The fat injections have broadened and strengthened the contours of her chin and jawline, and the submental crease has been filled. Typically, the chin must be treated in conjunction with correction of the geniomandibular groove, and the two areas will overlap each other in most cases. Treatment of the chin along with the geniomandibular groove and jawline areas strengthens the entire lower facial contour.



Injection of the chin is typically performed with a 1.2 or 0.9 mm injection cannula from the same injection sites on the mandibular border and the perioral area used to inject the geniomandibular groove. Occasionally a third incision is used in the midline of the lower lip. Fat is placed in all tissue layers between the periosteum and skin. Typically, 1 to 3 cc of fat is placed in each side of the chin, depending on its size and shape and the degree of atrophy, but occasionally the need for more fat will be indicated. Another guideline for the placement of fat in the chin area is for the surgeon to imagine filling the area in which one would place a “extended anatomic” chin implant.

Despite the suggestions of some to the contrary, fat injections to the chin are best used for small augmentations only. If large changes in chin projection are attempted with fat injections, a globular and less sculptural appearance usually results. Patients in need of larger increases in chin projection are arguably better treated with a chin implant.

Jawline

Injection of the jawline border area with fat can enhance a patient's facial shape and produce the kind of improvements obtained when mandibular border and Taylor-style mandibular angle implants are placed. This patient is shown before surgery with a small mandible, narrow intergonial distance, and lower facial disproportion. The patient is shown after high SMAS face lift and fat injections to the posterior jawline. No implants have been placed. Strengthening the jawline and posterior mandibular border results in a more fit and proportionate appearance, and helps avert the tight and deficient mandibular contour typically seen in an elderly face after a face lift is performed. Fat has also been injected in the chin, geniomandibular grooves, buccal recess, and lip areas. (See also the patient on p. 1626, whose jawline was broadened without implant placement, using only fat injections.)



Injection of the jawline is typically performed with a 1.2 mm injection cannula from the same injection sites on the perioral area and mandibular border used to treat the geniomandibular groove, and fat is placed predominantly in a preperiosteal position. Typically, 3 to 6 cc of fat is placed in each side, depending on the deficiency present, but occasionally 7 to 10 cc or more on each side will be indicated.

Although not intuitively obvious, strengthening the jawline and posterior mandibular border makes one appear more youthful, fit, and attractive and is an artistically powerful adjunct to a face lift. This helps to avert the scrawny, deficient, and fragile mandibular contour typically seen in an aging and elderly face, which is usually made worse when a face lift only is performed (see the patient examples on pp. 1669 and 1670).

Fat injections to the jawline are particularly useful in a secondary face-lift patient and in a patient with a long face seeking facial rejuvenation or improvement. Typically, the secondary face-lift patient has experienced significant loss of jawline volume as a result of loss of or inappropriate surgical removal of facial fat, and this is often compounded by overzealous tightening of the overlying tissues. These appearances are readily improved with fat injections to the jawline, and these form a major part of most of my treatment plans for my secondary and tertiary face-lift patients. A patient with a long face usually will benefit in a similar way, because face-lift procedures tend to narrow the lower face and accentuate facial length. Fat injections allow the face to be broadened, and the overall proportions are improved.



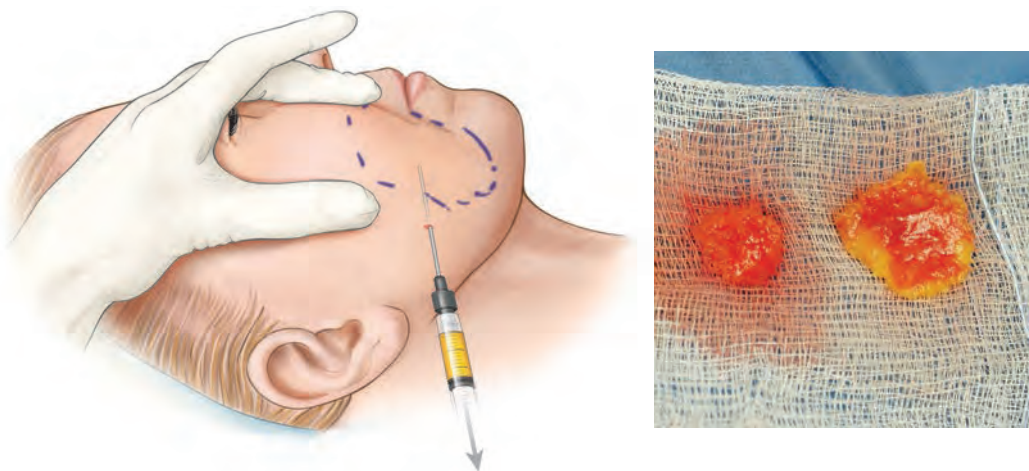
This patient had a small mandible and a long face. A previous face lift performed by another surgeon had tightened the mandibular line and accentuated her facial length. The patient is shown after fat injections to the jawline, chin, cheeks, midface, buccal recess, and lip areas. No implants were placed. The long appearance has been improved, and a more balanced and proportionate look has been obtained.

Final Touches

Injections are continued until the desired volume of fat has been added to target areas. Typically, a twofold to threefold overcorrection must be made compared with the volumes one would use if nonautologous fillers are used. As such, the process is time consuming and technically and artistically demanding, and its difficulty should not be underestimated. That said, it is likely it will also become an enjoyable one that will yield great benefits to patients.

After fat has been infiltrated, treated areas are palpated to ensure that the fat has been distributed smoothly and evenly in the target tissue, and any lumps or irregularities are gently pressed out. The lip and cheek areas can be bidigitally palpated after injection is complete to ensure that fat has been placed in an even distribution, and if the orbits have been treated, the ocular globe should be gently depressed and any irregularities sought in the infraorbital area.

Microliposuction



The face undergoes a process of lipodystrophy over time; the aging deformity consists not only of atrophy, but also of excess fat accumulation in some areas. When indicated, fat can be *extracted* from areas where excess is present by applying suction to an infiltration cannula attached to a 3 cc Luer-Lok syringe. This microliposuction technique provides a simple, precise way for removing small quantities of fat. The amount of fat extracted can be determined by emptying the contents of the syringe on a gauze sponge and allowing the blood and fluid to separate from the fat that has been removed. On the right is the fat extracted from the patient's jowl area; on the left is fat extracted from the nasolabial fold.

Documenting What Was Done

A member of the operating room team should keep a detailed record of areas treated and the amounts of fat injected in each; a Fat Injection Treatment Record is useful for this purpose. Typically, a mark is entered on the record by the circulator for each 1 cc syringe injected.

FAT INJECTION TREATMENT RECORD

Place patient sticker here

FACE

RIGHT

LEFT

Geniomandibular groove/perimental

Piriform/nasolabial crease

Cheek

Midface

Preauricular

Tear trough

Chin

Upper lip

Lower lip

Jawline

Stomal angles

Buccal recess

Perioral

Columella/nasolabial angle

Temple

Infraorbital

Brow/supraorbital

Glabella

Radix

Nasal base

Other (list): _____

Total Fat Injected: Face

HANDS

Ray: 1

2

3

4

Fingers: (thumb) 1

2

3

4

5

Thenar

Hypothenar

Dorsal wrist

Total Fat Injected: Hands**FAT HARVEST SITE** (check all that apply)☐ Outer thighs ☐ Hips ☐ Abdomen☐ Knees ☐ Inner thigh☐ Other (list): _____**FAT HARVEST DATA**

Total fat harvested (cc) _____

Total fat after centrifuging (cc) _____

Centrifuge time: ☐ 3 minutes ☐ _____ minutes

Nurse signature _____ Date _____



If no circulating nurse is present, a copy of this record can also be sterilized and a temporary tally of the fat injected kept by a scrubbed member of the operating room team using a sterile surgical marker. The information recorded can later be transcribed to the patient's official Fat Injection Treatment Record after the procedure has been completed.

Learning the Procedure

The first step in learning the fat injection technique and adding it to one's face-lift procedure is appreciating atrophy as a significant part of the aging process and learning to recognize it. This is more easily said than done and will take some time to master. Then one needs to obtain the needed equipment to properly perform the procedure and learn the basics of the fat injection technique. Once problems have been identified, needed equipment to perform the procedure obtained, and basics of the technique mastered, one must analyze patient problems carefully and budget the appropriate amount of time needed to carry out the procedure in a technically and artistically appropriate fashion. It is wise to make small additions of fat at first to "safe" areas, such as the geniomandibular groove and the cheeks, to gain familiarity with the technique. Less forgiving areas, such as the upper and lower eyelids (orbits), tear troughs, and temples, should be avoided until injection in the safe areas is mastered. Starting out conservatively in this manner will mean that problems, should they occur, will be minor and easily managed. Finally, patients should be followed up carefully, outcomes critically evaluated, and the injector should look for ways to improve technique and perform the next case with increased skill.

Learning the Fat Injection Procedure

Recognize atrophy as part of the aging deformity.
Learn the basics of the fat injection technique and obtain the needed equipment to properly perform the procedure.
Make the needed commitment of time to properly perform the procedure.
Do not underestimate the technical and artistic difficulty of the procedure.
Make small additions at first to gain familiarity with the technique.
Critically analyze outcomes.
Constantly seek ways to improve your technique.

Completion of Concurrently Planned Procedures

On completion of the fat injections, other planned procedures are performed to the face, neck, forehead, and upper and lower orbits. Next, perioral dermabrasion and any other adjunctive procedures are done, as indicated. Because the majority of fat is needed and will be injected in the anterior face and other areas that do not overlap the areas dissected in these other procedures, performing them after fat is injected does not interfere with their execution or compromise outcomes.

Dressings

After all planned procedures have been completed and all incisions have been closed, the patient's hair is shampooed and rinsed. No dressing is required or applied. Patients are typically discharged with a hat, scarf, and sunglasses.

Postoperative Care

Most patients undergoing combined face lifts and fat grafting are discharged to an aftercare specialist the first night after surgery with specific written instructions concerning their care. Patients are asked to rest quietly and apply iced compresses to their eyes and other treated areas for 15 to 20 minutes of every hour while they are awake for the first 3 days after surgery, or to use a commercially available thermostatically regulated water-cooled mask. For most patients, edema peaks at about 3 days.

All patients are provided oral analgesics, sleeping pills, antiemetic suppositories, and are instructed to sleep flat on their backs without a pillow. A small cylindrical neck roll is permitted if the patient requests it. This posture ensures an open cervicomental angle and averts neck flexion, dangerous folding of the neck skin flap, and the obstruction of regional lymphatics that inevitably occurs if the patient is allowed to “elevate the head on pillows,” as is commonly recommended. In addition, swelling will drain to the back of the head instead of the anterior neck and submental region in this position, where it is not harmful, is less noticeable, and is more rapidly transmitted away from the head and neck area to the torso when the patient sits upright.

Patients are allowed to take their usual diet as tolerated after surgery but are encouraged to avoid salty and difficult-to-chew foods for several weeks. Patients are asked to abstain from drinking alcohol for 2 weeks after surgery and until they are no longer taking pain pills (acetaminophen included) or sleeping medication. Showering and shampooing are not harmful and are permitted even when drains are in place.

Recovery and Healing

When patients can return to work and their social activities will depend on how aggressively their procedure was performed (how much fat was injected), their tolerance for surgery, their capacity for healing, the type of work they do, the activities they enjoy, and how they feel overall about their appearance. Patients are asked to set aside 2 to 3 weeks, to recover from surgery, and additional time off is recommended before an important business presentation, family gathering, vacation, or like events.

If the patient is doing well and is not experiencing problems, she or he is allowed to return to light office work and casual social activity 9 to 10 days after surgery. It is often wise for the patient to begin with a limited workday and to adjust the schedule thereafter. If a patient's job entails more strenuous activity or physical labor, a longer period of convalescence will likely be required. Patients are advised not to drive for the first 10 days after surgery and until they are feeling well, their vision is clear, and they are no longer taking pain medications.

Patients should avoid all strenuous activity during the first 2 weeks after surgery, including heavy lifting, stooping, straining, and bending forward; they should be informed that aerobic activities and exercise can result in internal bleeding and

hematoma formation. Two weeks after surgery, patients are allowed to begin light exercise and gradually work up to their presurgical level of activity. Four to 6 weeks after surgery, they are allowed to engage in more vigorous activities, including most sports, as tolerated.

Patients are informed that it will often take 2 to 3 months to have a natural appearance in a photograph or to be seen at an important function. They are also advised to expect some firmness in the face and submental areas for 6 to 9 months.

Patients will often mistakenly interpret the resolution of swelling and the return of some facial wrinkles as poor graft survival and will often comment once healing is complete that “the fat went away.” Such comments arise out of the joy most patients experience when they see their faces quite full and smooth initially after the procedure and the fact that volume addition to the face often produces subtle three-dimensional changes. Most patients simply forget the extent to which the treated areas lacked volume before the procedure. The treating physician may sometimes initially experience similar disappointment for related reasons; it takes time to train one’s eye to recognize the improvements that have been made. The key to assessing outcomes is to take well-matched photographs in multiple views and to learn to recognize the rejuvenating effects of the injections. Reviewing preoperative photographs with the patient after surgery is an excellent way to assure them that a beneficial improvement has been obtained and that the procedure was productive and worthwhile.

Retreatment

Most of the change in facial contour seen on the patient’s face 4 to 6 months after the procedure is likely to consist of living fat and comprises a persistent improvement. At that point, patients can be told that “what you see is what you get,” because swelling and induration will have almost completely resolved by that time. Four to 6 months after surgery is also the time at which most surgeons performing fat injections think that facial edema, induration, and inflammation have resolved sufficiently that retreatment can be considered if indicated and the patient requests it. Because there is a limit to the amount of fat that can be infiltrated into a thin, atrophic face, the need for secondary fat grafting should not be viewed as a failure of the primary procedure; it is simply an inherent limitation of the technique. If the patient achieved improvement with the primary treatment, a secondary procedure will typically be equally or more beneficial, and often can be far less comprehensive than the first.

Complications

No major complications attributable to fat injections have been seen while performing the procedure concurrent with face lifts, including infection and embolization. However, these problems have been reported and are known to occur when fat injections are performed. To date and to my knowledge, there had been no reports of embolization with blunt-needle injections, but this could change as infiltration cannulas become smaller and more surgeons perform the procedure. Embolization and related complications, including blindness, have been reported with sharp-needle injection; these and other complications of fat injections have been discussed in detail by Coleman.

Complications of simultaneous face lift and fat injections attributable to the fat injection procedure fall largely under the heading of “aesthetic problems” and include lumps, oil cysts, asymmetries, undercorrection, overcorrection, and donor site irregularities. These are more accurately considered inherent risks of the procedure, however, in that even if the procedure is technically performed properly and with care, variations in “take” that can occur with any graft that are beyond the surgeon’s control can cause them. This is particularly true in the case of a fat graft, because fat has shown itself to be a comparatively fragile tissue.

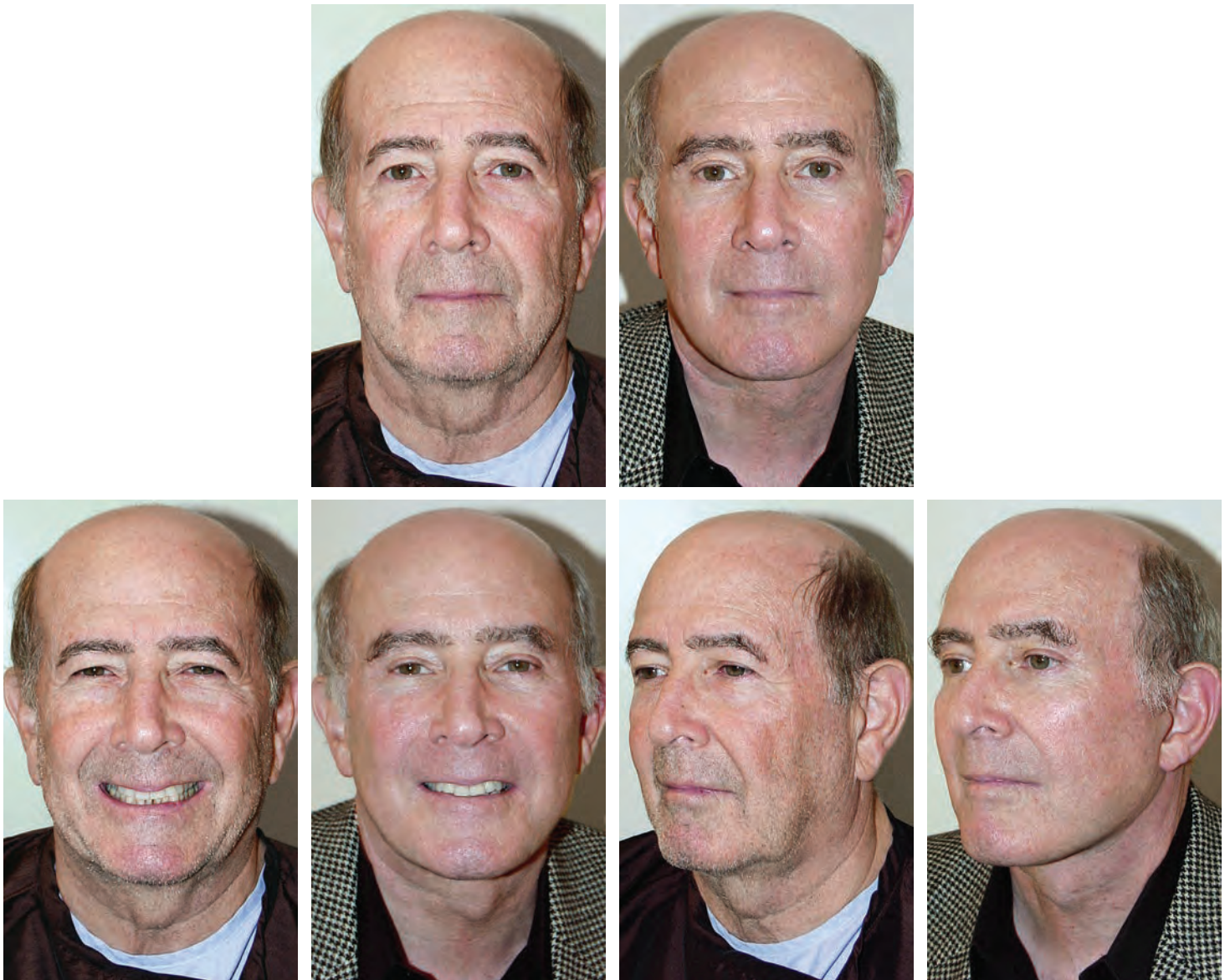
Most complications will be small and easily managed if fat injections are performed properly and conservative additions are made. Oil cysts can usually be simply aspirated or unroofed. Lumps have been exceedingly rare in my practice but are now being increasingly seen in patients treated by other physicians. These can usually be treated by microliposuction, direct excision, or overgrafting with more fat. Asymmetries and undercorrections are generally treatable by additional fat injections and donor site irregularities with touchup liposuction and/or fat grafts. Overcorrection is uncommon in single-stage treatments and is typically seen in patients undergoing multiple fat injection procedures. Overcorrection can usually be improved by judicious extraction of fat from overcorrected areas.

It is best to avoid complications altogether; the surgeons with the fewest are likely to be the ones who take the time to learn to perform the procedure properly, obtain the needed equipment necessary to do so, and introduce it into their practice gradually and in a conservative manner.

Results



This 45-year-old woman had overall facial laxity and panfacial atrophy; she had no previous plastic surgery. She is shown 2 years and 4 months after a high SMAS face lift, neck lift, closed forehead lift, lower blepharoplasty, and fat transfer to the temples, cheeks, lips, nasolabial folds, geniomandibular grooves, stomal angles, and upper and lower eyelid areas (see p. 1630 for an indication of where fat was placed in this patient). A total of 50 cc of fat was placed. Note the soft, natural facial contours and the absence of a tight, pulled, or face-lifted appearance. Facial atrophy has also been corrected, and the patient has a healthier, more youthful, and feminine appearance. The combined face lift and fat injection procedures have produced a result that could arguably not be obtained by either procedure alone.



This 68-year-old man had sagging cheeks, deep cheek folds, and jowls. Loss of facial volume was also evident in his cheeks and infraorbital, perioral, and genio-mandibular groove areas. The patient is shown 1 year and 9 months after a high SMAS face lift, neck lift, closed forehead lift, upper and lower blepharoplasty, partial facial fat injections, and earlobe reduction. A total of 28 cc of fat was placed. A more youthful facial shape has been restored without a tight or pulled appearance. His facial atrophy has also been corrected, and he has a healthier, masculine appearance. The combined face lift and fat injection procedures have produced a result that could arguably not be obtained by either procedure alone.



This 53-year-old woman had facial sagging, and although her face appears full at first glance, a careful examination shows that regional atrophy was present in her temples, cheeks, infraorbital, perioral, geniomandibular groove, chin, and jawline areas. The patient had prior upper and lower blepharoplasties performed by another surgeon. She is shown 1 year and 5 months after a high SMAS face lift, neck lift, temple lift, canthopexy, and fat transfer to the temples, cheeks, infraorbital, nasolabial, perioral, geniomandibular groove, chin, and jawline areas. A total of 66 cc of fat was placed concurrent with the face lift and related procedures. Soft, natural facial contours have been restored, without a tight, pulled, or face-lifted appearance. Her facial shape has been significantly improved, and she now has a more youthful appearance. Although fat has been added to her face, she has a trimmer, more fit, and feminine appearance. Her lips are fuller but natural looking. An unwanted mole has been removed from the left upper lip.



This 75-year-old woman had had multiple prior face lifts and related procedures, including previous laser resurfacing performed by other plastic surgeons. She had significant cheek laxity despite these surgeries, and a fragile, elderly appearance as a result of uncorrected panfacial atrophy. Another face lift would predictably have produced a gaunt, haggard, or even ill appearance. The patient is shown 1 year and 7 months after a high SMAS face lift, neck lift, forehead lift, upper and lower blepharoplasties, canthopexy, and fat transfer to the temples, cheeks, midface, upper and lower eyelids, lips, nasolabial folds, stomal angles, geniomandibular grooves, chin, and jawline. A total of 90 cc of fat was placed concurrent with the face lift and related procedures. No skin resurfacing, facial implants, or other ancillary procedures were performed. In these situations, fat injections are arguably more important to the overall outcome than the face lift itself. Her facial contour has been significantly enhanced and her facial volume restored. The patient has a healthy, fit, more youthful, and feminine appearance—one that could not be obtained by either procedure performed alone.

Clinical Caveats

Patients with significant *facial atrophy* will generally achieve suboptimal improvement from both surface treatments of facial skin and surgical lifts. The addition of fat to areas of the face that have atrophied from age or disease can produce a significant and sustained improvement in appearance that is unobtainable by other means.

Performing fat injections in conjunction with a face lift has certain disadvantages that must be acknowledged, including the learning curve associated with any new procedure, an increase in operating room time, increased postoperative edema, a longer period of recovery, and uncertainty of graft take.

Fat contains adult stem cells that are believed to elaborate growth factors and other as yet not clearly defined cellular mediators that appear to have a regenerating effect on adjacent tissues, and it is likely that injecting fat into the face as part of a face lift has a rejuvenating and regenerative effect on the facial skin.

Isolated fat injections are of questionable benefit to a patient with significant facial sagging and skin redundancy. Although aggressive filling of the sagging face with fat can improve contour and produce a smoother skin surface, it generally results in an unusually large, overfilled face that appears both unnatural and unfeminine.

Areas in need of treatment with fat will vary from patient to patient, and planning fat injections requires looking at the face more as a sculptor and less as a tailor, as we have done in the past.

Poor outcomes are typically obtained if sharp hypodermic needles are used to harvest and inject fat, and if fat is injected in a manner similar to that used to inject nonautologous facial fillers. Sharp needle injection can also result in fat embolization and serious related problems and is not recommended.

Donor sites are typically chosen in conjunction with the patient to improve his or her silhouette, although ideal locations are arguably those areas of diet- and exercise-resistant fat collections where the fat is biologically programmed to persist throughout the patient's life.

Donor sites and site markings should be photographed preoperatively to document what was agreed on and to avoid any dispute over the patient's preoperative condition after surgery.

Fat should be harvested in a thoughtful and artistic manner that improves the patient's figure. Thus it must generally be removed bilaterally and symmetrically, unless body contours dictate otherwise.

Continued

Clinical Caveats—cont'd

Harvested fat is generally not uniform in character: each syringe will contain a variable amount of fat, blood, local anesthetic, and ruptured fat cells, and processing is necessary to obtain uniform material for injection.

A common misconception in treating the hollow upper orbit is that the fat should be injected in the preseptal portion of the eyelid itself. Volume is more properly restored by placing fat in a preorbital position along the inferior margin of the supra-orbital rim.

When injecting the upper orbit, one is working in close proximity to the eye, and although the injection cannulas are blunt tipped, they are capable of perforating the ocular globe.

Filling the upper cheek produces a profoundly beneficial effect on the nasolabial fold, and treatment of the fold is more effective when combined filling of both these areas is made. If the cheek is filled, less fat is needed to improve the nasolabial fold.

A common error when injecting fat into the lips is to fill the lips in such a manner that a large but shapeless and unnatural-appearing “sausage lip” is produced.

Injection of the geniomandibular groove with fat has a high aesthetic payoff and is a good area for the beginning injector to gain experience with the technique.

Although not intuitively obvious, strengthening the jawline and posterior mandibular border makes patients appear more youthful, fit, and attractive.

It is wise to make small additions of fat to “safe” areas at first to gain familiarity with the technique.

Patients should be followed carefully, outcomes critically evaluated, and the surgeon should constantly seek ways to improve injection techniques.

Acknowledgment

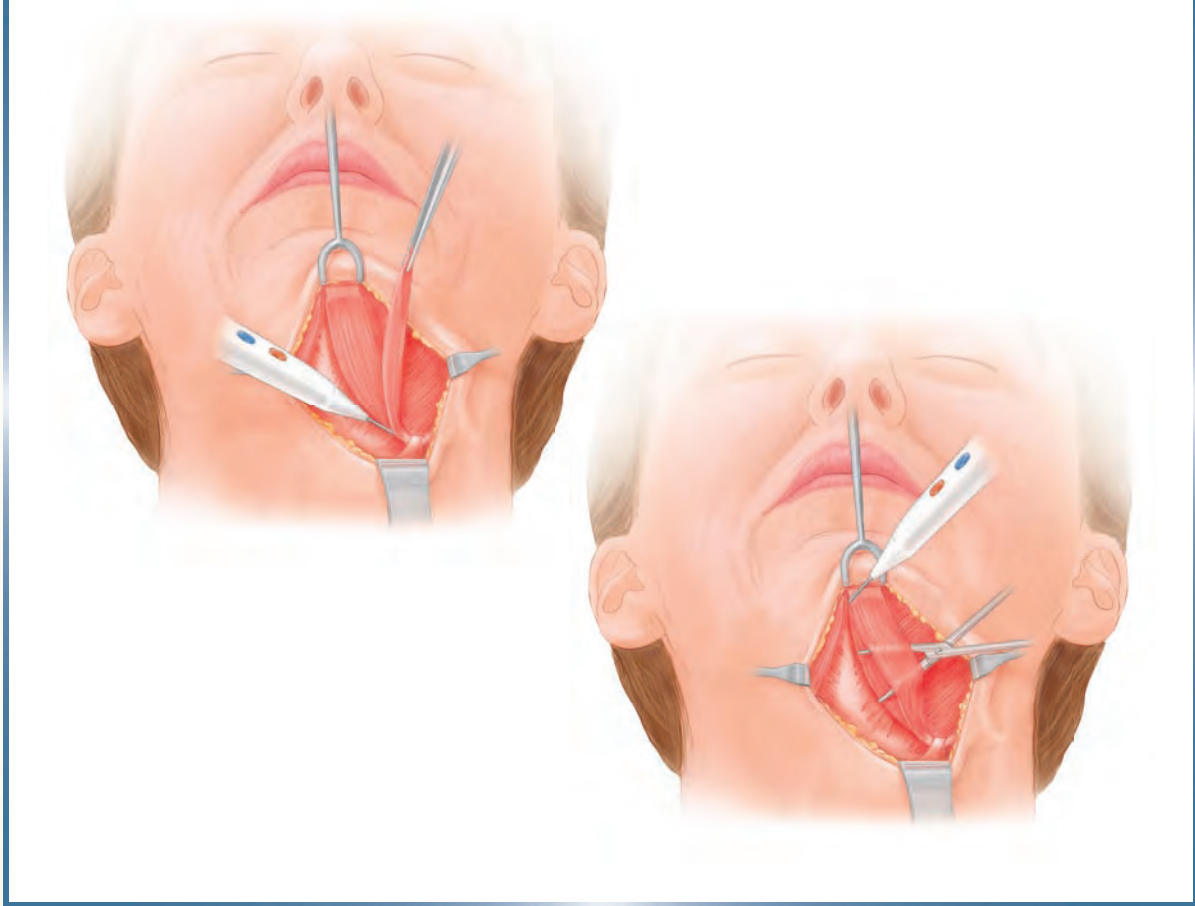
All photos in this chapter are reproduced courtesy of Timothy J. Marten, MD, Founder and Director, Marten Clinic of Plastic Surgery, San Francisco, California.

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CHAPTER 48



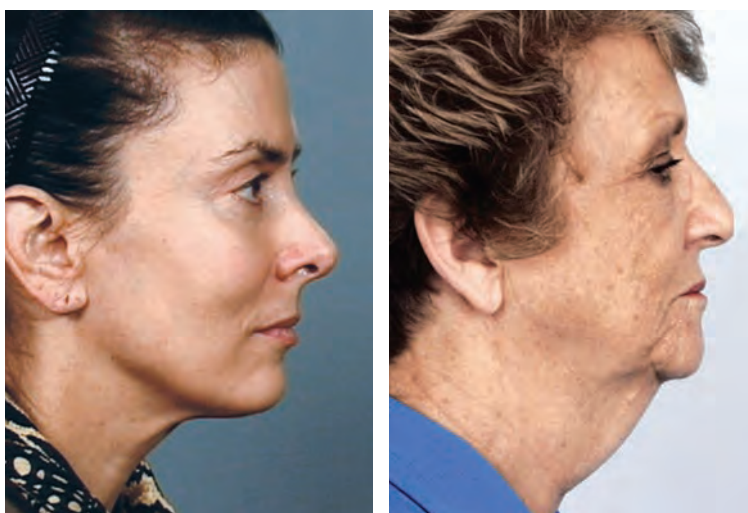
Neck Lift

FOAD NAHAI

My thinking and current approach to treatment of the neck have been influenced by the work of my close friends. Courtiss's submental liposuction, Feldman's corset platysmaplasty, and Connell's modification of the subplatysmal structures, combined with the experience John Bostwick and I had with endoscopic face and neck lifting, have all shaped my approach to the neck. Equally important has been the experience gained through secondary neck lifts.

Courtiss demonstrated that removal of submental fat resulted in redraping and recontouring of the submental skin without any redundancy. Normal skin quality and elasticity are prerequisites. Feldman's corset platysmaplasty improved the submental contour and jawline and eliminated platysma bands. Connell's subplatysmal approach further improved neck contour through the elimination of bulging fat, digastric muscles, and submandibular glands. Our experience with endoscopic face and neck lifts clearly established that all of the components of a neck lift could be performed through minimal-access incisions, and if skin excision was not needed, the standard retroauricular face-lift incision, serving only for access, could be totally eliminated.

Almost all face-lift procedures, especially those involving the SMAS, will have some effect on the neck, particularly the jawline. For a small group of patients this may be all that they need, whereas others will need more extensive procedures involving a submental incision. I have found the vertical simulation test very useful in my decision-making concerning the need for a submental incision and central neck procedures. Neck lifts are not only performed in conjunction with face lifts, but also as separate procedures without a concomitant face lift.



Not all patients' necks have the same morphology, nor do their necks age at the same rate or in the same way. The approach to each neck is individualized to maximize the result. Neck lifting involves a combination of rejuvenation or reversal of the aging process and recontouring. The spectrum of procedures available to us ranges from

liposuction only to a full open neck lift, and through multiple incisions with intervention in each of the three planes—superficial, intermediate, and deep. After careful evaluation, the surgeon selects the appropriate procedure and plans the incisions, vectors, and planes of intervention.

Surgical Options

Liposuction only	Endoscopic neck lift
– Suction-assisted liposuction (SAL)	Short-scar face lift, with or without submental incision
– Ultrasound-assisted liposuction (UAL)	Full-scar face lift, with or without submental incision
– Power-assisted liposuction (PAL)	
– Laser-assisted liposuction (LAL)	
Submental lift	

The components of a neck lift include fat contouring, muscle and fascia plication, subplatysmal procedures, skin redraping and redistribution, and skin excision. Fat may be removed from under the skin, between the platysma muscles, and below the muscle. In the superficial plane the fat may be removed through liposuction or direct excision. The fat between and deep to the platysma muscles is removed by direct excision, since liposuction deep to the platysma is risky and inappropriate. Muscle and fascia plication involves the platysma muscle and its investing fascia. The procedures deep to the platysma include fat removal, tangential excision of the anterior belly of the digastric muscles, intracapsular removal of the superficial lobe of the submandibular gland, and release of the suprahyoid fascia.

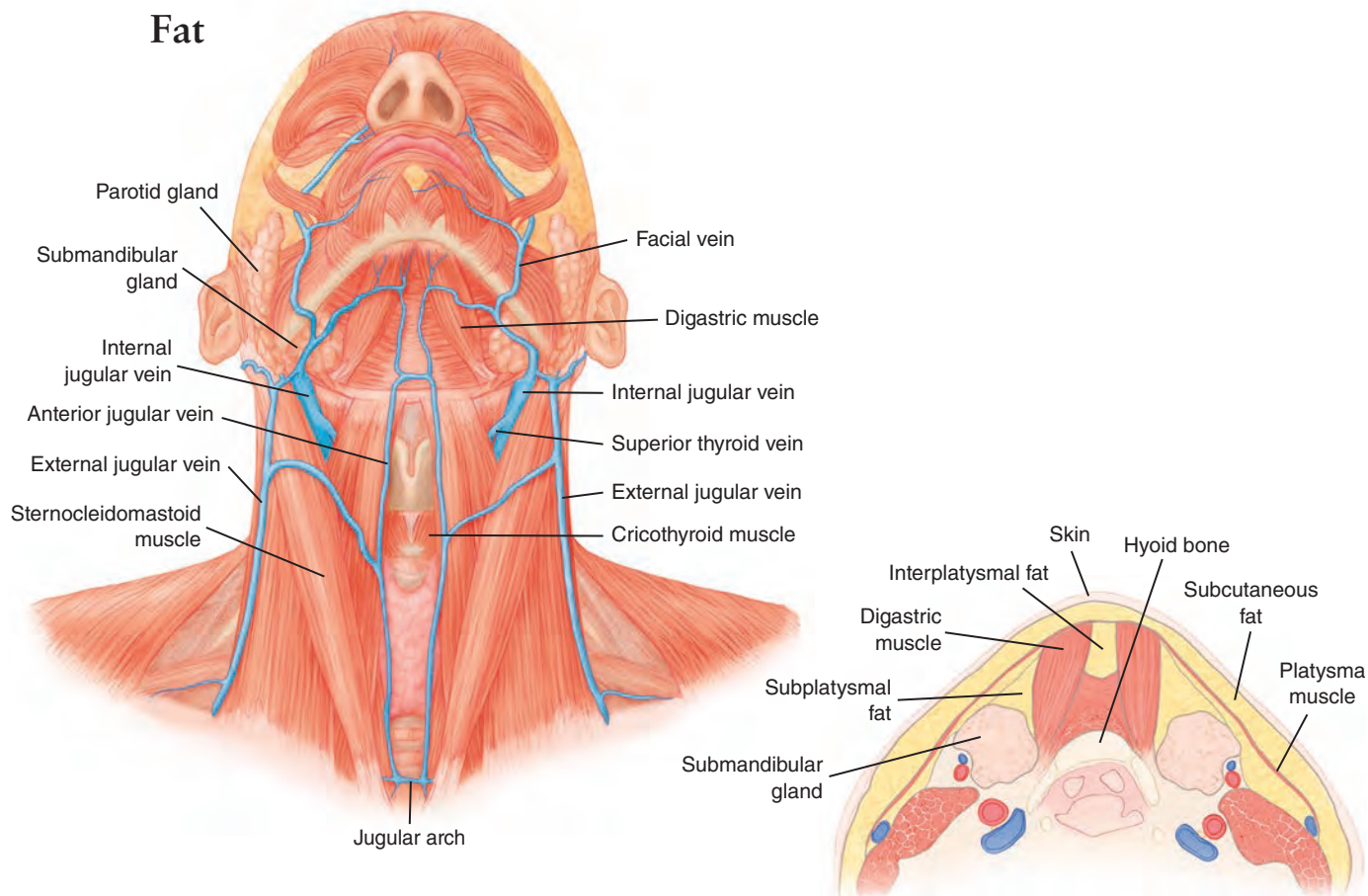
Components of a Neck Lift

Fat contouring	Subplatysmal procedures (deep plane)
– Superficial	Skin redraping and redistribution
– Deep	Skin excision
Muscle and fascia plication	Skin resurfacing

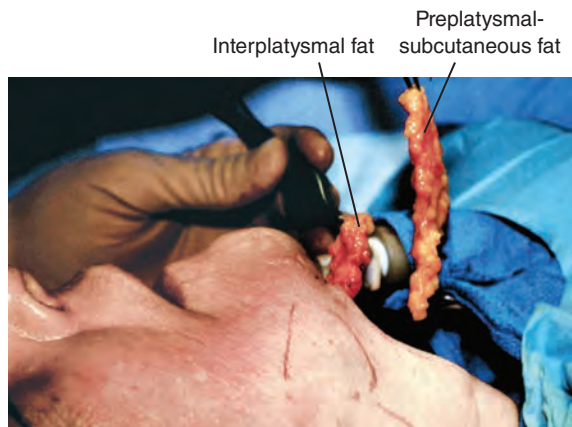
Management of skin in the neck differs from management of facial skin. To obtain optimal results in the neck, it is not always necessary to remove excess skin. The neck affords more options for skin redraping and redistribution, and excellent results are possible without skin excision. The key is to assess the skin of the neck and establish whether the excess, if any, is real or apparent.

Pertinent Anatomy

Fat



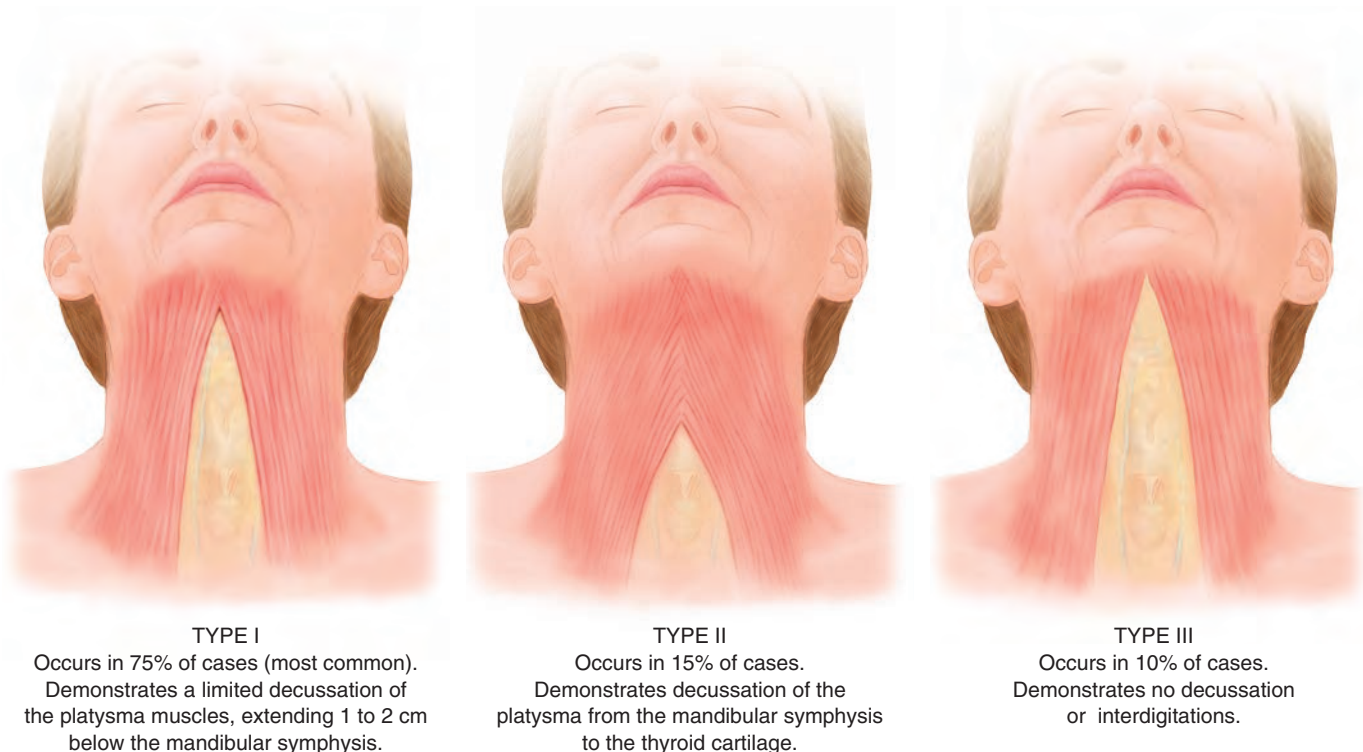
Within the neck, fat is found in the subcutaneous tissue between the skin and platysma muscle. The thickness of this fat pad will vary according to the patient's morphology and weight. It is usually more abundant in the submental area, extending in between the platysma muscles if they are separated at this level. There is also a collection of fat deep to the platysma muscles and superficial to the digastric muscle and the submandibular gland. Dramatic neck recontouring can be achieved through removal of neck fat in these different levels.



This operative view demonstrates en bloc resection of preplatysmal-submental fat and separate en bloc resection of interplatysmal and subplatysmal fat.

Although the jowls or the jowl–fat pads extend into the neck, it is facial fat that should be returned to the lower face where it belongs, or be excised as needed. It is not part of the fat in the neck.

Muscle

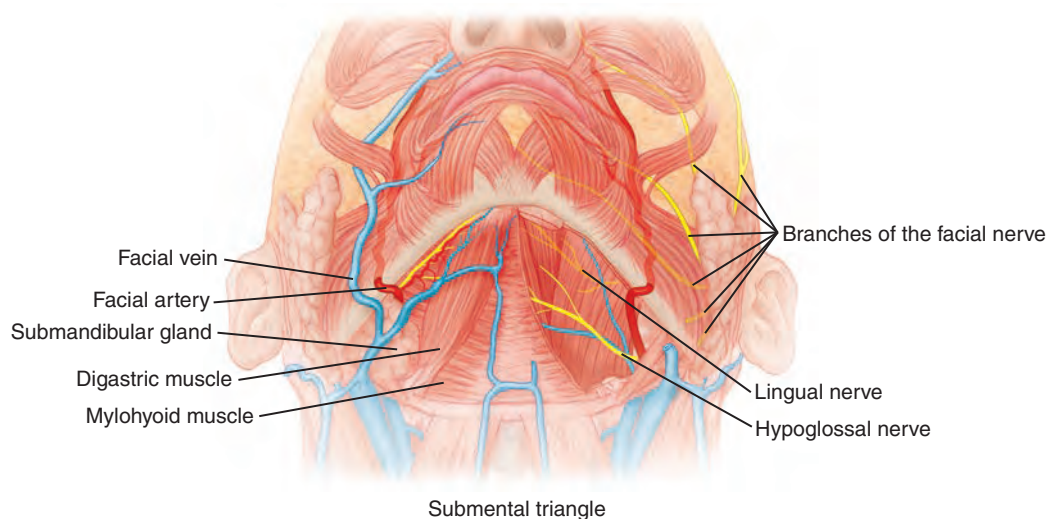


The platysma muscles separate the neck into superficial and deep compartments. The muscles are large, thin sheets that extend from the face across the neck and down to the clavicle. Within the submental area the anatomy of the muscle varies greatly from individual to individual.

Cardoso de Castro's anatomic studies led him to classify the relationship of the two platysma muscles and their interdigitations or decussation in the submental area into three types.

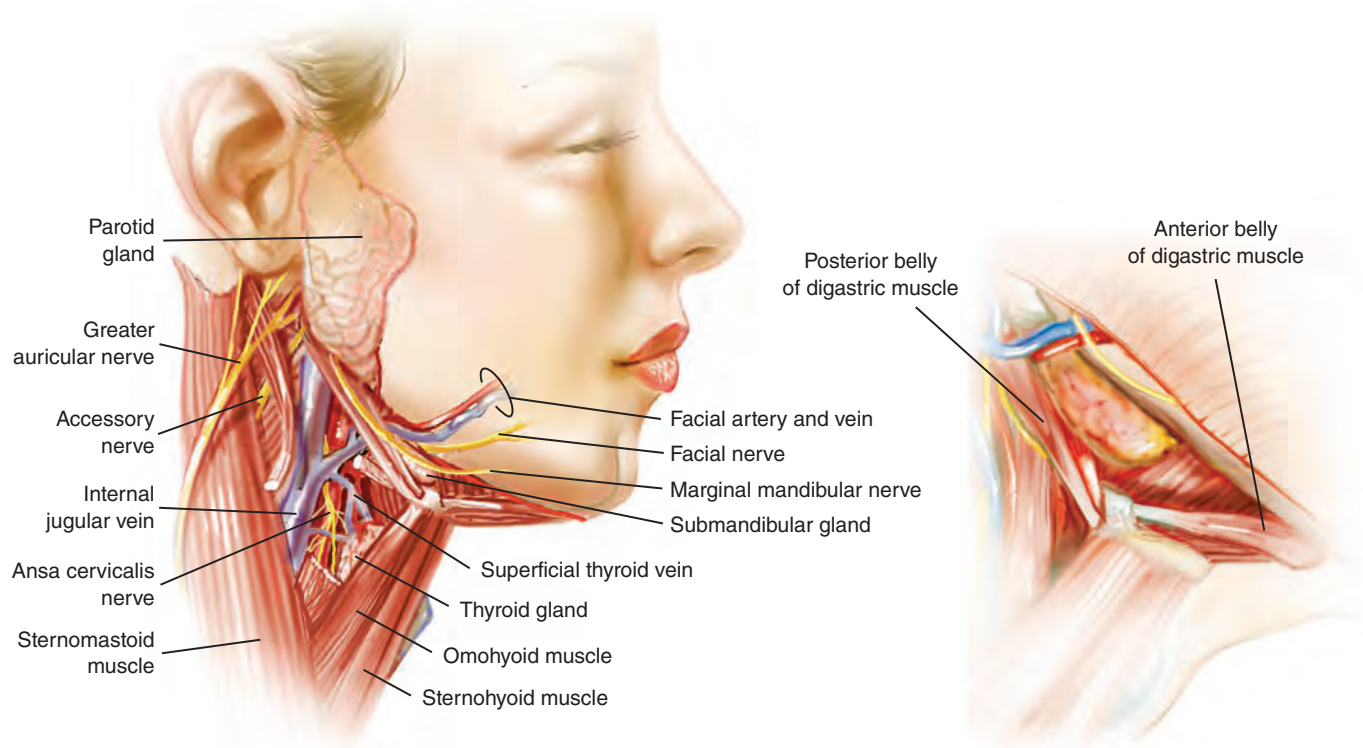
This confirms our clinical impression that in the majority of patients there is very limited interdigitation of the muscles medially, as evidenced by the two visible platysma bands in the aging neck. Stuzin discussed retaining ligaments that hold the platysma against the deep cervical fascia; he described them as a series of fibrous bands extending from the mandibular symphysis distally to the thyroid. With aging, attenuation of this retaining ligament system allows platysmal descent, which accounts not only for platysma bands but also for the increasingly oblique cervical angle, both hallmarks of the aging neck.

Digastric Muscle



The anterior belly and posterior belly of the digastric muscle form two sides of the submental triangle. The third side is the ramus of the mandible. Within this triangle lies the submandibular gland, facial artery and vein, the lingual nerve, and the marginal mandibular branch of the facial nerve.

Submandibular Gland



Submandibular glands lie within the submental triangle. Whether clinically visible glands are protic or simply enlarged is currently a matter of debate. The submandibular gland lies in close proximity to the facial artery, which crosses superficial to the

posterior portions of the gland. The marginal mandibular branch of the facial nerve crosses the gland superficially. The safest approach to resection of the gland is intracapsular, because all of these structures lie outside of the capsule of the gland.

Clinical Correlations

The platysma divides the neck into a superficial and deep compartment. My clinical approach to the neck, the layered approach, includes intervention in three planes: superficial, intermediate, and deep.



The superficial plane includes only the subcutaneous fat, and intervention in this plane is limited to fat contouring.

The intermediate plane includes the platysma and any fat lying between the two muscles and the occasional lymph node. Intervention in this plane includes resection of the fat and plication of the platysma muscle medially and laterally. The deep plane includes the subplatysmal fat, the digastric muscles, and the submandibular gland. The resection of the subplatysmal fat is relatively safe; however, the anterior veins of the neck may course within the fat.

Tangential excision of the anterior belly of the digastric muscle is also relatively safe and bloodless. The dissection of the submandibular gland has to be performed cautiously and within the capsule. Resection of the superficial lobe is relatively safe, because this portion of the gland is well away from the facial vessels, facial nerve, and lingual nerve. Dissections beyond this superficial lobe or extracapsular dissection of the gland are more likely to lead to vascular injury with profuse bleeding and nerve injuries. The suprahyoid fascia also lies in the deep plane. This fascia is occasionally released to further improve on the cervical angle in patients with a high hyoid.

Preoperative Assessment

Careful evaluation of the neck and its relationship to the lower third of the face will lead to selection of the appropriate procedure to meet the patient’s goals. This evaluation also helps to determine incisions, vectors, and planes of intervention. In order of importance in neck recontouring and rejuvenation, I assess the fat, muscles, submandibular gland, and finally, the skin for skin excess and skin elasticity. The jowls and the jawline, the interface of the neck and face are also evaluated.

Focus of Neck Evaluation	
Fat	Skin
Muscles	Neck-face interface
Submandibular gland	

Fat removal has the most dramatic effect on neck contouring. Therefore it is important to determine the accurate location of fat in the neck, whether it is only under the skin or also between and below the platysma muscles.



Evaluation of the location of submental neck fat, pinching the submental area at rest

Subcutaneous versus subplatysma fat is assessed by pinching the submental area during contraction

To differentiate between subcutaneous and subplatysmal fat, the surgeon pinches the submental area with the patient at rest and then after contraction of the platysma muscle. If the amount of fat within the pinch diminishes on contraction of the muscle, a significant amount of fat lies deep to the muscle, indicating that subcutaneous fat removal alone may not result in an ideal contour. If there is subplatysmal fat, an open procedure for defatting below the platysma is indicated, and subcutaneous fat removal or liposuction will yield a suboptimal result.



Evaluation of excess skin of the neck and platysma bands with the patient at rest



Evaluation of platysma bands on animation

The platysma and digastric muscles are evaluated. The platysma bands may be visible at rest or on animation only. The location of the bands and the distance between them is noted. Transcutaneous evaluation of the digastrics may not always be possible, especially in a heavy neck. The digastric muscles are best evaluated during the procedure, after the subcutaneous fat is removed.

If flexion of the neck results in a bulge, it may be appropriate to consider digastric muscle excision. Occasionally the digastric muscle may be visible transcutaneously, especially in candidates for a secondary neck lift. The submandibular gland is often visible transcutaneously, presenting as a bulge within the submental triangle. In a heavy neck it may not be visible, and intraoperative evaluation may be necessary before the surgeon decides about the gland.

Skin

The length of the skin incision in neck lifting reflects the location of the excess skin to be removed. If there is no excess, the entire neck procedure is performed through minimal incisions. I evaluate whether the skin excess is real or apparent, and if it is real, where that excess lies. The success of short-scar procedures relies not only on

assessment of the location of skin excess, but also on the quality and elasticity of the skin. The vertical simulation test is invaluable in evaluating skin quality and skin excess. Normal skin elasticity is essential for all short-scar procedures. Patients who have inelastic, sun-damaged skin must have the full retroauricular incision for a good result.

Apparent excess skin will redrape after recontouring below the skin, such as submental skin following fat removal in all three planes, as well as digastric and submandibular gland excisions. The skin must have sufficient elasticity to redrape. It is the long side of the triangle redraping into the two shorter sides, thus eliminating the apparent skin excess.



Skin redraping is shown after fat removal and platysma plication through a submental incision. A short preauricular incision was made to tighten the SMAS to improve on the jowls and the jawline. No neck skin was excised.

Real excess skin usually extends below the thyroid cartilage and posteriorly beyond the sternocleidomastoid muscle. If there is real excess skin or if skin quality is poor, a full retroauricular incision is essential.



This patient demonstrates skin excess beyond the thyroid cartilage and behind the sternocleidomastoid muscle, as well as poor skin elasticity, as evidenced by the sun-damaged appearance. A full face-lift incision, including a retroauricular extension, is required for an optimal result.

Vectors

Skin evaluation influences my choice of vectors. The vertical vector applied to the neck in combination with a face lift, through SMAS and skin elevation, will define and improve the jawline. The more diagonal vector required for skin resection in the retroauricular area will define and improve the lower and lateral neck.

Neck-Face Interface

If there is significant jowling and descent of the neck-face interface, an isolated neck lift procedure will not address that problem and will lead to a suboptimal result. In such patients a lower face and neck lift is a more appropriate operation. In selected patients, judicious liposuction of the jowl fat will improve the jawline.

Planes of Intervention

Through clinical evaluation of the neck I determine the planes of intervention. If only subcutaneous fat excision is needed, liposuction in the superficial plane would be the procedure of choice. If platysma bands have to be dealt with, an intermediate plane intervention is planned. If subplatysmal fat removal, modification of the digastric muscles, or submandibular gland excision are required, intervention in the deep plane is planned. It is not rare to perform procedures in all three planes.

OPERATIVE TECHNIQUE

Liposuction

The best candidates for liposuction recontouring of the neck are usually younger patients with normal-quality skin and localized excess submental fat. Clinical evaluation of the platysmal muscles and subplatysmal fat is the key to patient selection. In addition to the pinch test described earlier, the patient's neck is examined at rest and on animation for the presence of platysma bands.



Platysma bands visible at rest

No visible platysma bands at rest

Platysma bands visible on animation

If platysma bands are present at rest, the patient would be best served by a submental lift. If bands are visible on animation but not at rest, removal of the subcutaneous fat will expose the bands, and these patients are also best served by an alternative approach that would eliminate the platysma bands. Liposuction will unmask underlying platysma bands or deep plane fullness. The best way to avoid this is a complete and detailed evaluation of the neck before selecting liposuction as the procedure of choice for neck contouring.

Technique

Liposuction of the neck may be performed with the patient under local or general anesthesia. I prefer general anesthesia if additional procedures are planned. The patient is placed supine on the operating table with the neck in full extension. Through an access incision in the submental area and optional incisions behind each earlobe, the neck is infiltrated with a wetting solution. My preference is Ringer's lactate solution with 250 mg of lidocaine and 1 mg of epinephrine added to each liter. I find

that 100 ml of this solution is more than adequate for anesthesia, vasoconstriction, and sufficient wetting of the tissues for UAL. I usually wait 12 to 15 minutes following infiltration for full anesthetic effect and vasoconstriction.

Ultrasound-Assisted Liposuction

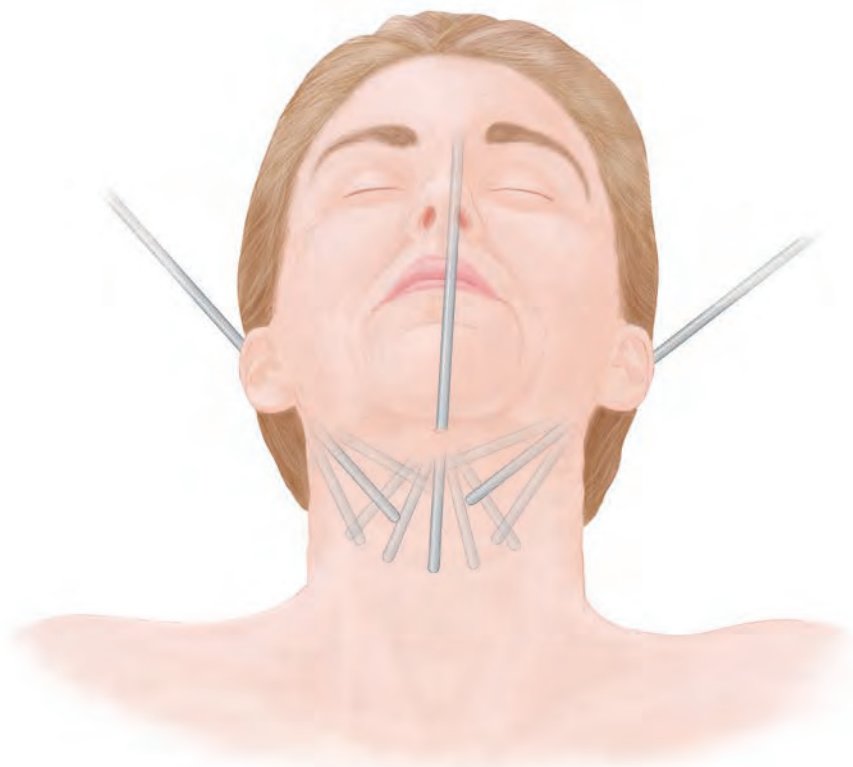
For UAL of the neck, I use a short 2 or 3 ml solid probe with a power setting of 5 and either continuous or pulse mode with the LySonix UAL device (Mentor Corp., Santa Barbara, CA). The UAL phase is usually no longer than 2 to 3 minutes. This is followed by aspiration with a flat 2 or 3 ml cannula. I prefer UAL over SAL in the neck, because in my hands it yields a smoother result.

Suction-Assisted Liposuction

My choice of cannula for suction-assisted liposuction of the neck is a flat 2 or 3 ml single-hole cannula. The suction is started through the submental incision with the hole always toward the deep tissue, never toward the skin. It is important to leave at least 3 to 5 cc of fat on the deep surface of the skin to avoid postoperative irregularities. Removal of an excessive amount of fat or oversuctioning under the dermis will lead to adherence of the skin to the underlying platysma, resulting in tethering and banding.



Excessive fat removal in the subcutaneous plane to mask or correct problems deep to the platysma is a common error that is often difficult to reverse, as seen in this woman. Overaggressive fat removal from her neck and submental area has unmasked platysma bands and prominent digastric muscles.



In SAL of the neck the cannula is passed slowly through separate tunnels, fanning out from the submental incision. I make it a point to never make more than one or two passes in each tunnel, because repeated passes within a tunnel will lead to oversuction and irregularities. If suction of the jawline and lateral neck is also indicated, a separate incision behind each earlobe is made for access. This also allows a crisscrossing of the tunnels in the submental area. It is best to err on the side of leaving too much fat behind rather than oversuctioning. The endpoint is judged by direct observation of the recontouring effect and by pinching the skin and subcutaneous tissues. I also roll my fingers along the skin with gentle pressure to look for irregularities to ensure that the fat removal has been uniform.

No drains are required for liposuction of the neck, but compression is applied with either foam tape or an elastic garment.

Results



This patient underwent liposuction of her neck 4 years earlier. The redraping of her excess neck skin in the submental area is apparent. No skin excision was performed.



This young woman underwent UAL of the submental area and neck; she still has some persistence of her jowls, but the jawline and submental area have been improved.



This patient underwent liposuction of the submental area and transoral chin augmentation with a solid silicone implant. Improvement of facial proportions is demonstrated, with a more pleasing jawline and neck-jaw angle.



Liposuction of the submental area and neck unmasked this patient's platysma bands, which are more noticeable on the right than on the left. A better result would have been achieved through a submental neck lift, including platysma plication.

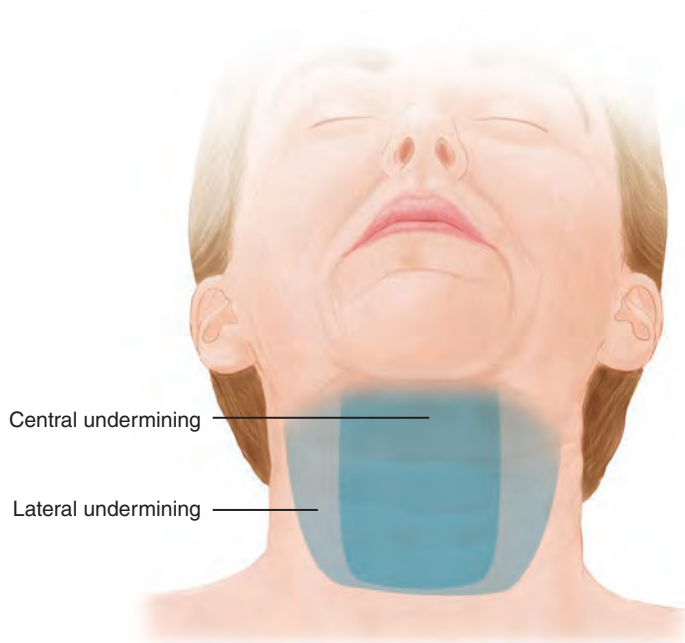
Submental Neck Lift

The submental neck lift includes an incision in the submental area, variable undermining of the neck, and intervention in each plane of the neck as indicated. The submental neck lift may be performed as an isolated procedure for recontouring of the submental area and neck or in combination with a short- or full-scar face lift. The degree of skin undermining will vary from individual to individual, depending on the clinical appearance of the neck, skin quality, and skin excess.

Technique

An isolated submental neck lift is not a common procedure in my practice. The submental approach described here is usually performed in combination with a face lift.

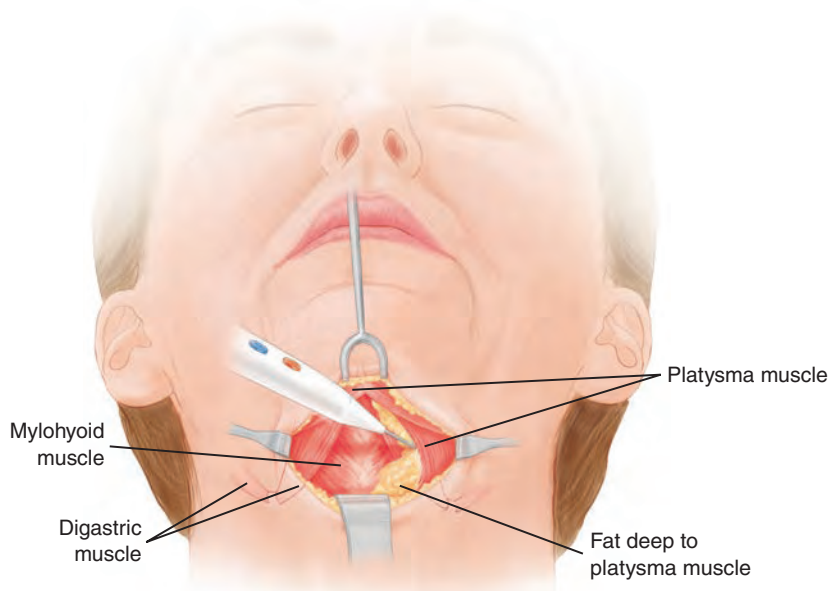
The procedure is performed with the patient under general anesthesia; the patient is placed supine with the neck extended. The neck is infiltrated with a dilute lidocaine and epinephrine solution, usually 0.25% lidocaine with epinephrine 1:400,000. The incision is made just posterior to the submental crease. The dissection is then continued anteriorly under the crease to release it from the underlying tissues. If indicated, this dissection progresses forward and laterally to release the mandibular ligaments. Subcutaneous defatting is then performed. I prefer to do this directly rather than through liposuction. With the scissors, I elevate the skin with a 3 to 5 mm layer of fat.



Extent of undermining laterally varies from patient to patient

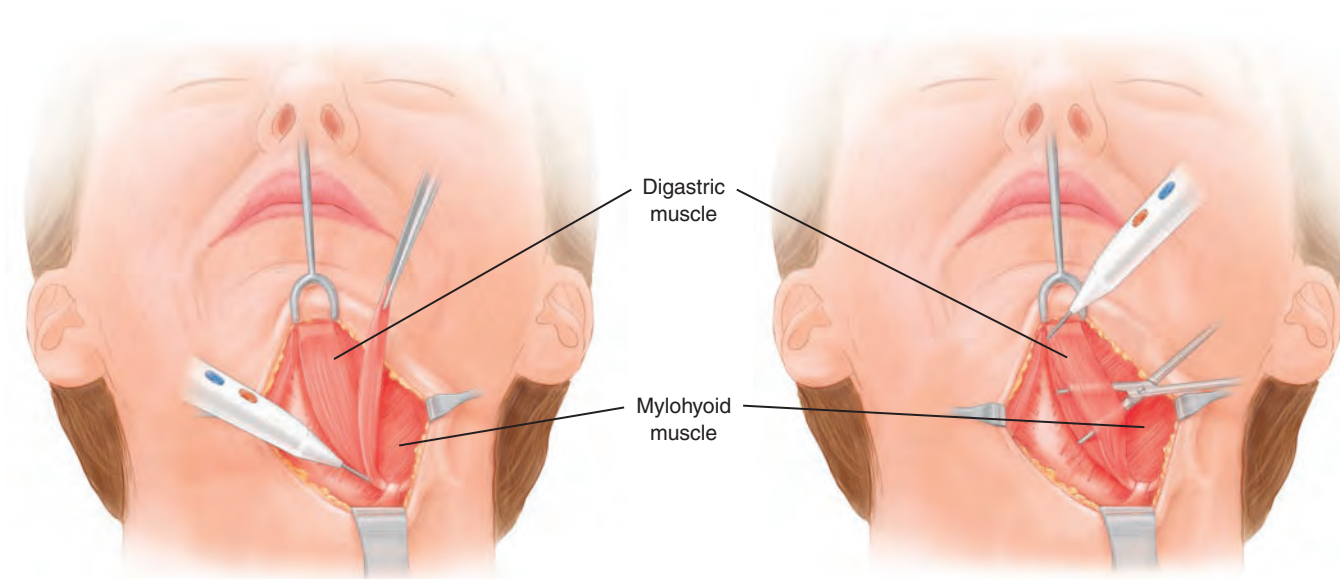
The skin is undermined in this plane toward the thyroid cartilage and laterally as needed. Then this submental fat is resected from the superficial surface of the platysma. In thin individuals in whom no fat removal is planned, the dissection starts directly over the platysma, leaving all the fat on the deep surface of the skin.

If procedures are planned deep to the platysma, the platysma on each side is elevated, and any fat in between and deep to the platysma is directly excised as needed. If interplatysmal or subplatysmal fat excision is planned or performed, it is very important to leave an adequate subcutaneous layer of fat to avoid a submental depression. There is often a very small lymph node or two in the fatty layer, between and deep to the platysma, which is usually included in this resection.

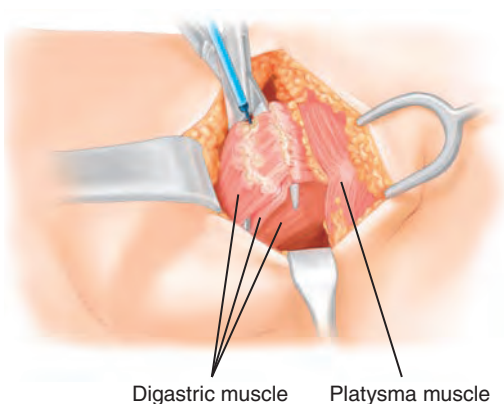
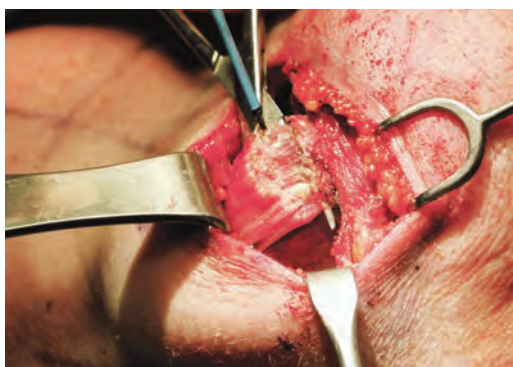
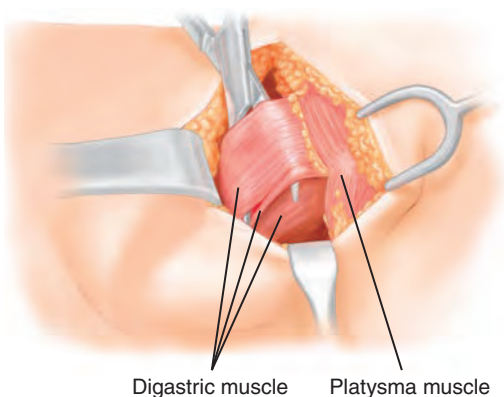
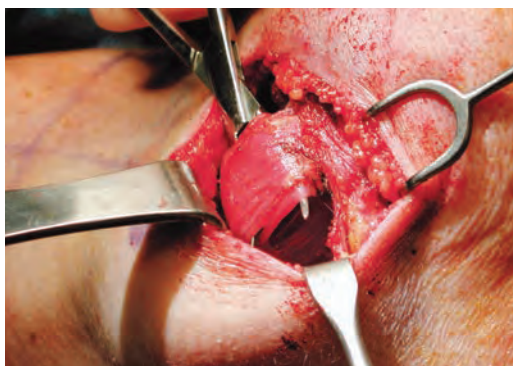


Platysma muscle elevated to expose fat and digastric muscle

Once the platysma has been elevated and the fat deep to it removed, the anterior belly of the digastric muscle on each side can easily be visualized. The anterior bellies of the digastric muscles may be tangentially excised, totally excised, or the two pliated in the midline.

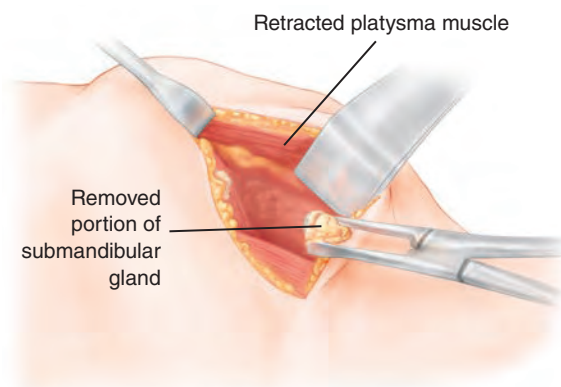
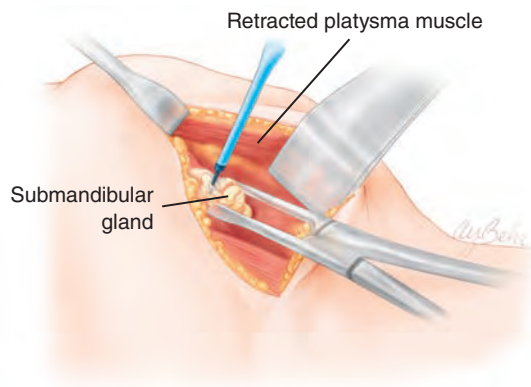
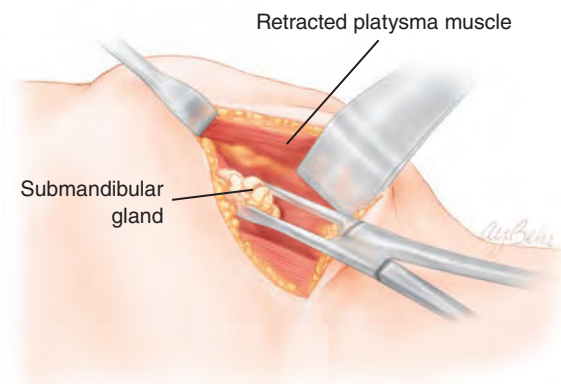


Most commonly I do a tangential excision. This starts anteriorly at the origin of the muscle. A hemostat is passed halfway through the thickness of the muscle.

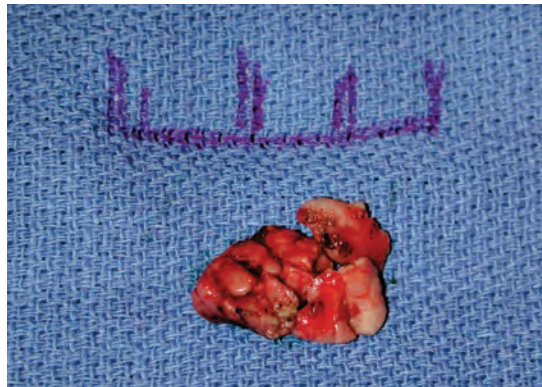


The tips are then spread, and with electrocautery the muscle fibers are transversely divided so that at least half the thickness of the muscle is tangentially excised by dissecting posteriorly along the muscle to its tendinous junction. On the rare occasions when I resect the entire anterior belly, the origin is divided first with electrocautery and then the tendinous junction.

Once the anterior belly of the digastric muscle has been dealt with, an enlarged submandibular gland is easily visualized. Even if a decision has already been made to dissect the gland, the neck is flexed and the contour assessed before proceeding with partial gland excision. The most important step in resecting the gland is to incise the capsule and to perform the resection piecemeal. This will greatly decrease the risk of bleeding and damage to the surrounding nerves.



Once the gland is visualized, I grasp it with an Allis forceps or place a 3-0 suture through the gland and pull the gland into view. The capsule is incised with needle-tip cautery; then the gland is resected piecemeal. If there is any bleeding, the vessels are easily cauterized. Occasionally the small artery feeding the gland is encountered and must be suture ligated. Once the gland has been suitably reduced in size, the neck is again flexed and the effect on neck contour assessed. Gland excision proceeds in this manner until the desired contour is achieved.



Piecemeal excision of superficial lobe
of submandibular gland

After these deeper procedures are completed, the platysma muscles are plicated in the midline. I prefer interrupted sutures with permanent material. The tail end of a suction drain is left deep to the platysma before completing the midline plication. Occasionally I plicate the platysma in two layers. The second layer is sutured with an absorbable material.

For an isolated submental lift, the procedure at this stage is almost complete. Neck undermining extends laterally on either side until effective skin draping is seen. If there is any skin redundancy, the undermining is extended until this excess is eliminated. Any remaining contour irregularities are dealt with through direct fat excision, if possible. Otherwise, liposuction is done with a small, flat 2 or 3 mm cannula. A suction drain is routinely placed in the neck. The skin is closed in two layers—4-0 Monocryl for the dermis and intracuticular 5-0 Monocryl for the skin. Tapes and dressings are applied.

Postoperative Care

Patients undergoing an isolated submental lift may be allowed to go home on the same day as surgery. Those undergoing a face lift in combination will remain overnight in our facility. A compression tape or garment is worn for several days postoperatively. The drain is removed the next day after surgery.

Result



Preoperative evaluation of this man demonstrated platysma bands on animation, with fat superficial and deep to the platysma muscle. He had an indistinct neck-jaw angle. He underwent a submental neck lift, including subplatysmal fat excision and digastric excision. No subcutaneous fat was removed so that a smooth contour remained. He also had chin augmentation with an anatomic solid silicone implant. Postoperative views demonstrate improved contour without skin irregularities.

Endoscopic Neck Lift

Technique

The submental neck lift described earlier has almost entirely replaced our original endoscopic neck-lift procedure. This procedure was essentially the same through the submental incision. Additional incisions were then made behind each earlobe, and the endoscope aided in the wide undermining of the neck skin from one sternocleidomastoid muscle to the other. Endoscopic visualization also facilitated hemostasis. A headlight and a Deaver or lighted retractor through the submental incision have now replaced the endoscope.

Results



This patient underwent an endoscopic neck lift, including platysma plication and neck suspension sutures through a 4 cm submental incision and a 1 cm retroauricular incision on each side. There was no skin excision.



A similar procedure was performed on this patient, who exhibited platysma bands and apparent excess skin in the submental area.

Short-Scar Face and Neck Lift

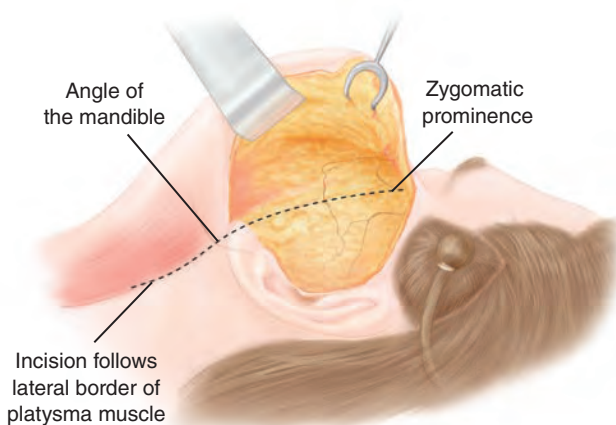


The ideal candidate for a short-scar face and neck lift is a patient who has no excess neck skin with jowls and aging of the neck-face interface. The short-scar approach, with a vertical upward vector on the SMAS and slight diagonal vector on the skin, will improve the jawline. If needed, neck recontouring through liposuction or through a submental approach may be performed at the same time. With the submental approach, I connect the face and neck dissection in the subcutaneous plane. The technical aspects of the procedure for the neck were described earlier.

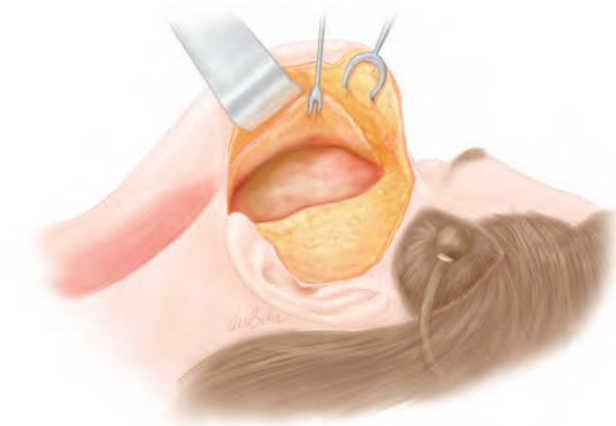
Technique

A prehairline incision is made below the sideburn and a preauricular intratragal incision down to and around the earlobe.

The skin flap is elevated and the dissection connected with the neck dissection, which usually extends to the posterior border of the sternocleidomastoid.



The sub-SMAS dissection is then initiated at the junction of the adherent and mobile SMAS. A diagonal incision is made in the SMAS, extending from the zygomatic prominence medially toward the angle of the mandible laterally. The dissection then continues along the lateral border of the platysma.





The SMAS-platysma flap is mobilized by blunt dissection and then pulled upward in the face and posteriorly in the neck. Usually in a heavy face, a portion of the elevated SMAS and platysma is resected; in thin faces, it is plicated with permanent suture material. My preference is 3-0 Mersilene. The lateral plication of the platysma will further define the neck. This lateral plication is always performed regardless of whether a submental approach and medial platysmal plication is performed. I place a drain in all face lifts. The drain is brought out behind the earlobe.

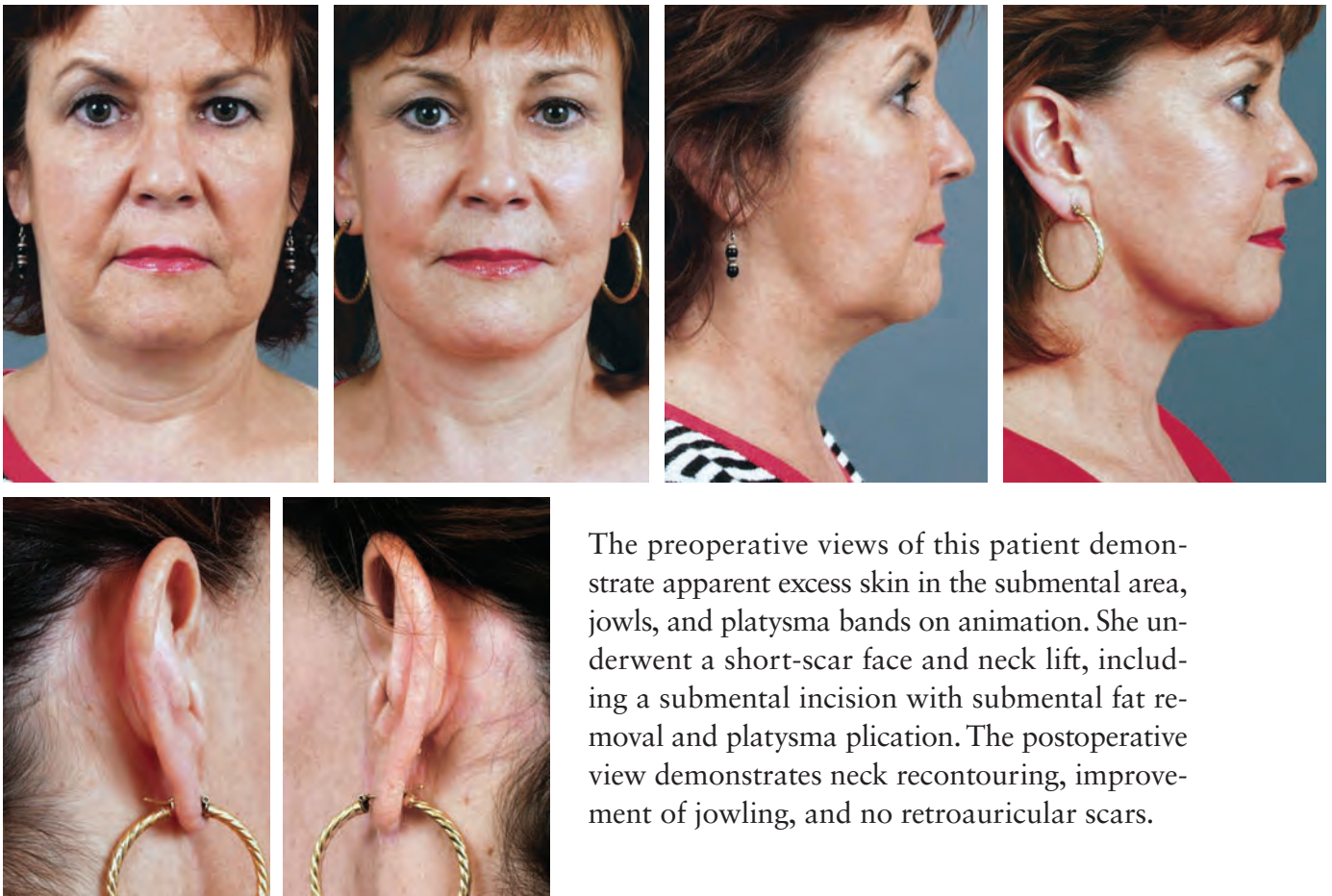


The facial skin is pulled directly upward with a slight diagonal vector posteriorly. The excess skin is resected and an anchoring suture of 3-0 PDS is placed at the base of the concha. The excess skin is then trimmed, tailored around the tragus, and inset. A two-layer closure of 4-0 Monocryl to the dermis and running 6-0 rapid-absorbing catgut to the epidermis completes the procedure. Dressings are applied, and the patient remains overnight in our facility.

Results



This woman underwent a short-scar face lift that included a submental incision with platysma plication. She is seen 4 years postoperatively.



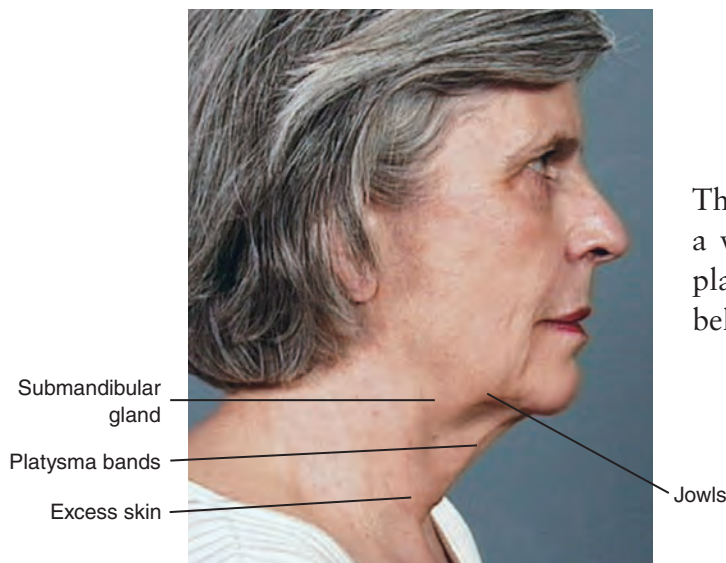
The preoperative views of this patient demonstrate apparent excess skin in the submental area, jowls, and platysma bands on animation. She underwent a short-scar face and neck lift, including a submental incision with submental fat removal and platysma plication. The postoperative view demonstrates neck recontouring, improvement of jowling, and no retroauricular scars.



This ideal candidate underwent a short-scar face lift through a submental incision with subplatysmal intervention, including partial excision of the submandibular gland. A lower lid blepharoplasty was also performed. The postoperative result demonstrates improvement of the submental area and jawline.

Full-Scar Face and Neck Lift

The best candidates for a full-scar face and neck lift are individuals with aging changes of the face and neck, especially the neck-face interface, with inelastic skin and excess lower and posterior neck skin. The vertical simulation test is most useful for selecting short or long scars. The procedure is similar to the operation described previously, with the exception that the skin incision is continued around the earlobe up to the level of the tragus or higher and then across into the occipital hair.



This patient demonstrates jowls, a visible submandibular gland, platysma bands, and excess skin below the thyroid.



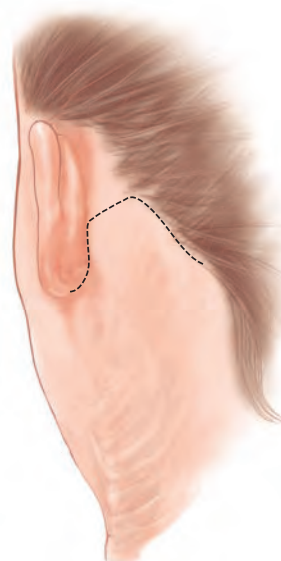
The vertical vector on the SMAS will improve her jowls, and the redraping of the apparent submental skin excess will improve the submental area.



With rather long sideburns, this patient is a candidate for the classic face-lift incision, extending from the temporal area into the occipital hair. The postoperative view demonstrates neck recontouring.

Technique

Occasionally, in individuals with unusually lax skin with significant excess skin in the lower neck, this incision is modified so that at the level of the tragus or just below, it will cross to the hairline and follow the occipital hairline downward and posteriorly. This modification allows resection of more of the neck skin without altering the occipital hairline. There is more extensive skin undermining with this incision, extending beyond the posterior border of the sternocleidomastoid muscle and behind the ear. Management of the SMAS and platysma was described previously, as was the anterior closure of the wounds.



A second anchoring suture of 3-0 PDS is placed through the skin flap and into the mastoid fascia at the level of the earlobe. The excess skin behind the ear is resected in stages, aligning the hairline first and then resecting the skin. I close the hair-bearing scalp with staples and two layers of Monocryl, including a final intracuticular layer behind the ear. When closing behind the ear, it is important to include the deep fascia in the retroauricular sulcus within the closure; this will prevent outward migration of the retroauricular scar. Dressings and postoperative management are the same as described earlier.

Results



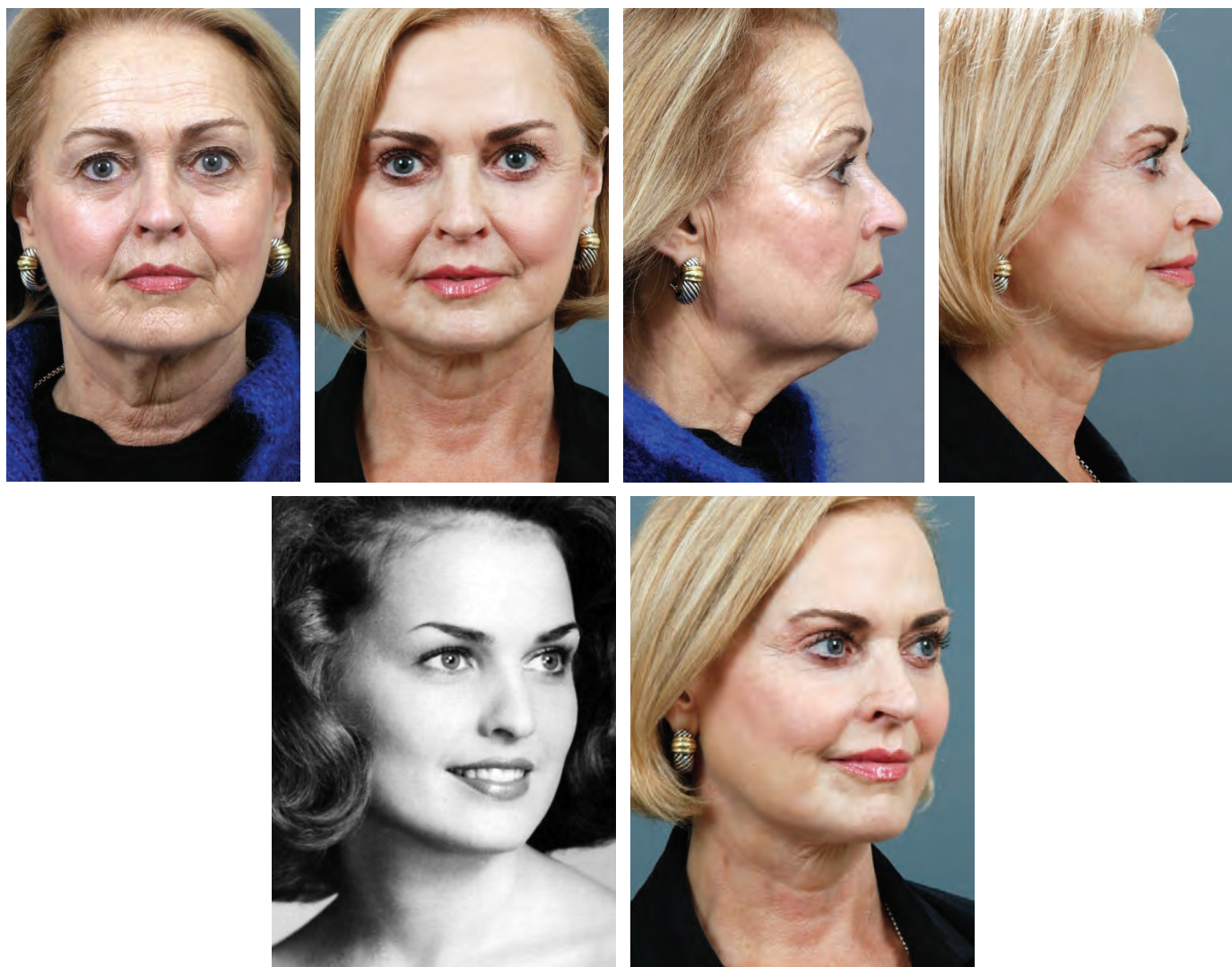
This middle-aged woman, seen preoperatively and 5 years postoperatively, underwent an endoscopic brow lift, upper and lower lid blepharoplasty, face and neck lift with platysma plication, and CO₂ laser resurfacing of the forehead and perioral area. The split-face view demonstrates that brow position has been maintained and platysma bands have been eliminated.



This middle-aged patient underwent a face and neck lift, with upper and lower lid blepharoplasty. No subcutaneous fat was removed from her neck. Her improved contour is the result of subplatysmal procedures, including digastric and submandibular gland excision.



This woman had a lower lid blepharoplasty, face and neck lift, including a submental incision, subplatysmal fat removal, and platysma plication. Her postoperative result demonstrates smooth recontouring of the neck.



This patient in her sixties is shown 3 years after a full-scar face lift, a neck lift with no fat removal, a temporal brow lift, an upper lid blepharoplasty, a lower lid blepharoplasty including fat preservation, orbicularis redraping, and canthopexy. An oblique view of her in her twenties is included. The only flaws in an otherwise good result at 3 years are the wrinkles around her lateral brow and central neck. This is related more to skin quality than to the effectiveness of her face and neck lift. A resurfacing procedure at this stage would be beneficial.



This middle-aged patient underwent a face and neck lift, including subplatysmal fat removal and platysma plication. No subcutaneous fat was removed to maintain a 5 mm layer of fat over the platysma. The improved neck contour is the result of subplatysmal procedures and platysma plication.

Problems and Complications

The most common error I see in neck recontouring is overoperating in the superficial plane to mask or improve intermediate or deep plane problems. The tendency is to overdo the removal of subcutaneous fat, rather than dealing with problems related to interplatysmal or subplatysmal fat, the digastric muscle, and submandibular gland. Reluctance to deal with the deeper layers in the neck leads to suboptimal contouring. The excessive removal of subcutaneous fat leads to adherence of the denuded dermis directly onto the platysma muscle, contraction bands, and unusual skin tethering that is most obvious on movements involving the platysma. Although correction of untreated subplatysmal contour problems is relatively straightforward, improvement of skin-platysma adhesions is very difficult.



Preoperatively, this patient demonstrated neck irregularities, reflecting overzealous subcutaneous fat removal in a previous surgery rather than a subplatysmal procedure to recontour the neck. The problem was further compounded by skin dyschromias resulting from CO₂ laser resurfacing. Excision of digastric muscles and submandibular glands improved her contour; however, the problem of adhesions of skin directly to the platysma is extremely difficult to overcome.

I have found that full mobilization of the skin off the platysma with secondary re-draping offers some improvement. Autologous fat, dermis grafts, and acellular dermal matrix are suitable options for improvement of such problems.

Another common error with neck lifts is related to vectors. The preferred vectors include an upward vector in the face and a diagonal posterior vector. Excessive posterior traction on the neck without adequate vectors of elevation anteriorly along the jawline will lead to a banding or a “hammock effect” whereby the lower and posterior neck are effectively tightened, but laxity remains in the submental area, jowls, and neckline.



This patient, who had undergone two previous face lifts, demonstrates the inappropriate vectors and planes of intervention employed during her previous face lifts. She is shown 1 and 2 years after a tertiary face and neck lift, with redirection of SMAS and skin vectors and subplatysmal recontouring.

Secondary problem areas include the following:

- Skin
- Fat
- Platysma
- Digastric muscles
- Submandibular glands
- Inappropriate vectors

Skin problems following neck lifts are usually related to failure of adequate redraping as a consequence of insufficient undermining or poor skin quality. Most often, however, the cause is undercorrection or failure to correct the jowls, jawline, and the neck-face interface. Correction requires a face lift with appropriate management of the facial skin.

Fat problems are related to overexcision or underexcision. Overexcision is most often performed in the subcutaneous plane; this can be avoided through the use of smaller cannulas, turning the hole away from the skin, limiting the passes in each tunnel, and striving to leave a uniform 3 to 5 mm thickness of fat deep to the skin. Underremoval of fat is most often seen deep to the platysma and adjacent to the submental incision itself. These can be avoided through proper planning and appropriate management of each plane or layer of the neck.

The most frequently encountered problem with the platysma is the persistence of platysma bands. These occur when the bands are not dealt with primarily or when the plication sutures fail. Solutions include reoperation to plicate or resect as indicated, or temporary treatment with *botulinum* toxin injections. Alternative approaches such as transcutaneous division of platysma bands, as advocated by Gonzalez, and stairstep division of the platysma, as described by Saylan, are appropriate options.

A persistent bulge following neck contouring in the submental area most often is the anterior belly of the digastric muscle, which may have been unmasked when subcutaneous fat was removed. Correction is relatively straightforward, entailing digastric excision through a submental incision.

Bulging in the submental triangle results from an enlarged submandibular gland. Most often this was present preoperatively and was not dealt with or was unmasked by subcutaneous defatting. Correction entails a submental approach and partial excision.

Appropriate vectors in the neck include an upward vector in the submental area where the skin redrapes, an upward vector along the jawline, and a diagonally posterior vector behind the ear. For an optimal result, a balance must be struck among these vectors. Excessive traction in any one of these vectors without appropriate countertraction in the others will result in banding or a hammock effect. Correction includes reoperation and remobilization with more balanced traction.

Concluding Thoughts

The neck does not always have to be opened in order to be recontoured and rejuvenated, nor is it necessary to operate deep to the platysma in every patient. A full pre-operative assessment of the three planes, together with intraoperative evaluation, will indicate the procedure or procedures that will most effectively recontour the neck.

Clinical Caveats

The surgeon should avoid overoperating in the subcutaneous plane to overcome deeper problems.

For optimal results, the deeper planes must be approached and modified directly.

For liposuction, cannulas of 3 mm or smaller in diameter should be used.

Patients must be evaluated for platysma bands and subplatysmal fat before liposuction.

Liposuction may unmask preexisting platysma bands.

Liposuction should be avoided in patients who have fat superficial and deep to the platysma, because results will likely be suboptimal.

The number of liposuction passes should be limited to one or two in each tunnel.

The cannula hole should be turned away from the dermis.

Undermining widely is recommended to achieve adequate skin redraping.

Stretched, inelastic skin will not redrape and must be resected.

Recontouring the neck without addressing the lower third of the face will yield suboptimal results.

At least 3 to 5 mm of subcutaneous fat should be left on the skin flap.

Subplatysmal fat should be removed rather than overresection of subcutaneous fat.

The need for digastric or submandibular gland excision should be evaluated intraoperatively.

Submandibular gland excision is performed within the capsule of the gland.

Submandibular gland excision is approached in a piecemeal fashion.

The surgeon must maintain harmony between the lower third of the face and the jawline.

Resurfacing (20% TCA) should be considered to improve skin quality in the neck.

Annotated Bibliography

Connell BF, Shamoun JM. The significance of digastric muscle contouring for rejuvenating the submental area of the face. *Plast Reconstr Surg* 99:1586-1590, 1997.

The authors present the technique of partial resection (tangential excision) of the anterior belly of the digastric muscle. They also discuss the benefits of this procedure; they have found that it results in a well-contoured submental area, prevents residual fullness, is easy to perform, and averts the need for secondary neck-contouring procedures.

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Feldman JJ. Corset platysmaplasty. *Plast Reconstr Surg* 85:333-343, 1990.

Contemporary surgery to rejuvenate the aging neck commonly includes some type of platysma modification. Corset platysmaplasty was developed to avoid postoperative imperfections. The author discusses the rationale and surgical technique for this procedure. A number of case examples are also presented.

Fuente del Campo A. Midline platysma muscular overlap for neck restoration. *Plast Reconstr Surg* 102:1710-1714; discussion 1715, 1998.

The author describes a variation of platysmaplasty, consisting of the overlapping (double-breasted fashion) of the platysma muscles in the midline, solely through a submental approach. This variation allows excellent platysmal suspension and neck recontouring, eliminating the need for posterior traction of the platysma muscle and in many cases avoiding the need for cervical incisions.

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The author describes his classification of the aging neck and his approach for rejuvenation of the neck. This article includes the original description of suspension sutures designed to improve on the jaw line and neck jaw angle.

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In this article I note that in my experience the suspension sutures only temporarily improve and mask problems that lie deep to the platysma. The suspension sutures are designed to tighten the platysma and thus temporarily correct the deep problems. I have found that a direct approach to the fat digastric muscle and submandibular gland deep to the platysma provides longer lasting results. For this reason, I tend to limit the use of suspension sutures in my practice, and I prefer to approach these deeper tissues directly.

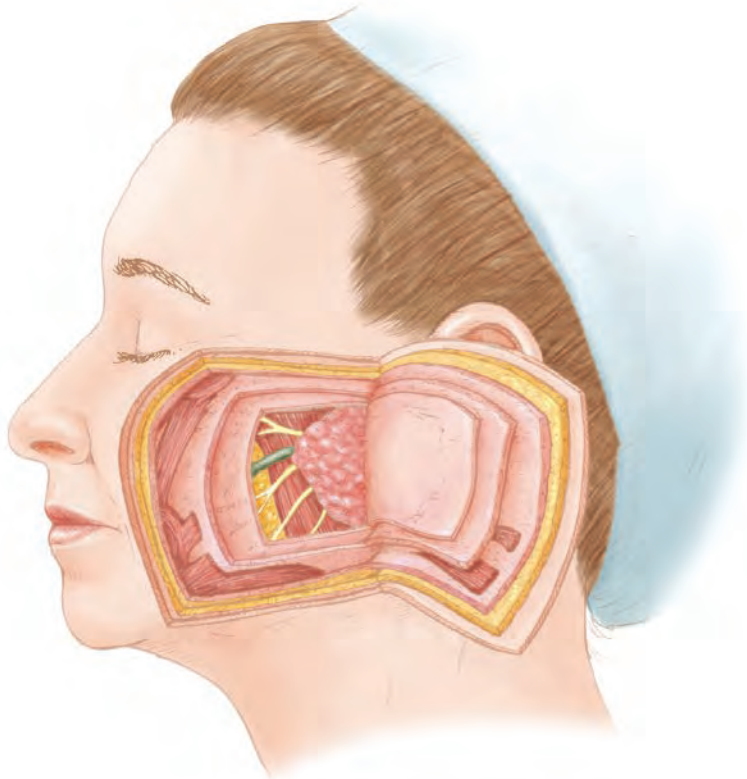
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CHAPTER 49



Reoperative Rhytidectomy

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Plastic surgeons today are seeing more and more patients returning to the practice, or presenting for the first time, with requests for facial rejuvenation after previous facial procedures. Primary face-lift patients' concerns are more generalized; the concerns of reoperative aesthetic patients vary but tend to be very specific. A secondary face-lift patient will often return and have common complaints such as "My creases (nasolabial folds) are back," "My neck is loose again," and "My kids ask me what I'm mad about when I'm not mad at all." Reoperative aesthetic patients are unique in that they already know what they're getting into. They wouldn't have returned to the surgeon if they were not prepared to have a correction. Generally, they will not be dissuaded by fear of pain, fear of anesthesia, or financial issues.

Every facial rejuvenation patient asks, "How long will my face lift last, Doctor?" Although it isn't possible to answer a query like that with precise accuracy, all plastic surgeons know that a face lift does not last forever. Patients must understand that surgery will turn the clock back for them, but the inexorable march of time will catch up with them once again. Patients will always look better than if they had not undergone the operation, although continued aging still occurs. Having a face lift is a very big decision for most patients. Yet having a second or third procedure is becoming much more common.

Educating patients about the possible need to "shore things up" at a future time helps to keep patients within a practice and helps grow one's experience with secondary procedures. If the patient's tissues have lost all elasticity and the subcutaneous fatty layer is full, the chances of requiring an early secondary correction are high.

There are generally five categories of patients who require reoperation. The first category is patients with complications following primary face-lifting. The second is those seeking adjunctive procedures to improve or enhance the previous results. These adjunctive procedures may not require traditional lifting procedures: the patient may only require less-invasive procedures to rejuvenate the face. The third category consists of individuals requesting reoperation for continued facial aging. In this group of patients, only a "tuck-up" procedure may be required. The fourth category is patients for whom the surgeon has previously planned a staged approach. There are two subsets to this: the first group consists of younger patients who require only minimal procedures, such as lipocontouring of the jowls or submental areas, and who subsequently undergo more traditional lifting procedures as they age. The other group comprises some of the most difficult patients to provide satisfactory results for in

one procedure. These patients tend to be older, with doughy skin, fatty facial tissue, and severe neck laxity that extends below the thyroid cartilage and into the sternal notch. They usually require early postoperative tightening procedures in the neck, even as early as 1 year. We find it best to counsel these patients preoperatively about their risk of early recurrence. The fifth category includes those who have not had any complications but are dissatisfied with the results they obtained from their primary facial rejuvenation procedure.

How is reoperative facial surgery different? Often there are asymmetries created by the previous operation that need to be addressed. The anatomy is different; the facial nerve can be in an unexpected place. This is especially true in a thin patient who has had multiple previous procedures. It is very easy to get into the wrong plane and damage the facial nerve; scar tissue and fibrotic adhesions create this altered anatomy. In addition, changes in the blood supply may dictate a new approach. In one way, the previously undermined skin flap can be considered a delayed flap, which is safe to reelevate, but in other situations it can be quite tenuous, especially in a patient who smokes.

In this chapter we will discuss the various reasons that patients request reoperative facial rejuvenation, the diagnosis and management of complications seen in primary rhytidectomy, aesthetic evaluation for reoperative facial rejuvenation, the anatomic differences that must be considered in secondary rhytidectomy, secondary face-lift procedure options, the prevention and correction of the “overoperated” look, and how to maintain the results of facial rejuvenation.

Reasons for Reoperative Rhytidectomy

Continued Signs of Aging

The inevitable signs of aging can be mitigated, but not halted. A patient may have previously been happy with the results of a primary rhytidectomy, but as the years pass, facial aging continues. The patient’s genetics and sun exposure influence the aging process. As we discuss later in this chapter, the appearance of the face as it ages is different in patients who have already had facial rejuvenation surgery. Therefore the approach to correcting facial aging is different in primary versus secondary rhytidectomy patients.

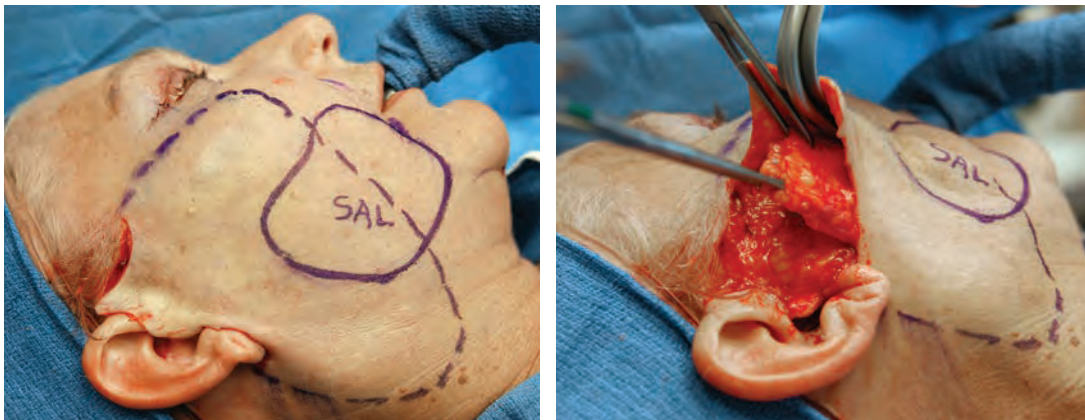


This 58-year-old woman had undergone a subperiosteal face lift and an open brow lift 14 years earlier. She felt that she had lost the rejuvenating glow of her primary face lift. Patients such as this want to maintain a certain look and are excellent candidates for secondary face-lifting. She is shown 1 year after undergoing a secondary face lift with an extended SMAS dissection and endoscopic brow lift.

Continued aging is the primary reason for secondary (or tertiary, and beyond) face-lift procedures. It is helpful if the surgeon knows exactly what was done in the initial procedure. In this case, the patient's lift had been performed in the subperiosteal plane, so in the secondary face lift we felt that a formal SMAS elevation would give the desired result while remaining in a plane free of previous scar.

Adjuvant Procedures to Enhance Previous Results

A patient's previous rhytidectomy may not have included treatment of midface descent, which has influenced his or her decision for a secondary rhytidectomy. Patients may want to add skin treatments with facial laser resurfacing, facial shaping with lipocontouring and/or lipofilling with autologous facial fat injections, or periocular and/or forehead rejuvenation to enhance the previous results. The neck may have been liposuctioned in the previous surgery, but skin tightening or platysma tightening might not have been performed.



Failure to adequately contour the jowl fat in the initial procedure may lead to the need for secondary lipocontouring and reelevation of the SMAS.

Planned Staged Intervention

As aesthetic procedures become more popular, patients are beginning to have facial rejuvenation procedures earlier in life. Many are starting with less-invasive procedures such as neurotoxin injections for improvement of dynamic rhytids, soft tissue fillers for static rhytids, and facial skin laser resurfacing for fine rhytids. At this early stage in the facial aging process, less-aggressive surgical procedures are required to satisfy their expectations, such as facial lipocontouring and/or lipofilling. However, these patients are counseled about the continued aging process and will likely request additional procedures years later.



This patient is a good example of a staged procedure over the course of 15 years. At age 36, she requested improvement of her jowls and submental regions. She was pleased with the results she obtained from suction-assisted liposuction (SAL) of the jowls and submental regions.



Six years later, the patient returned at age 42 and requested surgical correction of her neck and cheeks. She is shown 2 years after undergoing a rhytidectomy. As can be seen, the excess fat in her jowls and submental area were greatly improved with lipocontouring alone. However, as she continued to age, the deeper tissues began to descend, and the rhytidectomy allowed repositioning of the deeper structures and better definition of the jawline.

A planned, staged procedure should also be anticipated in patients who are typically difficult to achieve excellent results in one stage or in those with tissues that are prone to early recurrence of laxity. These patients can be identified by the poor quality of their skin and/or the heaviness of their tissues and should be counseled regarding the expected staged procedure so that the results that both the surgeon and patient anticipate can be achieved.



This 66-year-old woman had considerable loss of skin elasticity, with very loose tissues in the neck and a rounded facial appearance. This type of patient is a likely candidate for an early secondary correction, even as early as 1 year after the primary procedure, because of the probable recurrence of jowling and tissue laxity. Patients must be informed of this in advance to avoid dissatisfaction and unrealistic expectations. She is shown 4 months after undergoing an extended SMAS rhytidectomy.



The patient developed a postoperative neck hematoma. Although the hematoma was drained, she developed a fibrous mass in the central aspect of her neck that failed steroid injection therapy. She subsequently underwent direct excision of the mass 7 months after the initial procedure.



The patient returned 1 year after her primary rhytidectomy with persistent fullness in the jowls and requested surgical correction. She underwent SAL of the jowls and was pleased with the early results.



One year later, she began to develop early descent of the malar fat pad, prominent nasolabial and labiomental folds, and early signs of neck laxity.



4 months after primary extended SMAS rhytidectomy 1 year later: following SAL of jowls 18 months later: 6 months after secondary rhytidectomy

Six months after her secondary rhytidectomy, the patient was again pleased with the results; the recurrent jowling and tissue laxity have been significantly improved.

Dissatisfaction With Previous Results

Even if they have not had any surgical complications, some patients are still dissatisfied with the results from their previous rhytidectomy. It is very important for the reoperative surgeon to spend adequate time with these patients to clearly understand what their expectations are and to discuss with them in detail exactly what results can realistically be achieved. These patients may or may not have discussed their dissatisfaction with the results with their previous surgeon when they seek correction. It is important in this situation to obtain the patient record from their previous surgeon.

Early Complications

The face-lift operation, like any other aesthetic procedure, presents risk for early complications, as shown in the box.

Early Complications of Rhytidectomy

- Hematoma
- Infection
- Skin slough
- Nerve injury (sensory and motor)
- Dysphagia
- Emotional issues

Hematoma after a face lift is a significant source of morbidity. Various authors report the incidence among all patients at 1% to 12.9%. The risk factors for hematoma include hypertension, especially when it is uncontrolled preoperatively; male sex; bleeding disorders; and the use of various medications that interfere with coagulation. Clearly, prevention is paramount in reducing the incidence of postoperative hematoma. Blood pressure control pays the highest dividends in this effort. The incidence of hematoma among patients undergoing facial rejuvenation with local anesthesia and sedation may be a bit lower than for those who are given a general anesthetic. However, with either group it is crucial that blood pressure be normalized before the start of the procedure. If the patient's blood pressure remains greater than 180 systolic or 90 diastolic after initial sedation, we do not proceed until the blood pressure is diminished. Persistent elevation is an indication for referral and workup by the patient's primary physician. Clonidine has been recommended as a useful agent for preoperative control of blood pressure at doses of 0.1 to 0.2 mg orally the morning of surgery.

Men have a higher incidence than women of bleeding during face-lift procedures and more frequently develop postoperative hematomas (between 3.97% and 12.9% of cases). This phenomenon is probably caused by the presence in men's faces of more sebaceous glands and hair follicles, each of which is surrounded by a more extensive capillary network. As a result, the vascularity of male skin is increased, leading to greater potential for blood vessel disruption. Because of this phenomenon, more-limited undermining in men as well as a conservative closed approach to the neck can decrease the surface area at risk for postoperative bleeding. The use of fibrin glue has also shown some benefits for rhytidectomy.

We ask our anesthetists to avoid spikes in blood pressure as the patient emerges from general anesthesia, because this is the time of great risk for the development of a hematoma. Drains are useful as a monitoring mechanism for the amount of bleeding, but it is well accepted that they do not prevent hematoma. Head elevation, cool compresses, pain control, and continued sedation are all useful for maintaining blood pressure at an acceptable level.

Management of Hematomas

Hematomas that develop after a face-lift procedure can fall into two categories: small ones that can be drained at the bedside without returning the patient to the operating room, and large ones in which the cheek and/or neck must be reopened and explored to control the bleeding source.

Bedside Management of Hematomas

The key to successful management of a hematoma is early detection. When detected early, it is more likely that the hematoma can be managed without a return to the operating room. Bedside management is accomplished by removal of enough sutures or staples to be able to remove clots and fresh blood. Preparation for this procedure should include some oral pain medication or sedation if the patient is overly anxious. Blood pressure must be under good control. Thorazine and nitropaste are useful agents for decreasing blood pressure by vasodilation. Towels or "chucks" are spread beneath the patient's head, and the area is prepared with a solution such as povidone-iodine (Betadine) solution. A Yankauer suction tip or red Robinson catheter is helpful for evacuating all the clots; the surgeon can then assess ongoing bleeding. The area is irrigated profusely with saline solution until the return is clear. Then a solution of 20 to 30 ml of 0.25% lidocaine with 1:200,000 epinephrine is injected under the flap. Compression is held for 5 to 10 minutes, and a supportive circumferential dressing is applied.

Operative Treatment of Hematomas

If the hematoma is large and seems to involve both cheeks and the neck, a return to the operating room is indicated. Other factors that should influence the surgeon toward a return to the operating room are these:

- An uncooperative patient
- An overly anxious patient
- A large, delayed hematoma
- Labile blood pressure
- Bilateral hematomas
- A compromised airway

If the patient is having difficulty breathing, immediate removal of sutures and decompression are essential. Since intubation and airway control in the presence of a large hematoma can be exceedingly difficult, we prefer to initially get control of the situation with the patient under local anesthesia with a little sedation. Often very little is needed, because the tissues are frequently still numb from the initial procedure, and antianxiety and pain medications may already have been given. The surgeon must try to locate the primary source of fresh bleeding and pack that area while evacuating the remainder. With large hematomas, we usually remove the majority of the sutures to make absolutely certain that all sources of bleeding have been controlled, because the worst scenario is to think one has control of the bleeding source, only to find that the hematoma has recurred after the patient has left the operating room. Profuse irrigation with saline solution and dilute hydrogen peroxide will usually reveal the bleeding source. Of course, the surgeon can feel most confident when a single “pumper” is found. When multiple bleeding vessels are encountered, we prefer to keep the patient in the operating room under observation a bit longer until we are certain no further bleeding is going to occur. Drains should always be replaced and their proper function confirmed.



Four hours after undergoing a face lift, an endoscopic brow lift, and an upper and lower blepharoplasty, this 59-year-old woman developed an obvious hematoma involving both cheek pockets and the neck. Exploration revealed two arterial bleeding points in the neck that were controlled. All regions were washed out and the skin was reclosed.



The patient is seen 4 months postoperatively with near-complete resolution of the sequelae of this complication.



The consequences can be devastating if a large hematoma goes untreated. This 48-year-old woman was seen in consultation after having undergone a primary rhytidectomy in another state. Postoperatively she developed bilateral hematomas that were treated conservatively. She developed extensive preauricular and cheek scarring for which she underwent a “pickle-fork” procedure 5 weeks later. The patient presented to our practice 7 weeks after her primary rhytidectomy requesting correction of the deformity. She was depressed and was unable to resume her normal activities. The mainstay of treatment of any patient with significant deformity as a result of complications is to not reoperate too soon. In this situation we attempted conservative nonsurgical treatments, including ultrasound and endermologie, while waiting for the tissues to soften. Of key importance is avoidance of additional traumatic injury to the area by manipulation or injections. After 1 year we felt that the tissues and the patient were ready to undergo definitive correction. The plan was to release the scar tissue between the dermis and the SMAS and provide a pad of soft tissue between these layers. Because the patient also requested an abdominoplasty, we developed a plan to harvest dermal fat grafts from her pannus for use in the cheeks.



The dermal fat grafts were spread out and sutured under tension at the periphery of the released pocket. In addition, autologous fat injection was performed in the bilateral nasolabial folds. Very little facial skin was removed during this procedure, which is common in secondary face-lifting.



The patient is seen 3 years after the revisionary facial procedure. Although the lateral cheek rhytids have not been completely eliminated, they are greatly improved, the patient's depression has resolved, and she has resumed her normal activities.

Skin Slough

Skin sloughs usually occur as a result of closure under excessive tension. Blood under the flap, tight dressings, flexed neck positioning, smoking, and diabetes are all contributing factors. If impending tissue necrosis is diagnosed in the early postoperative period by flap cyanosis or lack of capillary refill, sutures should be immediately removed and the skin allowed to retract. As in the case of a released nipple-areola complex, the open wound can be covered with Xeroform and a light dressing for 5 to 7 days, at which time one is often able to reclose the wound with salvage of the skin flap. If hyperbaric oxygen therapy is available, treatments once or twice daily for 5 days can be helpful in salvaging underperfused skin flaps.

If the skin is clearly demarcating, usually conservative treatment is indicated. The surgeon should make certain that the patient is not continuing to smoke if he or she is a smoker. These patients will require repeated reassurance, because this complication may seriously affect their ability to return to work or other social activities. On the other hand, little wound care is necessary in the eschar phase. When spontaneous separation begins to occur, we debride any nonviable tissue and begin dressing changes. Allowing the wound to contract and heal spontaneously usually gives a result that is a better color and texture match than a skin graft would. Obviously, if flap advancement and reclosure is a possibility, this is the best option. However, usually there is too much tension to accomplish this.

Infection

Fortunately, infections following face lifts are rare, but they can have devastating consequences. Prevention is the key. We have all our patients wash their faces themselves at least three times with an antibacterial soap on the morning of surgery. It is difficult to maintain a strict sterile field with facial rejuvenation surgery because of the presence of hair and the oral and nasal cavities within the field, as well as the endotracheal tube or airways and oxygen. Nevertheless, every attempt must be made to avoid contamination, especially when the procedure is prolonged. We have found that soaking braided sutures in Betadine before use has decreased small suture infections, especially in the region of the platysma plication. Also, before closure of the cheek dissection, we meticulously irrigate all open areas with dilute Betadine to wash out any debris, particularly loose fat globules.

Infections may arise in undrained hematomas or seromas; these are often seen as collections in dependent portions of the undermined area. An overlying erythema is usually the first sign, but there may be little or no associated pain or fever. Drainage is of paramount importance, even more crucial than appropriate antibiotic selection; however, cultures should be obtained to guide antibiotic selection. If the combination of drainage and antibiotic agents fails to rapidly resolve the problem, operative exploration should be considered to rule out an infected foreign body. Cotton used to plug the external auditory meatus has been known to drop into the wound and should be accounted for in the sponge and needle counts. In severe infections of the face, thorough irrigation, debridement of any nonviable tissue, and wide drainage is generally effective, in addition to administration of an appropriate antibiotic. Hospitalization and intravenous antibiotic therapy are rarely needed, but anything less than rapid resolution of the infection should be treated in this manner.

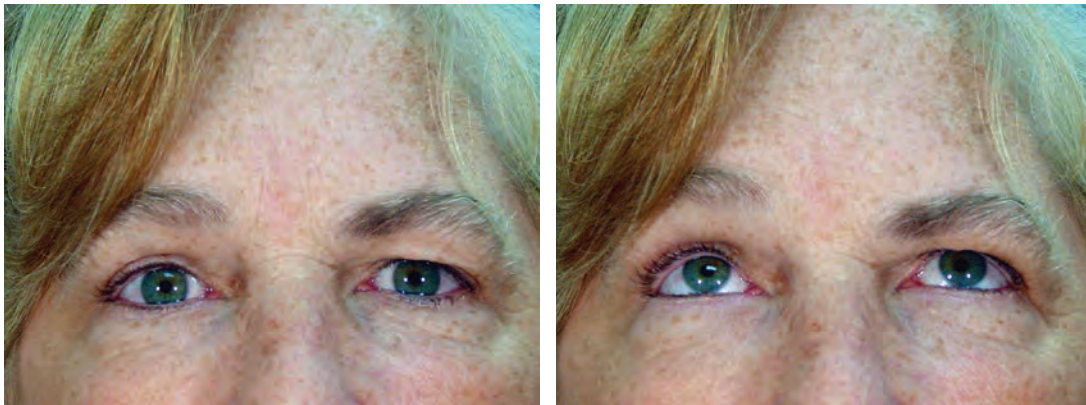
Parotid Fistula

Parotid injury has become a more common event with face-lift techniques that involve dissection in the sub-SMAS plane. Unfortunately, it is even more likely when the SMAS has been previously elevated, as in some secondary face lifts. With any secondary facial procedure the parotid is at greater risk of injury because of altered anatomy and scarring. The gland is at highest risk over its superficial lobe, just at the mandibular angle. The superficial fascia can usually be separated from the parotid fascia unless the plane has been previously obliterated surgically. Actually, raising both the superficial fascia and the parotid fascia in continuity is sometimes advantageous when the superficial fascia is thin, because this adds strength for the deep tissue fixation. However, one is dissecting right on top of the glandular lobules of the parotid, which can look very similar to the sub-SMAS fat and is therefore susceptible to injury. This is how most parotid injuries occur. The duct is rarely injured but can be obstructed if the gland is torqued by suture fixation.

The key to management is to recognize the injury to the parotid at the moment it occurs so that the plane of dissection is immediately corrected. The injured parotid is simply coagulated with the electrocautery or rarely, oversewn with fine sutures if the injury appears to enter the terminal ductules. The area is drained and compression applied for 48 hours. If there is obvious saliva appearing in the drain, the drain should remain in place until the output is minimal. Generally, these fistulas are self-limited as long as the duct is not obstructed. Sialography or duct endoscopy had been reported to be helpful in reopening an obstructed duct. Injuries late in the postoperative period are diagnosed by a swelling and fluid collection over the parotid that on aspiration yields a high amylase titer. Generally, the patient is afebrile. The swelling often increases with eating. It is managed by inserting a closed suction drain, adding a pressure dressing, and administering antibiotic agents. Atropine and glycopyrrolate have been reported to be helpful for their antisialagogue effects.

Nerve Injury

Any branch of the facial nerve can be injured during a face lift. With the anatomy altered from primary surgery, deeper dissections beneath the SMAS during secondary face lifts risk injury to the facial nerve. The frontal branch of the facial nerve is the most commonly injured branch, followed by the marginal mandibular and the buccal branches. Although severed branches do occur, the more typical injury results from traction or thermal injury from the use of cautery in close proximity. The vast majority of nerves which are still in continuity recover in time although this can take up to a year or more. Most recover within 2 weeks to 3 months.



When frontal branch weakness is noted postoperatively and persists beyond 1 month, we favor the use of *botulinum* toxin to weaken the normal side of the face if the patient will accept it while the injured side recovers. Often, as the *botulinum* toxin wears off, the nerve has recovered on the injured side and symmetrical movement is reestablished.

If the nerve has not recovered by 1 year after surgery, a more permanent solution is to perform either a direct or an endoscopic brow lift on the affected side, as well as on the normal side, if indicated. A similar strategy can be used for the marginal mandibular branch with weakening of the depressor anguli oris on the normal side with *botulinum* toxin. Resection of this muscle has been reported for perioral rejuvenation and could be considered if the smile remains asymmetrical beyond 1 year. Injuries to the great auricular nerve are usually managed conservatively; often sensation will return spontaneously.

Dysphagia

Dysphagia is attributable to platysmal tightening, which is a dramatic change for patients who are accustomed to a loose neck. Diazepam is effective for symptomatic treatment early on, and no surgical intervention is ever indicated, because the muscle always relaxes with time.

Emotional Issues

Recovery from a face lift is an emotional rollercoaster for some patients. The effects of anesthesia, steroids, and other medications as well as fear of their eventual appearance can take a serious toll on the emotional well-being of face-lift patients. Pre-operative education can help prepare them for “the blues” that frequently accompany the recovery process. Having a relationship with a clinical psychologist in your community can pay great dividends if intervention seems to be necessary and you need to refer the patient. For most individuals, reassurance is all that is necessary until the swelling and associated distortion has resolved. A recent patient satisfaction long-term follow-up study showed that the overwhelming majority described their improvement in facial appearance as “very good” or “beyond expectations.”

Aesthetic Evaluation for Reoperative Rhytidectomy

With better understanding of the aging process, we now know that repeated pulling of the skin, especially in a disadvantageous direction, will not restore a youthful appearance, but rather yield an appearance that belies repeated surgery and may be exceedingly difficult to correct. The lateral sweep of the lifted lateral cheek and jowl but uncorrected midface is a classic example of this. Therefore patient evaluation must begin by careful analysis of which features are yielding an aged appearance.

Although the aesthetic evaluation for a secondary rhytidectomy is similar to that of a primary rhytidectomy, there are certain physical examination characteristics that may differ. There is on average 8 to 12 years between the time of the primary rhytidectomy and the secondary rhytidectomy. During that time, the patient's skin quality and texture deteriorates from further actinic damage. In addition, some areas of the face retain their tightened support, whereas other areas, such as the midface, continue to descend, creating an unnaturally aged appearance. Other unnatural appearances created by a previous rhytidectomy include distortion of the hairline and sideburns, malposition of the earlobe, loss of tragal definition, facial asymmetries, cross-cheek depressions, and visible scars. It is important to recognize these changes so that an appropriate and accurate treatment plan can be formulated.

Factors to Be Considered in Secondary Facial Rejuvenation

Quality and texture of skin	Visibility and quality of previous scars
Degree of skin relaxation	Perioral lines, lip thickness and length
Degree of fat atrophy with residual hollowing	Platysmal banding and laxity
Facial asymmetries	Submandibular gland prominence
Depth of nasolabial, labiomental, and nasojugal creasing	Chin shape and ptosis
Ear and earlobe malposition, ptosis, and deformities	Contour deformities of the neck resulting from excess fat in neck or jowls
Tragal definition and position	Malar flattening
Hairline shifts or hair loss	Digastric muscle prominence
	Dentition

It is a mistake to immediately conclude that what every patient must have is your definitive face lift, as if whoever did it the first time might be lacking your skill. Many patients may have come to you because they have heard that you are not a surgeon who immediately wants to do another face lift on everyone. You now have multiple approaches available, so the first rule is to *listen to your patient!* Then ask, “What is it about your face that is beginning to bother you?” and “Were these features improved after your first face lift?” Starting with questions like these will assist you to tailor valuable consultation time toward the patient’s primary concerns rather than discussing all sorts of items that the patient will simply not consider. Nevertheless, the consultation is also an opportunity to help educate the patient about procedures or treatments that will give lasting improvement versus treatment options that he or she may have heard about but for which the patient is not a candidate. *Botulinum* toxin and fillers are, quite obviously, not going to produce a face-lift-like result, but some patients are confused about issues such as these.

In recent years, much more attention has been paid to the midface as well as to volumetric shaping of the face. These are issues that might not have been addressed during the patient’s initial face lift. Of course, if the patient returns to the surgeon who performed the original procedure, access to the original records will be at hand. If the original surgery was done by someone else, it may not be possible to determine the exact technique and what was done the first time around. If the assessment reveals an aged midface appearance, this will need to be addressed during surgery. Also, the addition of fillers, including autologous fat grafting for volumetric replacement, is more commonly done today. Therefore it is likely that the patient has not benefitted from some of the newer technologic innovations that plastic surgeons have available to them.

Often the quality of the skin has either further deteriorated or has never been treated in a secondary patient. This may be the primary source of concern for the patient, and improvement is more a matter of resurfacing, filling, or skin care.

Anatomic Differences in Reoperative Rhytidectomy

Skin and Scars

During the interval between the primary rhytidectomy and the planned secondary rhytidectomy, the patient's skin continues to age and thin. There is ongoing loss of collagen in the dermal layer, which causes increased skin laxity and a decreased ability to maintain support with tension. As mentioned earlier, the degree to which the tissues lose support depends on the anatomic area. Although the preauricular area maintains a high degree of support, evidenced by the lack of excess skin in this area removed in secondary rhytidectomy, the preauricular scars can become noticeable with small amounts of migration.



The postauricular scars are also vulnerable to this migration and visibility. The surgeon should make every effort in either a primary or a secondary rhytidectomy to place the scars in areas that are least noticeable.

The patient's scars from previous procedures are an important consideration when planning reoperative surgery. The character of the scars should be noted. Although rare, scars may have developed into hypertrophic or keloid scars. These scars may be improved with a secondary procedure, but the patient must be aware that they may

recur or even worsen. The location of the scars limits the surgeon's ability to place the scars of a secondary procedure in an inconspicuous location. The surgeon should try to place the final scar in an ideal location but should not commit to the final location until after the skin flap has been elevated and the amount of excess skin determined.

Hair Line

A previous temporal incision may have decreased or completely eliminated the patient's sideburns. If the distance between the lateral canthus and anterior portion of the patient's sideburn is long, an anterior hairline incision should be considered to prevent the loss of the patient's sideburn. The incision is usually inconspicuous and is much more attractive than the loss of the sideburn. We try to stay below the sideburn whenever possible and extend the incision as required for adequate skin redraping in the lateral temporal region.



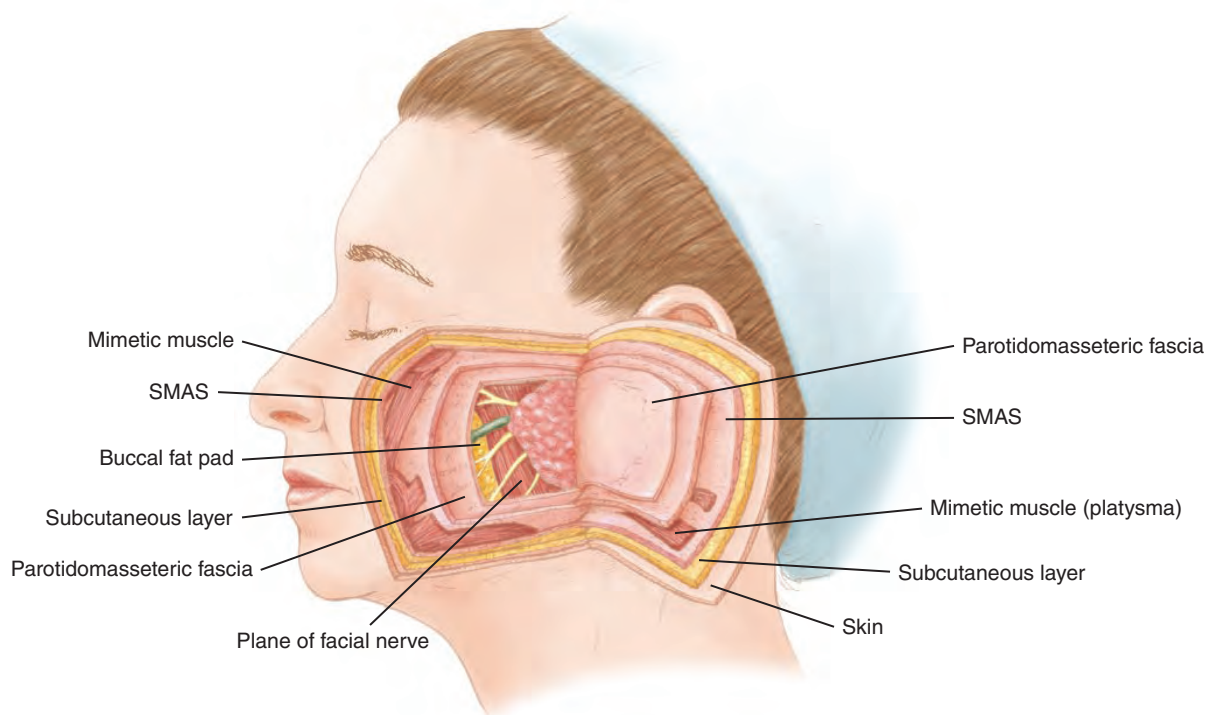
Subcutaneous Tissue



In secondary rhytidectomy patients, the amount of subcutaneous tissue under the previously undermined skin is atrophic. The previous elevation of the skin flap functions as a “delayed flap,” which provides a better blood supply to the skin. It is less likely to have skin blood supply issues unless the patient is a smoker. In such a case, it is important for the patient to quit smoking for at least 4 weeks before surgery and for 4 weeks after. Although the blood supply is of less concern in a secondary rhytidectomy, the previous elevation causes scar tissue to form, and in combination

with atrophic subcutaneous tissue, there is an inability to dissect distinct layers, as in this patient, who had undergone three previous rhytidectomy procedures. It is recommended to proceed with knife dissection until the planes are well established.

Previous SMAS Elevation



It is important to determine from the patient's medical documentation whether the SMAS was elevated in the previous rhytidectomy. If not, a secondary procedure provides a good opportunity to improve the midface with tension on the underlying structures. If the SMAS has been elevated previously, the scar tissue between the SMAS and the underlying parotid fascia is much more difficult to separate. The mobility of the SMAS should be assessed to determine whether plication alone will accomplish the improvement desired.



This is a patient who had previously undergone a primary rhytidectomy with an extended SMAS dissection. She had concerns for recurrent facial aging in the lower third of her face and underwent a secondary rhytidectomy. During the procedure the amount of correction needed to rejuvenate the lower third of the face could be achieved with SMAS plication alone. The markings before the plication can be seen.

Facial Nerve Risk With Reelevation of SMAS

When the SMAS has been elevated previously, the facial nerve is at a greater risk during dissection. In this situation, it is usually safer and easier to plicate the SMAS in the areas that produce the effect that is desired.



This patient developed a marginal mandibular neuropraxia after a primary rhytidectomy with SMAS elevation. Three years later, she returned with concerns for early recurrent neck laxity and prominent labiomental folds. Because of her prior nerve injury with SMAS elevation, we elected to use SMAS and platysmal plications for correction.

Surgical Options for Reoperative Rhytidectomy

Determining which procedure is best for a patient depends on many variables. A good understanding of what the patient's goals are will help to narrow the options. Once this is understood, determining what techniques were used in the previous surgery will help to establish the surgeon's risks and limitations.

Secondary Face Lift Options

- Isolated neck lift
- Threads/suspension suture technique
- “Tuck-up” procedure/mini-face lift
- SMAS procedures (complete, extended, or plication)
- Endoscopic approach to the midface
- Facial shaping and volume restoration with autologous fat injection
- Facial lipocontouring with liposuction

Preventing and Correcting the “Overoperated” Look

Know When to Say When



The overoperated look can occur from a single poorly performed procedure or from multiple procedures performed on the same person. If a surgeon has performed multiple facial aesthetic procedures on a patient, yet he or she is requesting improvements that will inevitably produce an unnatural overoperated look, the surgeon must use better judgment and decline to proceed. It is important to thoroughly explain why further surgical intervention could cause an unnatural and uncorrectable appearance, so the patient does not seek surgical correction elsewhere. Such a pursuit would inevitably lead to further patient dissatisfaction and could also damage the reputation of the surgeon and the practice.

The Lateral Sweep



In this patient with sun-damaged skin and facial wrinkling, the wrinkles run in a cephalad direction as the result of a previous face lift. This problem usually becomes more evident with animation and when the patient flexes the neck.

The term *lateral sweep* is given to the unnatural appearance of the cheeks after facial rejuvenation surgery when there is a distinct curve of the lower facial skin from the jawline toward the superior portion of the ear. The curved rhytids present an obvious overoperated look.

The lateral sweep is created because of skin tension differences between the pulling vectors of the lifted tissues. The greatest tension on the skin is superolateral toward the superior aspect of the ear, where the skin is anchored. The central portion of the face, the midface, is farthest from the skin anchoring and therefore has the least skin tension.

As the face ages, skin tension lessens and begins to descend. In an unoperated face, the tissues descend at equal rates, creating the normal stigmata of facial aging: an obvious lid-cheek junction, prominent nasolabial folds, marionette lines, downturned oral commissures, jowling, loss of an obvious jawline, and cervical laxity with the development of an obtuse cervicomenal angle. However, in a patient who has undergone facial rejuvenation surgery, the tissues descend at differing rates, because after the surgery, the skin and deeper tissues are under different tensions. As mentioned earlier, the tissue of the midface is the farthest from the point of fixation after a rhytidectomy and therefore has the least amount of tension. As the operated face ages, the areas of least tension, the midface, begin to descend earlier. As the midface descends and the inferior and lateral tissues retain their tension longer, the lateral sweep is created.

Deeper tissue manipulation using the SMAS is used to try to minimize this occurrence by resuspending and tightening the tension on the midface tissue. However, the point of fixation for this tissue is not as durable as it is for the skin and therefore still ages earlier. The composite rhytidectomy described by Hamra involves repositioning of the orbicularis oculi muscle in an attempt to strengthen the support of the midface and to minimize the bunching that can occur in the periorbital area.

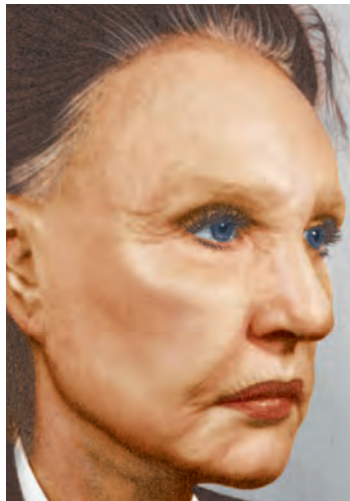
Tragal Distortion



Tragal distortion is a telltale sign of the overoperated face. It is caused by excessive skin tension at the tragus when the incision is brought behind the tragus to disguise the scar. This can be prevented by placing key sutures that will hold the majority of the skin tension at the superior extent of the incision near the anterior and posterior aspects of the ear. After these sutures have been placed, the excess skin can be judiciously excised near the tragus to prevent any skin tension at this point. In addition, we also remove some of the excess fascial tissue directly anterior to the tragus to create the natural depression that should be present and use a deep dermal suture (5-0 PDS) to hold this depression in place.

If a previous surgery has created anterior displacement of the tragus as a result of excessive skin tension, there are techniques to recreate the natural appearance. The base of the tragus can be incised and released using a No. 15 blade scalpel, and a 5-0 nylon suture can be placed between the concha and the tragus to hold it in position. This suture is removed in the clinic 3 weeks later.

Hairline Distortion



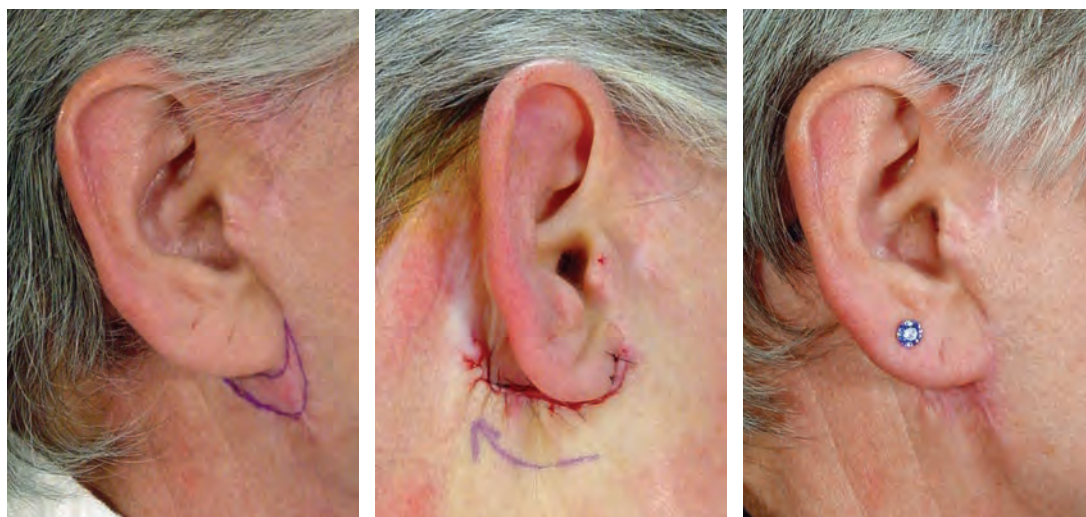
Secondary rhytidectomy procedures can cause hairline distortion, especially at the level of the sideburn. If the previous rhytidectomy incision extended into the temporal hair, then chances are the length of the patient's sideburn has been shortened. Although less skin is removed during a secondary rhytidectomy compared with a primary rhytidectomy, any additional loss of sideburn hair will look overoperated and unnatural. In this case, it is best to extend the incision just below and then cephalad anterior to the sideburn. This incision should be beveled at an angle of 30 to 45 degrees to the external skin surface to permit hair growth through and anterior to the scar. The resulting scar can be inconspicuous and does not risk causing hairline distortion. The area of skin between the previous scar and the new incision should have an adequate blood supply.

Pixie Ear and Earlobe Scar Migration



A *pixie ear* forms when there is too much skin tension at the base of the earlobe inset. This causes an elongation of the earlobe at the site of the inset that is unnatural and is an obvious overoperated look.

This can be prevented by redistributing the skin tension to the appropriate place with key sutures of 3-0 nylon at the superior extent of the anterior and posterior ear. Once these key sutures have been placed and the tension removed from the base of the ear, judicious skin excision can be performed. To further reduce the potential of developing a pixie ear, an area of excess skin at the base of the ear can be deepithelialized and sutured to the base of the concha. This is especially helpful during a short-scar face lift, where the postauricular incision stops at the base of the earlobe. In this case, there is no posterior-superior key suture to redistribute the skin tension. This suture will act to minimize the skin tension at the base of the earlobe inset.



Earlobe scar migration can also be a problem after primary rhytidectomy. Although most scars can be hidden by the patient's hair or make-up, this scar can be very upsetting to the patient. After the scar has had time to mature, this abnormality can easily be treated in the office under local anesthesia. The scar tissue can be deepithelialized and sutured to the caudal portion of the conchal cartilage to provide added support. The skin should be rotated posteriorly, as in this patient, to recreate the natural aesthetic of the earlobe-cheek junction.

Obvious Scars



Visible scars are an obvious sign of an operated look. Most patients would prefer to have the scars hidden from view. This can be accomplished with placing the anterior incisions in or near the hairline and within the natural facial creases adjacent to the anterior portion of the helix and earlobe and at the tragal margin. As the incision continues around the posterior aspect of the ear, the incision should continue in the posterior auricular crease. The incision should continue high before extending horizontally into the posterior hairline. With this incision, the well-healed scars will be very difficult to visualize. If the posterior horizontal incision is placed low, the scar is quite obvious and hinders the patient's ability to hide the scar when the hair is cut short or pulled back.

It may be possible to reposition these scars higher if the incisions were initially placed low or if tissue laxity has recurred and moved the incision lower. One should not commit to the final location of this scar until the entire skin flap has been reelevated and the excess amount of posterior skin is known.



Another rare complication of rhytidectomy is hypertrophic or keloid scar formation. This patient underwent primary rhytidectomy and revision of an anterior vertical midline chest keloid scar. She had other scars that had not developed keloid formation. She was counseled on the risks of obvious scar formation with her known history, but she elected to proceed with the operation. Postoperatively, we treated her with Kenalog-40 injections diluted with 1% lidocaine, with slight improvement.

Recognizing Body Dysmorphic Disorder

When discussing any reoperative aesthetic surgery, it is important to recognize patients with body dysmorphic disorder (BDD). There are three diagnostic criteria listed for the diagnosis:

1. A preoccupation with an imagined or slight defect in appearance
2. Marked distress or impairment in social, occupational, or other areas of functioning resulting from the appearance preoccupation
3. The preoccupation is not attributable to the presence of another psychiatric disorder

Patients with BDD may visit the plastic surgeon for correction of their presumed deformity. It is imperative that the surgeon know the signs of this disorder and refer these patients to the appropriate mental health specialists. It has been reported that patients with this disorder who have undergone corrective surgery have a high rate of dissatisfaction with the results and have even become physically violent. (See Chapters 1 and 8 for more detailed discussion of this disorder.)

How to Maintain Your Results

“How Long Will My Face Lift Last, Doctor?”

As mentioned earlier, most patients want to know the answer to this question in their initial consultation. Patients who have already undergone a primary rhytidectomy have a better understanding of what to expect. Although it is impossible to accurately predict the longevity of this procedure for any given patient because individual differences in current age, skin laxity, actinic damage, genetics, previous procedures, and many other factors, studies show that 10 years is a good estimate.

Over the years, we have learned that the final result and longevity are influenced by the types of procedures performed. Facial rejuvenation has evolved from simply a skin-excision procedure to skin excision with manipulation of deep structures to skin excision with manipulation of deep structures and the inclusion of adjuvant procedures, such as chemical peels, laser resurfacing, dermabrasion, muscle modulation with neurotoxin, and volume restoration with soft tissue fillers, implant augmentation, and/or autologous fat injections. With these various combinations, the procedures can be tailored to the individual's desires and goals to obtain the best results and to improve longevity.

Lipofilling/Lipocontouring

Even with the evolution of rhytidectomy from skin-only resection to skin resection combined with repositioning of deep tissue support, patients and their plastic surgeons longed for improvement in certain areas that were poorly corrected by rhytidectomy. The areas of most concern are in the supraorbital hollow, tear trough deformity, prominent nasolabial and labiomental folds, and the jowls. These areas are either not improved after rhytidectomy, or they develop early recurrence of the deformities.

As the face ages, facial fat begins to descend (creating prominent nasolabial folds, labiomental folds, and the lid-cheek junction), atrophy (creating the supraorbital hollow, temporal hollow, tear trough deformity, prominent zygomatic arches, and cheek depressions), and accumulate (creating the jowl). The results of these facial changes create shadows at these anatomic transitions like that created in a valley between two mountains. To minimize this shadowing, one would either need to fill the valley, decrease the size of the mountains, or a combination of both. As facial rejuvenation has evolved, we have learned that the face should be analyzed and treated as a three-dimensional structure and that we must correct not only the skin and deep tissue laxity but also the volumetric changes seen with aging.

With the improvements in technology, such as ultrasound-assisted liposuction (UAL), and techniques of autologous fat injection, we can now improve these facial areas that have been resistant to long-lasting facial rejuvenation. Liposuction (either SAL or UAL) can remove the fat in areas of excess (analogous to decreasing the size of the mountain); fat injection can add the fat needed in areas of deficiency (analogous to filling the valley). Despite the lack of quantitative evidence of fat survivability, clinical experience demonstrates its benefits. The combination of facial rejuvenation lifting techniques with autologous facial fat injection and facial liposuction has significantly advanced the field of facial rejuvenation by facilitating correction of the volumetric changes seen with aging.

We prefer the use of UAL to slowly and precisely remove jowl fat in patients with lipodystrophy in this area. After repositioning of the malar fat pad and SMAS in a rhytidectomy, we carefully harvest fat for lipofilling of the areas of facial fat atrophy. The donor site chosen depends on the patient's preference and on adequate adipose stores. We most commonly use the lower abdomen. This combination of repositioning the malar fat pad with deep tissue support and replacing lost fat and/or removal of excess fat has significantly improved the lasting results of facial rejuvenation. These techniques can be used in a secondary rhytidectomy to help improve contour irregularities caused by previous facial procedures.

Soft Tissue Fillers

Soft tissue fillers can also be employed as a nonsurgical temporary treatment of facial aging. Many products have been used for soft tissue filling, but hyaluronic acid products have some of the most widespread use. They differ based on the amount of cross-linking present and their particle size. In general, the larger the particle size and the more cross-linking present, the longer the results tend to last. The soft tissue fillers differ in the material that is injected and their longevity. They can be used for facial sculpting and are most frequently used for temporary improvement of prominent nasolabial and labiomental folds, lip augmentation, and tear trough deformities. (See Chapter 12 for a more detailed description of these products.)

Dermabrasion

With the use of a small hand-held electrically powered instrument and an abrasive substance, such as a wire brush or diamond fraise, the epidermis and a portion of the superficial dermis is removed. The dermal appendages allow reepithelialization to occur in approximately 7 days, thus improving the surface texture of the skin. This technique can be used to improve acne scars and deep, coarse rhytids in the perioral area. The pilosebaceous glands of the face should be present in the skin for reepithelialization to occur. This technique should not be used in areas with a paucity of pilosebaceous glands due to the risk of abnormal scar formation. (See Chapter 14 for a detailed description of this technique.)

Laser Resurfacing

Laser skin resurfacing can be performed at the same time as a rhytidectomy. However, deep tissue penetration should not be used over the undermined skin unless the fractional technique is used. We do not resurface the lateral cheeks, since this is the area most at risk for healing problems because of the decreased blood supply in this area of the skin flap. Deep perioral resurfacing will improve the vertical rhytids around the lips that are not corrected with a rhytidectomy. Deep periorbital resurfacing can be used to tighten loose skin around the eyes in patients who have previously undergone a blepharoplasty or in those with minimal excess skin. A micro-laser peel can be performed on the central portion of the face in conjunction with a rhytidectomy to remove up to 30 microns of epidermis; this will improve the patient's complexion and remove superficial pigmentation changes. The ProFractional laser technology improves skin tone through collagen remodeling. With this technique, microholes are made in the skin using the laser set at varying depths. As the skin remodels, collagen is laid down and tightens the skin.

Chemical Peels

A chemical peel can help to improve the actinic changes of the skin. However, this procedure should be performed after the patient has healed from the surgical procedure. The epidermis and varying degrees of dermis are removed through a chemically induced injury. A neocollagen-rich layer replaces the dermis and reepithelialization occurs. Different peels are available, including phenol peels, trichloroacetic acid (TCA) peels, and glycolic acid peels. The depth of the peel is determined by the type and concentration of the chemicals used. (See Chapter 15 for a more detailed description of the available chemical peels used.)

Neurotoxin

Botulinum toxin is produced by the bacterium *Clostridium botulinum* and causes muscle paralysis. The neurotoxin inhibits the release of acetylcholine at the presynaptic cholinergic neuromuscular end plates. It was originally used to treat strabismus in the 1970s but is currently used most frequently for improvement of dynamic facial rhytids.

Neurotoxin injections can be used to treat glabellar furrows (formed by the contraction of the corrugators supercilii and procerus muscles); horizontal forehead rhytids (formed by the contraction of the frontalis muscles); periocular crow's-feet rhytids (formed by the contraction of the orbicularis oculi muscles); marionette lines (accentuated by the contraction of the depressor anguli oris muscles); and vertical lip rhytids (created by the orbicularis oris muscles). In addition, with appropriate placement of the neurotoxin, the shape and position of the eyebrows can be changed to improve eyebrow aesthetics.

Skin Care

Maintaining good skin health will help to improve the appearance and longevity of the surgical results. There are many skin care products on the market today, but the first step in good skin care is to avoid sun exposure. The genetic factors that contribute to the aging of skin cannot be altered through behavioral changes, but the effects of sun exposure can. We recommend that all of our patients be consistent in their use of sunscreen products and sun exposure protection.

Patient Examples



This 60-year-old woman had undergone a primary rhytidectomy 4 years earlier and was concerned about recurrent neck laxity and skin excess. She is seen 2 years after an isolated neck lift.



This 47-year-old woman complained of continued facial aging and prominent scars following an initial face lift at age 36 and a mini-face lift at age 41. The presideburn scars were visible, as was descent of the malar fat pad and minor jowling. We performed a tertiary face lift that included an extended SMAS technique to anchor the malar fat pad to the malar periosteum. Her results are seen at 1 year.



This 60-year-old woman had undergone an endoscopic brow lift, mini-face lift, and lower lid blepharoplasty 4 years earlier. She was displeased with the appearance of her eyebrows and felt she had a continually surprised look. She requested correction of the eyebrow position. We performed a "reverse brow lift," with mobilization of the forehead in the subcutaneous plane and release of the periorbital ligaments through an endoscopic approach and suture fixation of the medial brow through an upper lid blepharoplasty incision. The patient was very pleased with the improvement of the eyebrow shape; the medial portion of the brow had been moved more caudally, correcting her constant surprised appearance.



This patient had undergone a primary face lift 10 years earlier. She now expressed concern about her continued facial aging and obvious scars. The secondary procedure was designed to elevate the postauricular scars up higher behind the ear and restore the gap in the hairline, elevate the midface, and tighten the neck; an endoscopic brow lift was also performed. She is seen 4 years postoperatively.

Concluding Thoughts

Facial reoperative conditions vary, depending on the patient's altered anatomy and concerns. This may include the need to correct complications such as hematoma and nerve injury. Adjunctive procedures are becoming more numerous and are being used to a much greater extent today. Staged procedures in which the patient may need early intervention can be anticipated or can be used to delay more definitive face-lifting procedures. Improving the results of dissatisfied primary facial rejuvenation patients can represent some of the more challenging cases; it can be difficult to achieve results that both the surgeon and patient will accept. The most common reason for reoperation is for the continued stigmata of aging.

It is important to make an accurate preoperative diagnosis and then design the reoperative plan. The surgeon can retain patients in the practice by advising them regarding ways to maintain their results, such as skin care, neurotoxin therapy, dermal fillers, laser skin resurfacing, and ultimately, additional surgical procedures.

Clinical Caveats

The surgeon must educate the patient about the fact that a face lift does not last forever.

It is a mistake to conclude that every patient must have your definitive procedure, as if the surgeon who performed the primary procedure lacked your skill.

Attend to what bothers the patient about his or her face: listen to the patient!

In a secondary procedure, there may be asymmetries resulting from the primary procedure, and anatomic differences: the facial nerve may be in a different place.

It is very important to determine exactly what was performed in the previous procedure, and in what plane.

Because there has been increasing emphasis on the midface and volumetric shaping in recent years, these issues might not have been addressed in the patient's initial face lift.

Patients with poor-quality skin and/or heavy tissues should be counseled that a staged procedure may be necessary to achieve optimal results.

Men have a higher incidence of hematoma after surgery, probably because of the increased vascularity of male facial skin.

Annotated Bibliography

Baker DC, Chiu ES. Bedside treatment of early acute rhytidectomy hematomas. *Plast Reconstr Surg* 115:2119-2122; discussion 2123, 2005.

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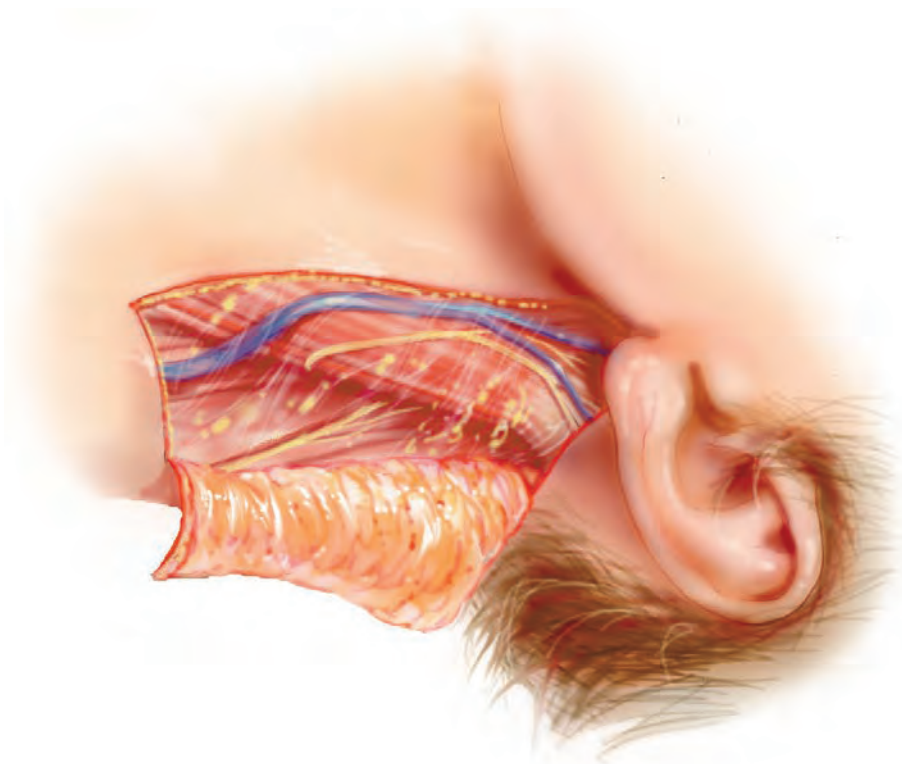
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CHAPTER 50



Avoiding Complications in Facial Aesthetic Surgery

FOAD NAHAI

The only surgeons who have no complications are those who do not operate, or those who deny having complications. The rest of us take measures and make every effort to minimize our complications. The overall complication rate for facial aesthetic surgery is reported to range from 1% to 10%; this rate is a little higher in men.

Data from the American Association for Accreditation of Ambulatory Surgery Facilities (AAAASF) reported by Keyes et al in 2008 included four deaths from face lifts and related procedures. These deaths were caused by venous thromboembolism (VTE) or oversedation and were associated with face lifts in combination with other procedures. Our Paces Plastic Surgery 4-year review of 468 face lifts showed a complication rate of 3.6% in patients who underwent face lifts and blepharoplasties. However, when an additional procedure was performed, this incidence almost doubled to 6.2%, and if two or more procedures were added to the face lift, the incidence more than quadrupled to 14.9%.

The list of potential complications includes the following:

- Hematoma
- Hair problems
- Skin necrosis
- Scars
- Contour irregularities
- Ear deformities
- Nerve injury
- Seroma
- Infection
- Parotid fistula
- Venous thromboembolism
- Death

Hematoma is by far the most common complication, accounting for almost 70% of all face-lift complications. Some complications are rare, some are devastating, and still others are not true complications but rather quality or craftsmanship (“finesse”) issues.

Common complications include hematoma and temporary nerve paralysis. Devastating complications include unrecognized or untreated hematomas, skin slough, permanent nerve injury, and VTE. Although an expanding hematoma is not uncommon, an unrecognized or untreated hematoma is a real disaster that can lead to significant skin necrosis or even airway compromise. Finesse issues include unfavorable results, un-

sightly scars, ear distortions, hairline distortions and hair loss, and contour irregularities. Unusual complications include seroma, parotid fistula, and infection.

In terms of litigation, face lift ranks number five among aesthetic procedures, representing 9% of the total number of lawsuits filed, according to data from The Doctor's Company (Napa, CA) for 1997 to 2002.

Avoiding Hematoma



The incidence of hematomas with face lifts ranges from 1% to as high as 10%. According to data from the AAAASE, hematoma after a face lift and related procedures managed on an outpatient basis ranked only second to hematoma after breast augmentation and revision and second to abdominoplasty for hematomas managed on an inpatient basis. The incidence in men and in patients with a history of hypertension is significantly higher.

Steps to minimize the risk of hematoma are taken before, during, and immediately after the operation. Preoperative measures include a workup and control of blood pressure and instructing the patient to avoid medications, dietary supplements, and herbal remedies that may affect bleeding. There have been recent reports that some antidepressants may play a role in the development of hematomas after face lifts. We encourage our patients to take supplements of vitamin C to minimize bleeding problems. All men are questioned about prostatic symptoms, and it is essential that such symptoms be controlled before a face-lift operation.

MEDICATIONS TO AVOID BEFORE SURGERY

Do not take vitamin E, garlic tablets, weight-loss products, aspirin, or aspirin products for 1 month before surgery, because these may promote bleeding.

If you are taking warfarin (Coumadin): Please notify us immediately; you must also contact your physician who prescribed this drug. He or she will need to make the decision as to whether you can be taken off this drug for surgery and will need to provide a written medical clearance.

ASPIRIN products include:

Alka-Seltzer
Anacin
Ascriptin
Bayer
BC Tablets
Bufferin
Cheracol
Cope
Coricidin
Darvon Compound
Dristan
Ecotrin
Empirin
Excedrin
Fiorinal
Midol
Percodan
Sine-Aid
Sine-Off
Soma Compound
Stendin
Triaminicin
Vanquish

IBUPROFEN medications include:

Advil
Alleve
Medipren
Motrin
Nuprin
Rufen

ANTIARTHRITIC medications include:

Anaprox
Ansaid
Butazolidin
Clinoril
Daypro
Dolobid
Feldene
Indocin
Naprosyn
Orudis
Relafen
Tolectin
Voltarin

DIETARY SUPPLEMENTS include:

Echinacea
Ephedra
Garlic tablets
Ginko biloba
Ginseng
Kava
St. John's wort
Valerian
Vitamin E

Please take only acetaminophen (Tylenol) for pain before your surgery.

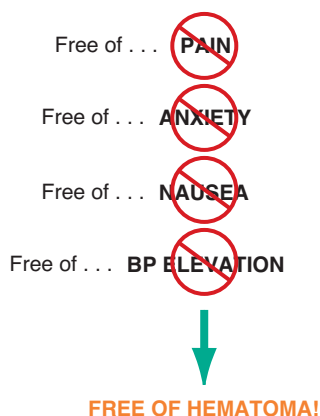
We encourage you to take 2000 to 3000 mg of vitamin C every day before your surgery and during the recovery to alleviate bruising and swelling resulting from the surgery.

Intraoperative measures include close cooperation between the anesthesiologist and the surgeon. When these two work as a team, the incidence of hematoma can be significantly reduced. Rigorous control of blood pressure during the procedure is important. The actual blood pressure, whether high or normal, is not as important as avoiding fluctuations in blood pressure. A report by Jones and colleagues suggested that postoperative hematoma might be related to the rebound effect through the use of vasoconstrictors; they recommended that vasoconstrictors be avoided. However, I still inject vasoconstrictors and rely on meticulous hemostasis. Appropriate fluid management during the procedure is also important. We routinely place a Foley catheter for procedures taking 4 hours or longer so that the patient will not have a full bladder in the recovery room.

The routine use of clonidine (a long-acting alpha-2-adrenergic blocker with central and peripheral effects) has been advocated perioperatively to control the systolic blood pressure. Most if not all of my patients undergo face lifts under general anesthesia, and I do not initiate clonidine therapy before the operation. All male patients are routinely treated with oral clonidine in the recovery room, and if need be, with parenteral antihypotensive agents until the clonidine becomes effective. Women are given clonidine on an individual basis.

I think the immediate postoperative period is the most critical for avoiding hematoma. In my experience most hematomas occur in the recovery room or within the first 12 to 18 hours postoperatively. Although delayed (up to 3 weeks) hematomas have been reported, these are most likely caused by bleeding from the superficial temporal or other relatively large vessels. Close monitoring and observation in the recovery room and during the first 12 hours postoperatively is the key to minimizing hematoma.

Patients are monitored for pain, anxiety and agitation, blood pressure elevation, restlessness, nausea and vomiting, and a full bladder. Aggressive control and treatment of each of these will significantly reduce the incidence of hematoma. Therefore, in all our male patients, in addition to clonidine, we administer postoperative sedation and antianxiety medication. Selectively in female patients, we do the same. I have found that by working with the same anesthesia team, the same operating room team, and the same recovery room team, the incidence of hematoma in my personal practice has been significantly reduced. When I was in practice at a university medical center, I did not always work with the same team in the operating room, nor did the same team always take care of my patients in the recovery room. During that time, the incidence of hematoma in my patients was 6%; over the past years that I have been in private practice, always working with the same team, the incidence has been lowered to 1% to 2%. This parallels the experience reported by Baker et al in private practice, after they instituted the guidelines that we have since adopted.



Sequential or repeated hematomas may indicate an underlying deficiency in the blood-clotting system. Even a bilateral hematoma may point to blood-clotting problems. We routinely review the patient's platelet count and solicit a history of bleeding tendencies, hematoma, or prolonged bleeding associated with previous dental or surgical procedures. In patients with unusual bleeding during the procedure or those with sequential or bilateral hematoma, administration of desmopressin acetate (DDAVP) has proved effective. The recommended dose is 0.3 $\mu\text{g}/\text{kg}$ given intravenously over a 10-minute period.

Management of Hematoma

Expeditious and appropriate management of hematoma will minimize its consequences. Immediate decompression of an expanding hematoma in the recovery room or at the bedside can often defuse the situation. Patients with expanding hematomas are agitated, apprehensive, fearful, and in pain. Cutting the sutures and inserting a gloved finger or sterile instrument will deliver the clots, relieving some of the tension, pain, and anxiety. Baker and colleagues advocate not only drainage but also complete management of face-lift hematomas at the bedside. I prefer to take the patient back to the operating room for exploration and control of the hematoma rather than trying to deal with it in the recovery room or at the bedside. Once the hematoma has been decompressed, there is time to call a team if needed and prepare an operating room. In the operating room, with the patient under general anesthesia (if appropriate), or otherwise under sedation and local anesthesia with full monitoring, enough sutures are removed to allow access. If need be, all of the sutures are removed. I resist the temptation to trivialize the hematoma and to minimize my treatment of it. Once the wound has been adequately opened, all of the clots are evacuated. A di-

lute 10% solution of hydrogen peroxide is useful in breaking up the clots. The wound is thoroughly explored, and sometimes no actual source of bleeding is identified. If a source of bleeding is identified, it is suture-ligated or cauterized as needed. The open wound is then observed for any further evidence of bleeding and then closed over a suction drain.

Management of Hematoma

- Remove sutures
- Evacuate all clots
- Irrigate with dilute peroxide to break up clots
- Close over drains



This patient, whose primary face lift was performed elsewhere, developed a small localized hematoma in her right cheek. This was initially observed and was aspirated at a later date. It has left her with a contour irregularity.

I have emphasized that an undrained, expanding hematoma can lead to disastrous skin slough or even airway compromise. Even a small undrained hematoma will lead to problems such as contour irregularities, prolonged ecchymosis, prolonged swelling, seroma, and scarring. I prefer to open and drain all postoperative hematomas, regardless of size, to minimize these sequelae.

In the final analysis, it is unlikely that hematomas can be totally eliminated. However, experienced surgeons, anesthesiologists, and operating room and recovery room nurses can reduce the incidence of hematoma to 1% by focusing on details.

Avoiding Skin Slough

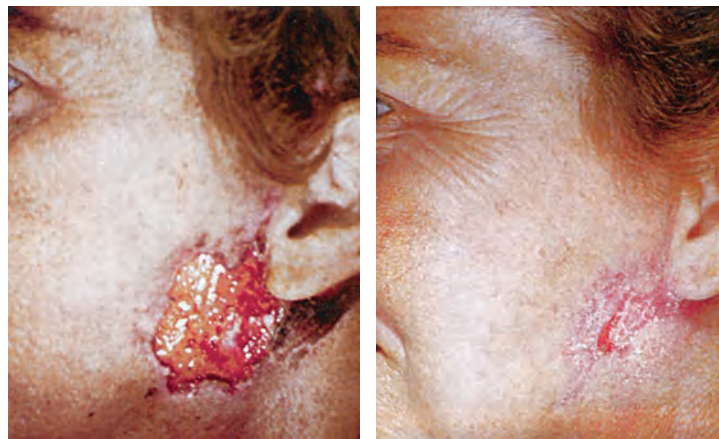


Skin slough most commonly results from tension on the skin rather than direct vascular compromise. The two most common causes of tension are tight closures and expanding hematomas. Factors leading to underlying circulatory problems that can increase the risk of hematoma include smoking, acne scarring, and diabetes. Unusual and devastating infections may also lead to skin necrosis.

Skin sloughs are minimized through measures taken before, during, and after the operation. High-risk patients, including smokers and those with acne scars, are identified preoperatively. Smokers are advised to stop smoking 3 or 4 weeks before and after surgery. However, it is impossible without a urine test to establish that patients have followed directions, because they all claim to have done so; I do not routinely ask for a urine test to confirm that the patient has ceased smoking. These high-risk patients are also started on systemic and local antioxidants, such as oral and topical vitamin C. The surgical approach to these patients is modified. Skin incisions, planes of dissection, and the extent of skin undermining are significantly altered in high-risk patients. Whenever possible, skin incisions are minimized and modified to avoid long retroauricular flaps. Skin undermining is limited and deeper planes of dissection, such as subperiosteal, subgaleal, and sub-SMAS, are preferred. I have found the short-scar face lift, which limits retroauricular incisions or undermining, is a good option in smokers. In some smokers I recommend a two-stage procedure to achieve an excellent result. I explain to all of them that given the restraints on the degree or extent of undermining, they should not expect an outstanding result. Concomitant skin resurfacing is restricted to the areas that have not been undermined or is postponed for a later time. Heavy or tight dressings are avoided, and the tissues are kept moist through the judicious use of petrolatum-based ointments. Postoperatively, a strict no-smoking policy is strongly emphasized.

Treatment of Skin Slough

The early treatment of skin ischemia or a pending slough is reduction of tension by removing the sutures. If necessary, Nitrol nitroglycerin cream is applied to the compromised flap. In the rare patient in whom infection is the cause of sloughing, the infection is aggressively treated. Hyperbaric oxygen has been advocated for the treatment of face-lift flap compromise and necrosis. This may well be an option, especially in a patient who smokes. Long-term treatment of skin slough requires patience from the surgeon and the patient. The surgeon must show a great deal of understanding and must frequently reassure the patient that eventually all of the wounds will heal. It is best to allow open wounds to heal secondarily and to deal with the consequences once the wound is healed. Late treatment of skin slough includes compression, topical agents, steroid injection, and eventually scar revision or even secondary procedures.

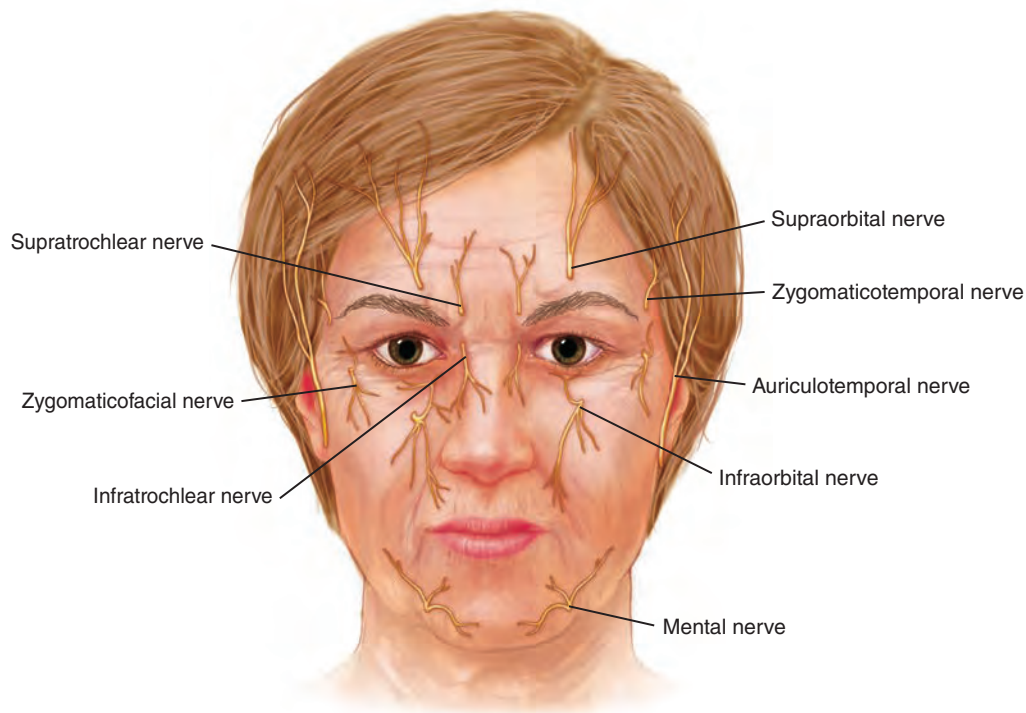


This patient had a full-thickness skin loss after a staphylococcal infection. She was treated conservatively, and the area was kept moist. It had almost completely closed through contraction and spontaneous reepithelialization by 6 weeks. The resultant scar matured sufficiently so that no scar revision was necessary.

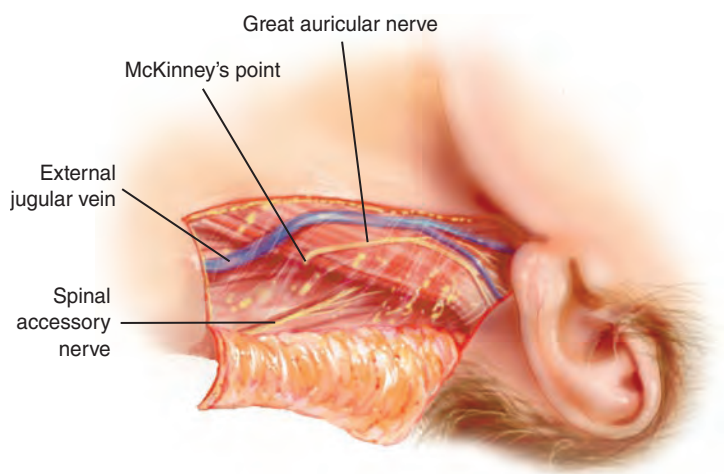
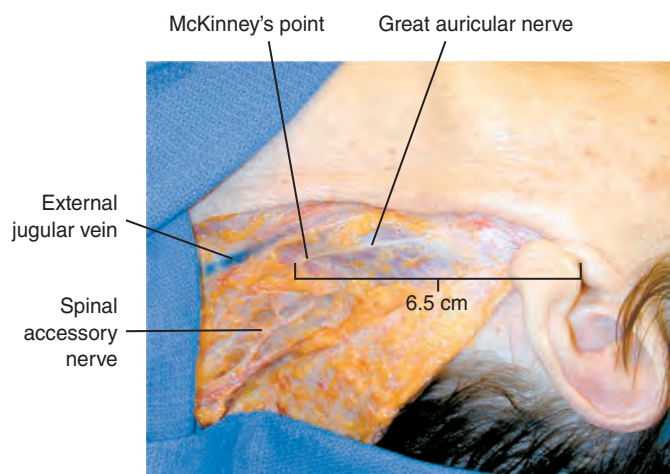
Nerve Injuries

Motor branches of the facial nerve and sensory nerves, mostly branches of the trigeminal nerve, are at risk during face lifts. Rare and unusual injuries to the accessory nerve have been reported.

Sensory Nerves



Sensory nerve injuries in facial aesthetic surgery are uncommon and are rarely of serious consequence. The great auricular nerve is at risk during standard face-lift procedures; the supraorbital, supratrochlear, and zygomaticotemporal nerves are at risk during brow lifts; the infraorbital nerve is at risk during subperiosteal midface lifts and during the placement of cheek implants; the zygomaticofacial nerve is at risk during subperiosteal midface procedures; and the mental nerve is at risk during chin augmentation.



The great auricular nerve is most at risk during face and neck lifts. It emerges around the posterior border of the sternocleidomastoid muscle at McKinney's point, 6.5 cm below the external auditory meatus, and courses almost directly upward to the ear-

lobe. The surgeon can avoid injury to this nerve through knowledge of its anatomy and cautious flap elevation over the sternocleidomastoid muscle. Leaving the sternocleidomastoid fascia intact will usually protect this nerve. It is advisable in secondary face and neck lifts to perform this dissection under direct vision rather than blindly, because the preexisting scar tissue may distort the planes of dissection. Injury to the nerve will lead to numbness of the lower two thirds of the ear. This sensory loss is not debilitating, but a painful neuroma of the greater auricular nerve can be. If an injury to the nerve is recognized, the surgeon should attempt to repair it with the aid of magnification. If this is not possible, the proximal stump should be buried well within the sternocleidomastoid muscle to prevent a neuroma. Painful great auricular nerve neuromas are rare, and even more rarely these neuromas may present as a neck mass and be mistaken for an enlarged lymph node.

The supraorbital nerve emerges from the orbit through a notch or a foramen, usually in the midpupillary line, and provides sensory innervation to nearly half of the forehead and anterior scalp. The lateral branch, which courses along the temporal crest, is responsible for most of the innervation of the anterior scalp. Injury to the supraorbital nerve during endoscopic brow lift is rare. However, the surgeon must be aware that this nerve can emerge through a foramen up to 2 cm above the orbital rim, so blind dissection should be limited to a distance of 2 to 4 cm above the orbital rim, and the orbital rim should be approached endoscopically to avoid nerve injury. The lateral sensory branch of the orbital nerve is almost always divided during a transcoronal brow lift, resulting in forehead sensory loss, paresthesias, and dysesthesias. These sensory changes, fortunately, are usually temporary but can be permanent.

The supratrochlear nerve has multiple branches and emerges through the orbit medially within 1 or 2 cm of the midline and usually courses within the corrugator muscle. It provides sensory innervation for a narrow strip of medial forehead and brow on each side. During an endoscopic brow lift, one or two branches of the supratrochlear nerve may be disrupted during the corrugator muscle excision. This is rarely of any clinical significance.

The zygomaticotemporal nerve is a very small nerve that emerges through the temporal fascia, usually accompanying the lateral of the two sentinel veins. When viewing this nerve during an endoscopic brow lift, I make every attempt to preserve it, although injury to the nerve is of little consequence.

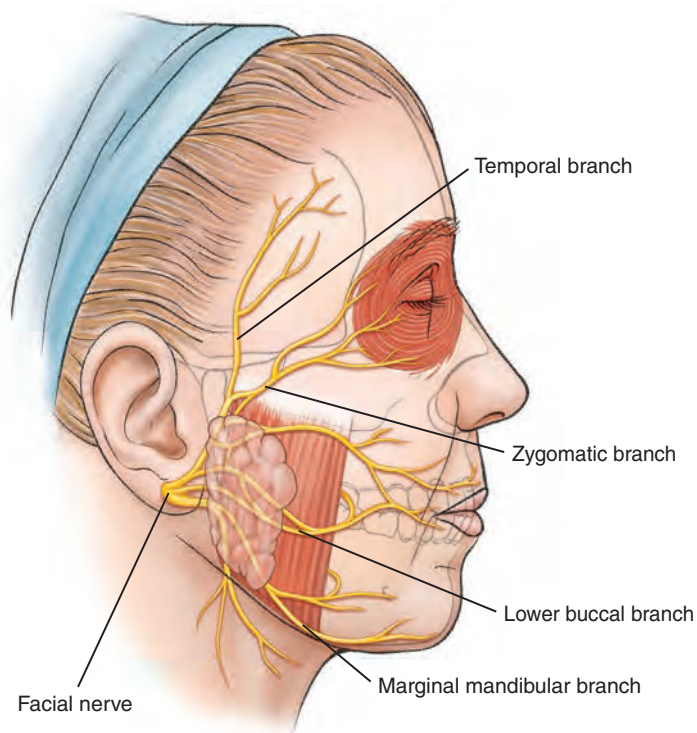
The infraorbital nerve emerges through a foramen 1 or 2 cm below the inferior orbital rim in the midpupillary line and innervates the cheek, lips, and teeth. It is rarely at risk during subcutaneous or sub-SMAS face-lift procedures. It is at greatest risk during subperiosteal midface dissections, whether through the mouth, lower eyelid, or temporal area. However, injury to this nerve is extremely rare, because it is very large, easily identified with or without an endoscope, and difficult to injure with a periosteal elevator.

The zygomaticofacial nerve is a small nerve that emerges through a foramen 1 to 2 cm lateral to and below the lateral canthus. It is only at risk during subperiosteal dissection of the periorbital area. Unlike the infraorbital nerve, the zygomaticofacial nerve is very small and very easily divided. It is always accompanied by a small blood vessel, and often the only indication that the nerve has been divided is the bleeding. I make every attempt to identify and preserve this nerve during subperiosteal mid-face lifts. Division of the nerve is of little consequence in terms of sensory loss, but irritating discomfort in the area has been attributed to division of the nerve.

The mental nerve emerges through the mandible in the midpupillary line at the level of the second premolar. This nerve is at risk during subperiosteal dissection for placement of chin implants. Fortunately, it is a large nerve that is easily identified and not easily injured with a periosteal elevator. Injury to the nerve results in debilitating sensory loss in the lips and teeth.

Motor Nerve

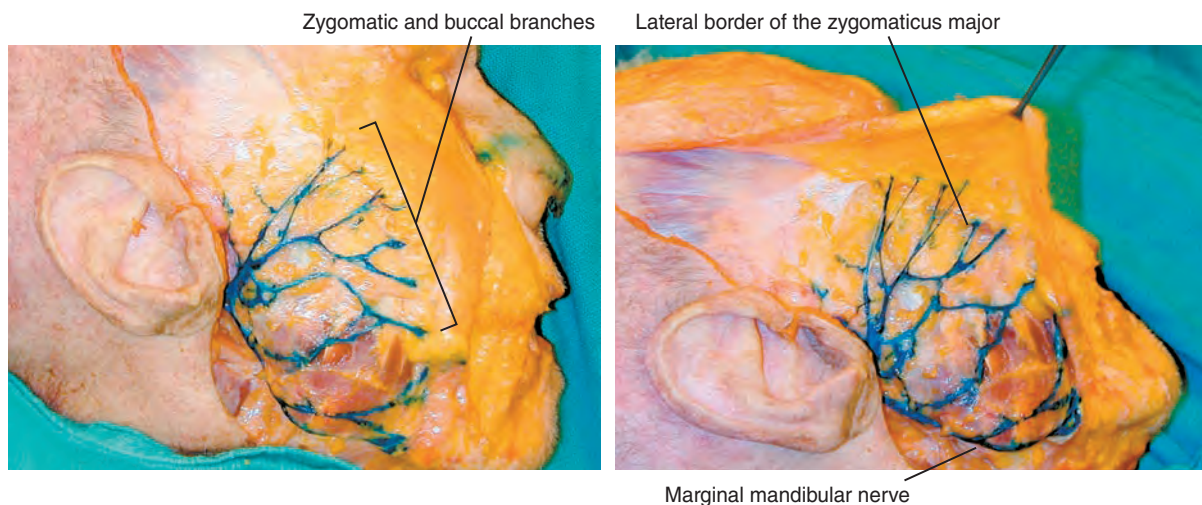
One of the most devastating and long-lasting complications after facial rejuvenation surgery is permanent injury of a branch of the facial nerve. Fortunately, the incidence of facial nerve paralysis is fairly low. In a reported series of 6500 patients, facial nerve paralysis was seen in 0.7%, with only 0.1% permanent. With endoscopic brow lifts, the incidence of temporary paresis to the frontal branch of the facial nerve has been consistently reported at 1%, with permanent injury of 0.1%. My personal experience parallels these reported series, but I have been fortunate enough not to have permanent paralysis in any of my patients.



The facial nerve branches most at risk include the buccal, frontal, and marginal mandibular branches. Recently concern has been raised about the zygomatic branches in association with complex periorbital procedures.

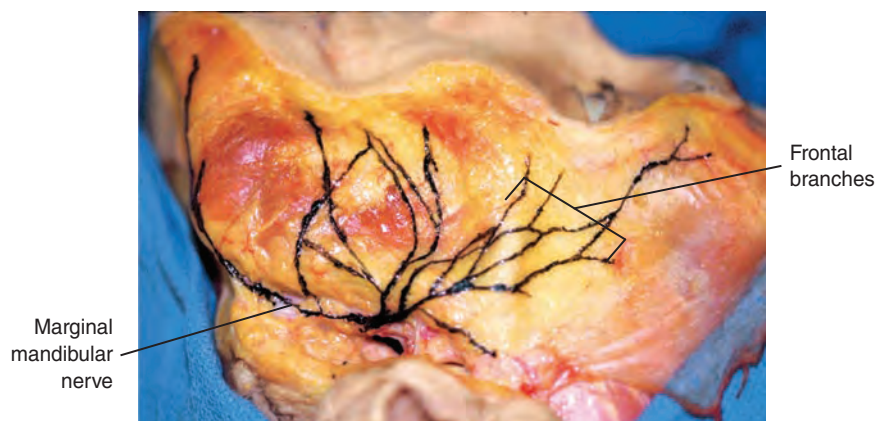
Most commonly reported injuries involve the buccal branches; however, because these are multiple branches rather than a single nerve, recovery is usually seen within 3 to 4 months. The frontal branch is the next most frequently reported injured nerve, and these are also multiple branches rather than a single nerve, and recovery is the rule; however, recovery takes longer than after buccal branch injury. The marginal mandibular branch is a single nerve, and complete recovery after injury is rare. Fortunately, the resulting asymmetry of the mouth can be improved through the judicious administration of *botulinum* toxin on the opposite side.

Buccal and Zygomatic Branches



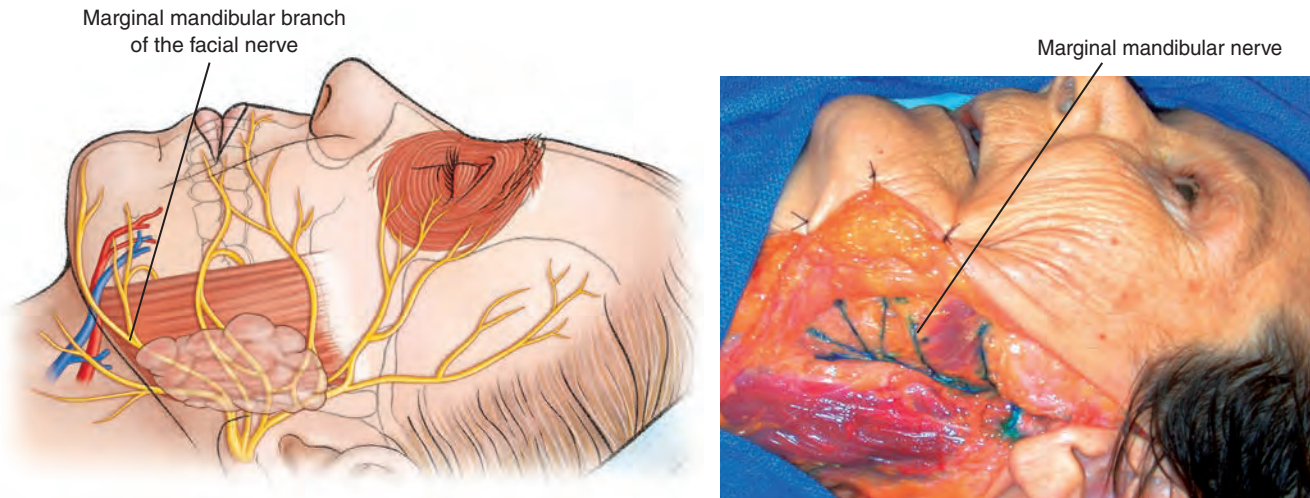
The buccal branches are multiple, and injury to all branches is rare. Dissection below the SMAS, beyond the parotid gland, puts these nerves at risk. Therefore in any face-lift procedure necessitating sub-SMAS dissection beyond the parotid gland, the dissection should be performed bluntly and with caution. These branches are readily visible, and injury is easily avoided. Blind or sharp dissection beyond the parotid gland should be avoided. These branches all run deep to the zygomaticus major muscle, so dissection beyond the zygomaticus major toward the nose and nasolabial fold is safe as long as it is in a plane above the zygomaticus major.

Frontal Branches of the Facial Nerve



The frontal branches of the facial nerve are at risk not only during forehead lifts (coronal and endoscopic) but also with sub-SMAS face lifts, especially techniques requiring a high-SMAS dissection. Classically the landmark for identifying the course of this nerve has been a diagonal line drawn from a point 5 mm below the tragus to a point 2 cm above the lateral brow. However, I have found that if the sentinel vein is visible through the skin, a point 5 mm above the vein will usually mark the course of the vein. I then draw a diagonal line toward the tragus and use this as the guideline. Because this nerve runs under the temporoparietal fascia above the zygoma and very deep to the SMAS, below the zygoma, the surgeon can avoid injury to the nerve by performing the temporal dissection of any forehead lift well below the temporoparietal fascia. In fact, I make a point of placing all of my instruments directly over the deep temporal fascia, pushing on the fascia as I dissect toward the zygoma and orbital rim. Below the zygoma, injury is avoided by staying above the SMAS. However, if high sub-SMAS dissection is undertaken, injury to the nerve is avoided by dissecting just below the SMAS. Recent anatomic data demonstrate that the nerve lies much deeper and closer to the periosteum of the zygoma rather than just below the SMAS. During a combined temporal and facial dissection, the development and maintenance of a “mesotemporalis” made up of the temporoparietal fascia and SMAS will ensure the safety of this nerve.

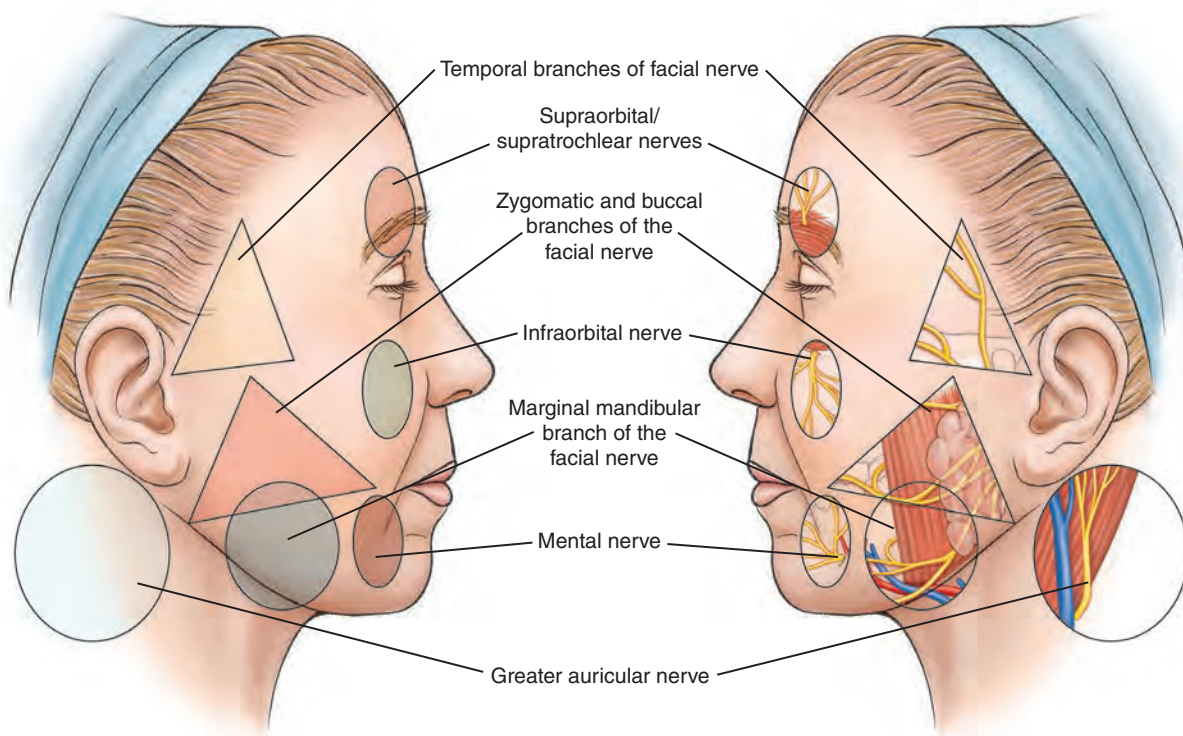
Marginal Mandibular Branch



Although the marginal mandibular branch is deep to the SMAS and the platysma along all of its course, it is still susceptible to injury, especially as it courses over the facial vessels at the level of the mandibular notch. The two factors contributing to this area of risk are (1) the thinning of the SMAS and platysma in that area and (2) the presence of perforating branches of the facial vessels. The thinning of the SMAS and platysma puts the nerve at risk during blind dissection, where the scissors can easily slip through the thin platysma and injure the nerve. The other mechanism of injury is the use of electrocautery in an attempt to control bleeding from the perforating vessels. As a general rule, I prefer to use bipolar rather than the unipolar coagulating current for hemostasis during facial rejuvenation, because there is less electrocautery current that can damage the nerve. In thin individuals I prefer to perform the dissection along the mandibular border under direct vision to minimize the risk of subplatysmal penetration.

When performing subplatysmal dissection of the neck, the surgeon must keep in mind that the relationship of the marginal mandibular branch to the inferior border of the mandible is variable; in fact, it can run 1 to 2 cm below the mandible along its entire course, not just proximal to the facial vessels and the mandibular notch.

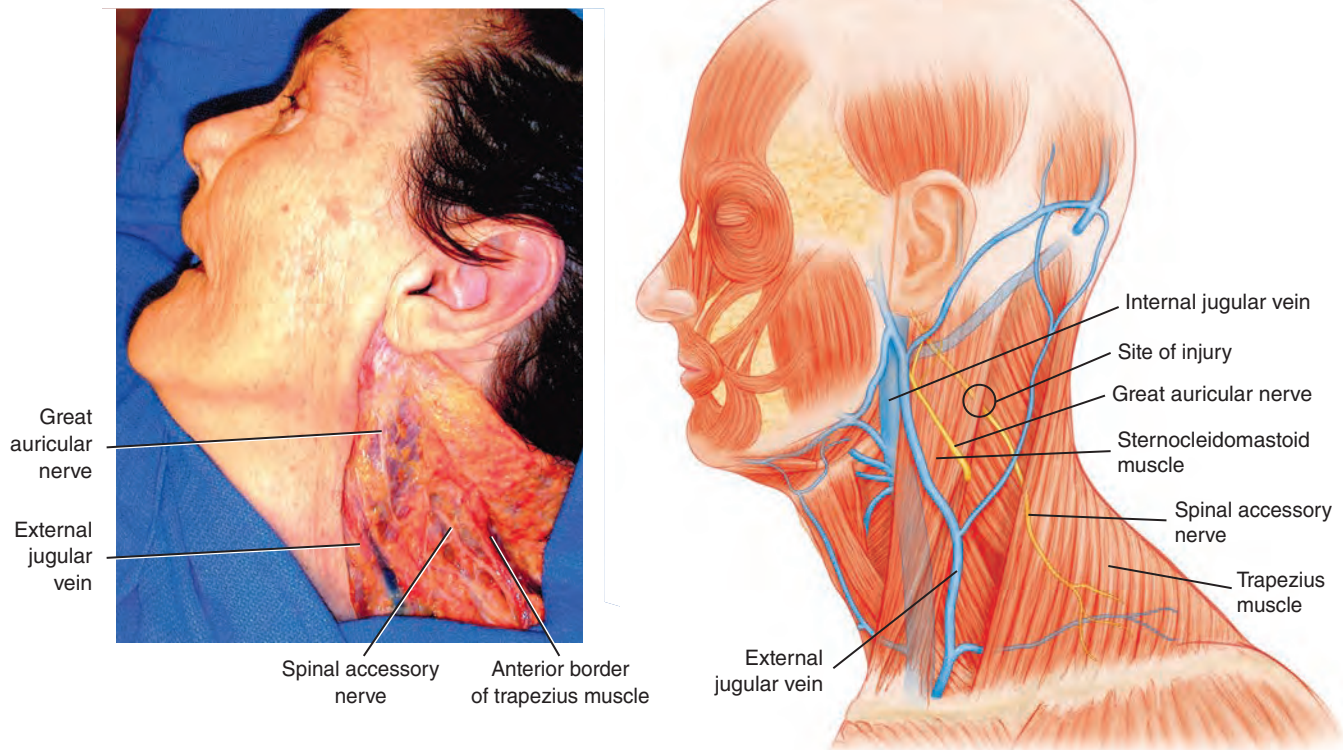
FACIAL DANGER ZONES: MOTOR AND SENSORY NERVES



Although permanent injuries to the branches of the facial nerve are rare, it is vital that the surgeon be familiar with the anatomy of these branches, their relationships to the various layers of the face, their specific danger zones, and the risk afforded each branch by the more complex and deeper dissections. Familiarity with specific techniques is essential to minimize risk and avoid complications. I encourage anyone performing facial rejuvenation to dissect the layers of the face and branches of the facial nerve in the cadaver laboratory.

Spinal Accessory Nerve

Although extremely rare, injury to the spinal accessory nerve and a resultant shoulder drop have been reported. The nerve is most at risk during posterolateral dissection in the neck. The nerve emerges behind the posterior border of the sternocleidomastoid, almost at McKinney's point or just above, coursing posteriorly and laterally toward the trapezius.



Deep Venous Thrombosis

Venous thromboembolism (VTE) and its consequences, deep venous thrombosis (DVT) and pulmonary thromboembolism (PE), are devastating, life-threatening, and fortunately uncommon. The exact incidence of DVT in facial aesthetic surgery is not known. Reinisch et al reported an incidence of 0.35% for DVT and 0.14% for PE in face lifts. A 4-year review of 468 face lifts at Paces Plastic Surgery revealed two patients with DVT, an incidence of 0.4%, with no PE. Our 0.4% compares to the 0.35% reported by the Reinisch group. Spring and Gutowski surveyed 3797 plastic surgeons in the United States, who reported 15 DVT and PE events associated with facial cosmetic procedures. Every precaution should be taken to minimize the risk of DVT. Factors increasing the risk include the following:

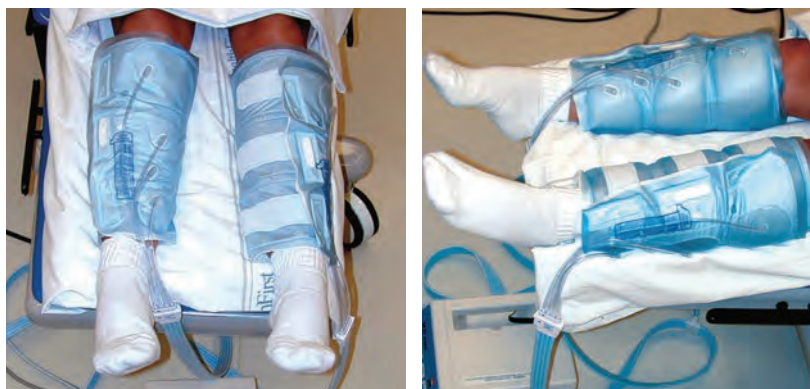
Age	Family history
Weight	Use of oral contraceptives
Length of procedure	Type of anesthesia

Based on these factors, the dual task force of the American Society of Plastic Surgeons (ASPS) and the American Society for Aesthetic Plastic Surgery (ASAPS) assigned risk categories and made recommendations for patients undergoing plastic surgery procedures according to the assigned risk category. These recommendations were published in the November 1999 issue of *Plastic and Reconstructive Surgery*. They are summarized in the table on p. 1778.

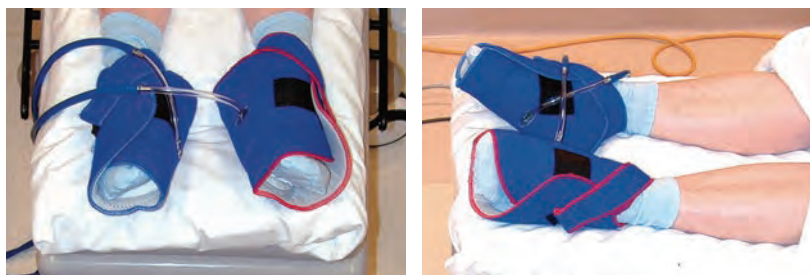
DVT Prophylaxis

Risk Factors	Recommendations
Low Risk <41 years of age No oral contraceptives/hormones No chronic disease, infections, malignancy No personal or family history of DVT, PE, etc. No history of venous insufficiency Short operative procedure	Comfortable position on operating table Slight knee flexion Avoid extremity compression or constriction
Moderate Risk >41 years of age Current oral contraceptives/hormones Chronic disease, infections, malignancy Personal or family history of DVT, PE, etc. Short operative procedure	Comfortable position on operating table Slight knee flexion Avoid extremity compression or constriction Intermittent pneumatic compression Frequent alteration of operating table position
High Risk >41 years of age Longer procedure (>1 hr) Current oral contraceptives/hormones Chronic disease, infections, malignancy Personal or family history of DVT, PE, etc.	Comfortable position on operating table Slight knee flexion Avoid extremity compression or constriction Consider preoperative hematology consultation Consider preoperative and postoperative anticoagulants Intermittent pneumatic compression

From McDevitt NB. Deep vein thrombosis prophylaxis. American Society of Plastic and Reconstructive Surgeons. *Plast Reconstr Surg* 104:1923-1928, 1999.



Standard pneumatic pressure garments extending from knee to ankle



PlexiPulse intermittent pneumatic compression devices (Kinetic Concepts, Inc., San Antonio, TX) placed on feet

In my practice almost all patients undergoing facial rejuvenation fall into the high-risk category. All of these patients are operated on under general anesthesia; support is placed behind their knees, and intermittent pneumatic compression garments are used in all of them. Stuzin et al have reported zero incidence of DVT in over 10,000 face lifts spanning 30 years, all of which were performed under local anesthesia with sedation. They comment that patients operated on with intravenous sedation moved during the procedure thus reducing the tendency of venous stasis and DVT.

Venous Thromboembolism Risk Factors for Plastic Surgeons to Consider

*Solid, consistent evidence that these are the most important risk factors**

Prior history of VTE (DVT or PE)
 Malignancy (active or in patient history)
 Thrombophilia disorders (inherited or acquired)
 Factor V Leiden mutation (makes factor V resistant to activated protein C)
 Prothrombin 20210A mutation (found exclusively in whites)
 Antithrombin deficiency
 Protein S and protein C deficiency
 High levels of fibrinogen or plasminogen, factor VIII, factor IX, factor XI, thrombin activatable fibrinolysis inhibitor (TAFI), or protein C inhibitor
 Low levels of tissue factor pathway inhibitor (TFPI)
 Hyperhomocysteinemia (plasma homocysteine level >18.5 mmol/L)
 Dysfibrinogenemia and polycythemia vera
 Antiphospholipid antibodies (lupus anticoagulant and anticardiolipin)
 Obesity (risk may be highest for those <40 years of age)
 Use of oral contraceptives, tamoxifen, hormone replacement therapy, or other estrogen-containing drugs

Known to be risk factors but probably not in the top tier; do not disregard as unimportant

Age $\geq$ 40 years (risk rises as age rises)
 General anesthesia (risk rises with each hour in surgery, regardless of procedure)
 Varicose veins
 Inflammatory disease (inflammatory bowel disease, rheumatologic diseases, especially systemic lupus erythematosus)
 Abdominal surgery (carries higher risk than most other types of surgery)
 Pregnancy, abortion, or miscarriage within 3 months
 Smoking
 Recent hip or knee replacement or hip fracture
 Recent surgery of any kind
 Prolonged travel by air, train, or car
 Recent physical trauma

*Important risk factors that are rarely encountered in plastic surgery practices include prolonged immobilization, ischemic stroke, heart failure, chronic lung disease, respiratory failure, serious infection, pneumonia, central venous catheterization, paralysis, spinal cord injury. Some risk factors are permanent (such as a history of VTE or cancer, chronic disease, thrombophilia, age) and some are transient (such as surgery, travel, estrogen use, pregnancy).

Craftsmanship Issues

Some postoperative concerns are not true complications; I prefer to call them issues of finesse, quality, or craftsmanship. But they are the issues that make all the difference in the patient's perception of the quality of the result. In this category I include the following:

- Scar placement and scar quality
- Ear distortion
- Hair loss and hairline distortion
- Contour irregularities

Scar Placement and Scar Quality

I regularly talk to patients to explain where the incisions and scars will be. Occasionally the patient looks back at me and comments, "Well, there won't be any scars, will there? This is plastic surgery, after all." I reply that all incisions leave scars and that the best I can offer them is to place the scars where they will be imperceptible or at least less noticeable, and that I will make every effort to ensure the quality of the scars, although this will depend as much on the location and tension as well as on the patient's biology as it will on surgical technique.

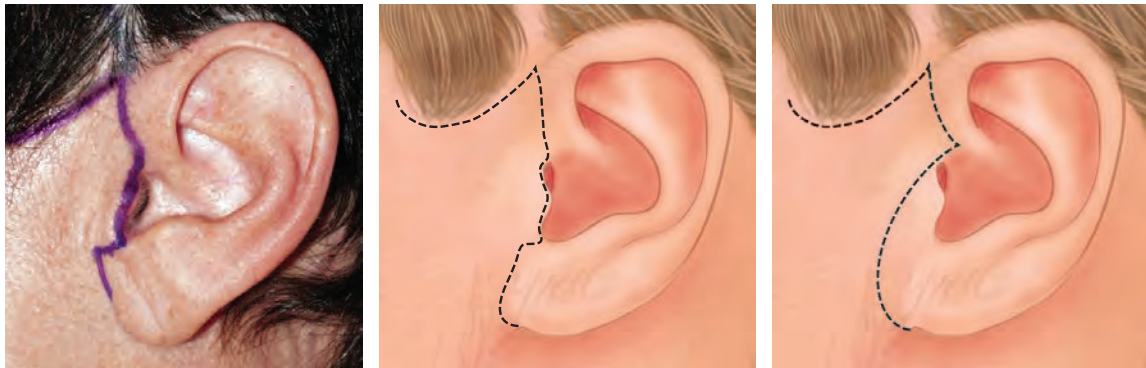
Avoiding Undesirable Scars

The key to avoiding undesirable scars is to manage tension appropriately. Special attention is required in those who are prone to hypertrophic scarring, especially red-headed individuals with a ruddy complexion and patients who are keloid prone.



This man underwent a MACS-lift elsewhere and has hypertrophic scars in front and behind his ear, most likely related to tension. Note that the horizontal scar below his sideburn has healed well. Incisions are planned so that they will be inconspicuous and allow appropriate distribution of tension. Meticulous closure under mini-

mal tension and aggressive early management of scar problems are important. Incisions in the hair are made parallel to the hair roots; the use of cautery is judicious and limited to preserve hair roots. Closure must avoid excessive tension, which damages the hair roots. Incisions along the hairline are also made in the direction of the hair roots to preserve and encourage hair growth through the resulting scar.

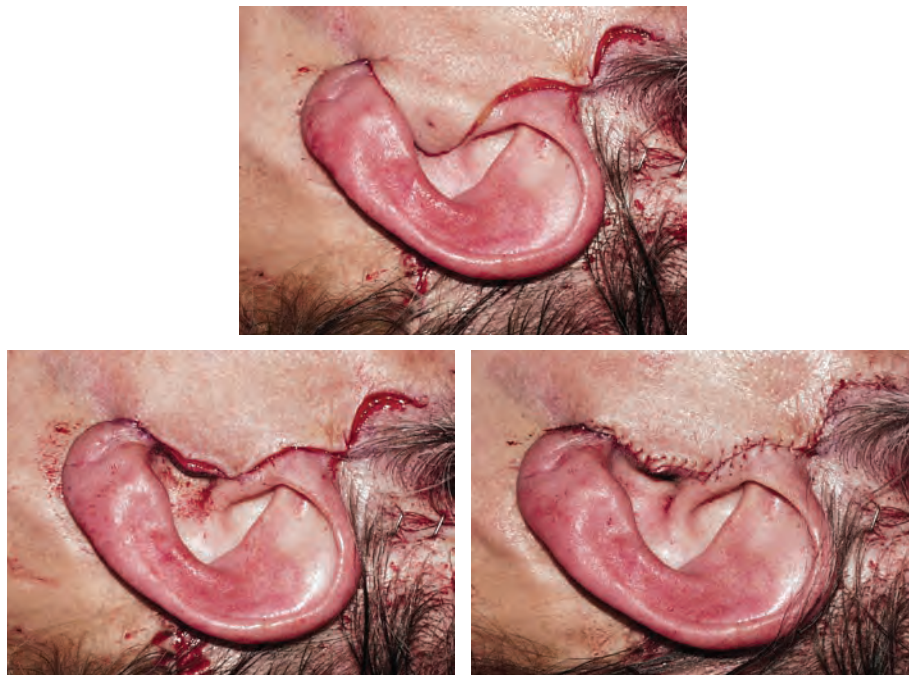


The preauricular incision should never be a straight line. It should be broken up above and below the tragus. I prefer the intratragal incision whenever possible.

This incision is made in such a way that the tragus has a beginning and an end. Far too often this is not done, and the tragus blends into the lower face with a telltale sign of a face lift. The incision behind the ear is placed either within the sulcus or 1 to 2 mm on the posterior surface of the ear. My preference is to make it on the ear rather than within the sulcus.



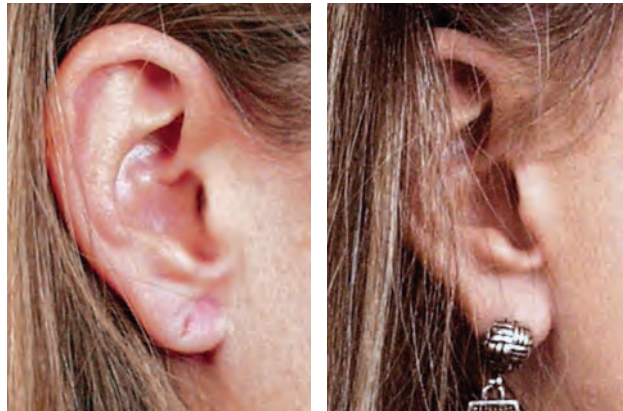
This woman underwent a face lift by a nonsurgeon who left her with a hypertrophic straight-line scar in front of her ear and little in the way of facial rejuvenation. I saw her in consultation and performed a secondary face lift with appropriate placement of the incisions. Seven years later, the tragus appears natural and there is no hypertrophic scarring or distortion. In the intervening 7 years she has colored her hair.



Distribution of tension during the closure defines the quality of the resultant scar. Tension should usually be placed at the level of the concha, behind the earlobe, and behind the ear, never in the preauricular or tragal area or the earlobe. Once the skin tension has been appropriately distributed, the excess skin along the preauricular area and behind the ear is excised and closed in two layers under no tension. Usually this closure will not require a suture any larger than a 6-0. If sutures stronger than 6-0 are required for this closure, then there is too much tension and the scar will widen unacceptably.



This patient, who had a face lift with the full classic incision including preauricular intratragal incisions, is seen preoperatively and in early postoperative and late postoperative views.



Preoperative and 4-year postoperative views of a patient who underwent a short-scar face lift with a preauricular intratragal incision ending at the earlobe.

Closure of the retroauricular incision requires as much attention to detail or perhaps even more than the preauricular incision. It is very unusual to see hypertrophic scarring in front of the ear; however, it is not so uncommon to see it behind the ear. I think this is related to excessive tension and overresection of retroauricular skin. Another problem is scar migration in an outward direction from the retroauricular sulcus. This is avoided by anchoring the posterior ear skin and the face-lift flap skin to the mastoid fascia with every bite or every other bite when closing the retroauricular portion of the incision.

Treatment of undesirable scars includes intralesional injection of steroid medications and the application of topical creams or silicone gels. Scar revision may also be an appropriate treatment.

Ear Distortion

Very often, close observation of the tragus and earlobe will reveal telltale signs of a face lift. It is not only the appearance of the scar but distortions of the tragus and earlobe that attract the eye and scream out: "*Yes, I have had a face lift!*"

The tragus must have a beginning and an end, and must project outward from the face and external auditory meatus with a gentle posterior tilt. Forward displacement renders the external auditory meatus more visible, creating the impression that it has been enlarged. This is a result of excessive tension with no break above or below the tragus. An extreme example is the ablation of the tragus. This is avoided by deepening the pretragal sulcus, especially in secondary face lifts and, if necessary, suturing the pretragal skin into the sulcus.



This patient who has had a previous face lift demonstrates near complete ablation of her tragus with wide open external auditory meatus. Her earring conceals the pixie ear deformity. On the right, her ear is seen on the operating table before a secondary face lift.

Earlobe problems are related to improper closure around the earlobe. I prefer to leave the earlobe hanging free rather than suturing it to the skin flap. This allows the natural “angle of the dangle” described by Connell. Suturing the earlobe leads to pixie earlobe deformity and a migration of the earlobe into the neck, another telltale sign of a face lift.

Another finesse issue with the earlobe is the concomitant reduction of the earlobe at the time of a rhytidectomy. This is especially important in older patients who have large, pendulous, creased earlobes. The addition of autologous fat or filler into the aging earlobe will eliminate the creases and render a more youthful appearance.

Hair Loss and Hairline Distortion

Hairline distortion is one of the most common stigmata of a face lift. Possible distortions include the following: elevation or elimination of the sideburns, irregular or a step-off in the retroauricular hairline, and frontal hairline elevation. The most common problem, however, is scar alopecia. This is also the simplest problem to resolve.

Sideburn elevation or elimination is avoided by appropriate placement of the incision. In a primary face lift in patients with a short sideburn, I will make a prehairline incision, and in all patients undergoing secondary face lifts I will also make a prehairline incision. This affords ample exposure for the face lift without any change in sideburn position. An alternative is to continue the preauricular incision into the temporal area and to take out the skin triangle below the sideburns. This will also maintain sideburn length.



After a previous face lift, this woman had elevation of the hairline, with elimination of sideburns and a wide, depigmented preauricular scar.



Preoperative and postoperative views are shown of a patient who had a secondary face lift. Hairline distortion and sideburn shortening was avoided through a prehairline incision extending into the preauricular, intratragal, and retroauricular areas.

Retroauricular hairline step-offs and distortion are avoided by aligning the occipital hairline first and then resecting the excess retroauricular skin and scalp. A certain amount of tailoring is needed in patients with excess or loose neck skin.

The high-forehead hairline is seen more commonly with coronal rather than endoscopic brow lifts, although brow elevation is also seen with the endoscopic approach. This problem is best avoided by techniques that allow shortening of the forehead; all of these techniques entail an incision in the frontal hairline, an incision that some patients are not willing to accept.

Scar Alopecia

Hair loss is avoided through minimization of tension and with gentle tissue handling. Overuse of the electrocautery, tight sutures, and staples will damage hair roots. The

most common scar alopecia that I have encountered has been at the external screw fixation site associated with the endoscopic forehead lift. All of these problems are relatively easy to correct through simple excision of the bald spots under local anesthesia.

Very rarely, after facial aesthetic surgery and brow lift (notably endoscopic brow lift), there may be partial or full alopecia of the entire scalp. Fortunately, most of these are self-limiting. Topical use of Rogaine and steroids may accelerate the recovery. In patients with thinning hair, as a preventive measure I encourage the preoperative and postoperative use of Rogaine on the scalp.

Contour Irregularities

Contour irregularities result from improper defatting, SMAS plication, and mismanaged hematoma.

Oversuction or suction too close to the dermis, especially in the neck, will lead to banding and skin adhesion to the platysma. This is best avoided by leaving 3 to 5 mm of fat on the deep surface of the skin, keeping the suction cannula hole pointed away from the dermis, and limiting the number of passes in each tunnel.



Excessive fat removal in the subcutaneous plane to mask or correct problems deep to the platysma is a common error that is often difficult to reverse as is seen in this woman. Overaggressive fat removal from her neck and submental area has unmasked platysma bands and prominent digastric muscles.

SMAS plication with or without SMAS resection can lead to contour irregularities. Multiple sutures should be placed to ensure that the plication and suture lines are smooth without any discernible irregularities. These are best avoided by inspecting and ensuring a smooth subcutaneous contour before closure.

Even the smallest hematoma, if inadequately drained, will lead to prolonged swelling, subcutaneous scarring, and irregularities. These irregularities are best treated through lymphatic drainage and skin massage. I have also found external ultrasound useful, especially with the banding in the neck. Steroid injections may also be helpful. Reoperation is also an option.

Some patients refer to these contour irregularities as “waves.” There are some patients, however, in whom the waves are seen only on animation, representing what I think is an imbalance of the mimetic muscles of the cheek after deep and subperiosteal procedures. These are difficult problems to correct and may be related to disruption and reattachment of muscle origins and partial denervation.

Motion Distortion

One of the more difficult problems to correct following a face lift is the distortion observed on animation, especially in the cheek area. The cause of such distortions is not fully understood, which makes the problem difficult to correct. It is thought to be related to a change in the relationship of the muscles of facial expression with the overlying soft tissues and/or the underlying bony skeleton.

Infections

Infections after facial aesthetic surgery are extremely rare, because the face has a plentiful blood supply. However, the sequelae of infection can be serious and include skin slough and scarring. All patients undergoing facial aesthetic surgery should have their faces washed and hair shampooed with antiseptic hair shampoo on the day of the procedure. The face and hair should be prepared and draped as with any other surgical procedure. Although controversial, I still use perioperative antibiotics on all patients undergoing facial aesthetic surgery.

Very rarely, *Pseudomonas* infection of the face is seen in swimmers who harbor *Pseudomonas* organisms in their auditory canals. As a precaution, we always soak the earplugs in povidone-iodine solution (Betadine) before placing them in the external auditory meatus.

Other Rare Complications

Although perforation of the parotid gland capsule or even the gland itself is encountered with sub-SMAS dissections, such violations of the gland and its capsule are very rarely of any consequence. However, a few cases of parotid fistula and even parotid cysts have been reported after rhytidectomy. If encountered, these problems are usually self-limiting and will resolve spontaneously. However, it is important to ensure that the parotid duct is intact. If the problem does not resolve spontaneously, exploration and open drainage will be required. The drug somatostatin (Sandostatin), which decreases salivary secretion, may be helpful in managing this problem. However, the side effects may not be acceptable. Injections of *botulinum* toxin A into the parotid gland will reduce its secretions and is preferred over somatostatin.

Concluding Thoughts

The results of a face lift are at best temporary. The consequences of complications may be permanent.

CLAUDIO CARDOSO DE CASTRO

Although complications cannot be totally eliminated, careful patient selection and preparation, attention to surgical and anesthesia detail, and attentive postoperative management by an experienced team will significantly reduce complications. Unlike any other field of surgery or even other areas in aesthetic surgery, complications and unfavorable results affecting the face and neck cannot be concealed or otherwise protected from public view. The problems are out there not only for you and the patient to see, but for the entire world! This is especially true for the patient's family and close friends and her hairdresser. It is vital to understand that regardless of how minor or inconsequential the problem may seem to the surgeon, these problems are significant for the patient. The patient's concerns must be openly discussed, the patient must be reassured, and every attempt should be made to rectify the problem as expeditiously as possible with minimum or no expense to the patient. After evacuation and closure of facial hematomas, I routinely reassure the patient that the hematoma will in no way affect the quality of their result but may delay their recovery, especially the resolution of the ecchymosis. Patients with temporary facial nerve paresis are reassured that in all likelihood the weakness is temporary and that permanent facial nerve weakness is extremely rare. None of us is happy about complications, least of all me. I make every attempt to personally see and take care of all my patients whenever possible. This becomes even more important with patients who have a complication. It is their own surgeon they want to see, not the surgeon's partner, assistant, or nurse. Their own surgeon should see them on every visit, and it is im-

portant that the visits become more frequent. Anything short of this will lead patients to believe that at best their surgeon is avoiding them and at worst that their surgeon has abandoned them.

Complications and patient dissatisfaction with results test not only the established doctor-patient relationship but also our abilities as physicians and compassionate human beings. The confidence and trust of the patients gained over a period of weeks, months, or even years is threatened or lost very easily if the situation is not handled sensitively.

Do not hesitate to consult partners or colleagues when dealing with complications, especially in patients who express anger or even undue concern that their problems have not been as self-limiting as you have indicated. In patients who will need extensive revisions, it is important to seek the advice of partners and other colleagues and to resolve financial issues up front and as soon as possible.

The best way to deal with complications is to avoid them. If we cannot avoid them, we must remedy them expeditiously and effectively.

Clinical Caveats

Preoperatively, patients should be given a list of medications, herbal remedies, and dietary supplements to avoid.

Appropriate blood pressure management should be initiated before, during, and after the operation to reduce the risk of hematoma.

The perioperative use of clonidine should be considered.

Pain, anxiety, nausea, and blood pressure elevation must be treated aggressively in the recovery room.

An expanding hematoma must immediately be decompressed; it is a potential disaster.

Excessive tension on the skin should be avoided.

The surgeon should be familiar with the anatomy of the sensory and motor nerves at risk.

Sub-SMAS dissection beyond the parotid gland should be done under direct vision.

Blunt instruments are best for sub-SMAS dissection beyond the parotid gland.

If possible, bipolar is preferred over unipolar coagulation of bleeders below the SMAS.

Continued

Clinical Caveats—cont'd

Preventive measures should be taken to avoid DVT in all patients.

The surgeon should be a craftsman, taking the time necessary to produce a satisfactory result.

The sideburns and hairline should be respected, keeping changes minimal.

A natural-appearing tragus and earlobe should be maintained.

The surgeon should be kind to the hair roots.

Avoid oversuction of neck fat should be avoided.

A smooth facial contour must be under the skin flap.

Complications must be treated expeditiously.

It is important to remember that the patient's facial complication is on view all the time.

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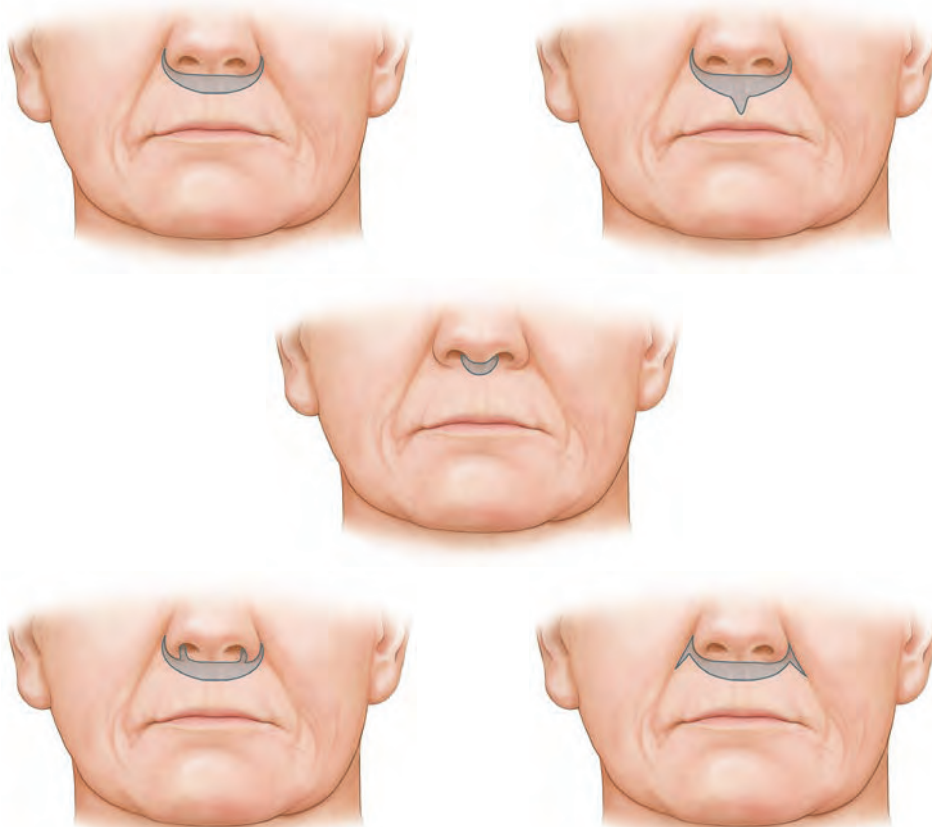
PART IX

REJUVENATION OF THE CHEEKS, CHIN, LIPS, AND EARS



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CHAPTER 51



Rejuvenation of the Aging Mouth

ROBERT K. SIGAL, BYRON D. POINDEXTER,
GEORGE W. WESTON

The mouth can be a difficult area to rejuvenate. In younger patients with minimal facial aging, the surgeon can frequently leave the mouth untouched and still produce a harmonious result with standard lifting and augmentation techniques. In these patients, often in their late thirties and their forties, the focus is the midface and jawline, where well-hidden incisions under the eyes and around the ears allow re-creation of youthful contours. The surgeon may choose to fill thinning lips, rhytids, and creases or perhaps resurface the perioral skin, but often that is all that is needed. In younger patients, more is not necessarily better.

In older patients, however, ignoring the mouth often leads to facial disharmony. An old mouth in the center of an otherwise rejuvenated face does not leave the patient looking young or old—it leaves the patient looking odd. The surgeon can be left in a difficult position, with an unhappy patient and the question, “What do we do now?” There is a tendency to look back and think that if a portion of the operation had been performed “better,” the result would be different. One may wonder whether pulling harder on the midface tissues or switching to a deeper plane for the face lift might have created a better aesthetic result on a long, aging lip or loose nasolabial fold. Perhaps if more fat or filler had been added, the effect might be more natural. Although these are worthy considerations, experience suggests the result would still probably be inadequate.

Two factors conspire to defeat our efforts to rejuvenate the perioral region indirectly from the well-hidden scars around the ears or under the eyes. First is the elasticity of the facial soft tissues. Lifting techniques in any plane above the periosteum lose power the farther they are from “the pull.” Pulling the skin and SMAS a centimeter at the ear ultimately moves the nasolabial fold only millimeters. Second is the nature of the deeper tissue to which the skin is attached around the mouth. With no subcutaneous fat beneath it, the skin inside the nasolabial folds is particularly resistant to remote pull. The intimate relationship of the perioral skin to the underlying muscle tends to keep it in place. The rejuvenative efforts inside the nasolabial lines are reduced to those that are easily done; that is, erasing the wrinkles and filling the lips. Although “lipstick wrinkles” and a thin vermilion certainly deserve attention, there is often more work to be done.

This is where the utility of a direct approach to perioral aging and aesthetics is evident. Plastic surgeons are comfortable with hidden incisions on the face, and comfortable with obvious scars on other parts of the body (such as from mastopexy and abdominoplasty), but we are uncomfortable with incisions on parts of the face that might be obvious. Surgeons justifiably fear creating scars that will be visible and irreparable, a permanent reminder of the surgeon’s hand. Yet most of plastic surgery requires acknowledging and making the trade-off of a particular scar for a change in shape. As long as that trade-off is worthwhile in the vast majority of cases, a technique makes it into the arsenal of “approved” plastic surgery procedures.

Although the idea of directly excising tissue around the mouth can be daunting, we have found that direct excisions around the mouth, when placed in natural creases, are actually less noticeable than most other scars. After performing more than 3000 such direct excisions, we are convinced that they have a significant role in rejuvenating the aging mouth. In this chapter we will attempt to define our approach to restoring a youthful appearance in this difficult region.



51-1 Rejuvenation
of the aging mouth

THE AGING MOUTH



At the extremes, the differences between young and old mouths are obvious. With age, the upper lip lengthens so that the upper incisal show of youth is hidden. The lower lip attenuates and involutes, revealing the lower incisal show of age. The tissue around the oral commissure deflates and descends medially around it, producing a saddened appearance. Soft, subtle rolls are erased and replaced with angular peaks and creased valleys. The chin pad drops, and the loose tissue around the nasolabial folds becomes so excessive that it is difficult to pull flat, even in the most experienced hands. That an indirect approach to these issues is inadequate is underscored by these images: the woman on the right has already had a face lift. We will address each of these distinct signs of perioral aging with strategies for their correction.

Long Upper Lip

With age, the distance lengthens between the nostril sill and the vermilion. The upper lip thins, widens, and hangs like a curtain over the upper teeth. A youthful mouth in repose should have at least 3 to 4 mm of incisal show with the lips parted. However, recognizing the problem and fixing it are two different issues. Indirect approaches have been frustratingly unsuccessful in our hands; although some plastic surgeons claim that a midface lift will indirectly shorten the upper lip, we have been unable to duplicate their results. We have found that fat grafting alone will give a sense of lip elevation because the fuller lip now recreates a bit of an arc. Although useful, this solution is restricted to correction of a minimal problem.

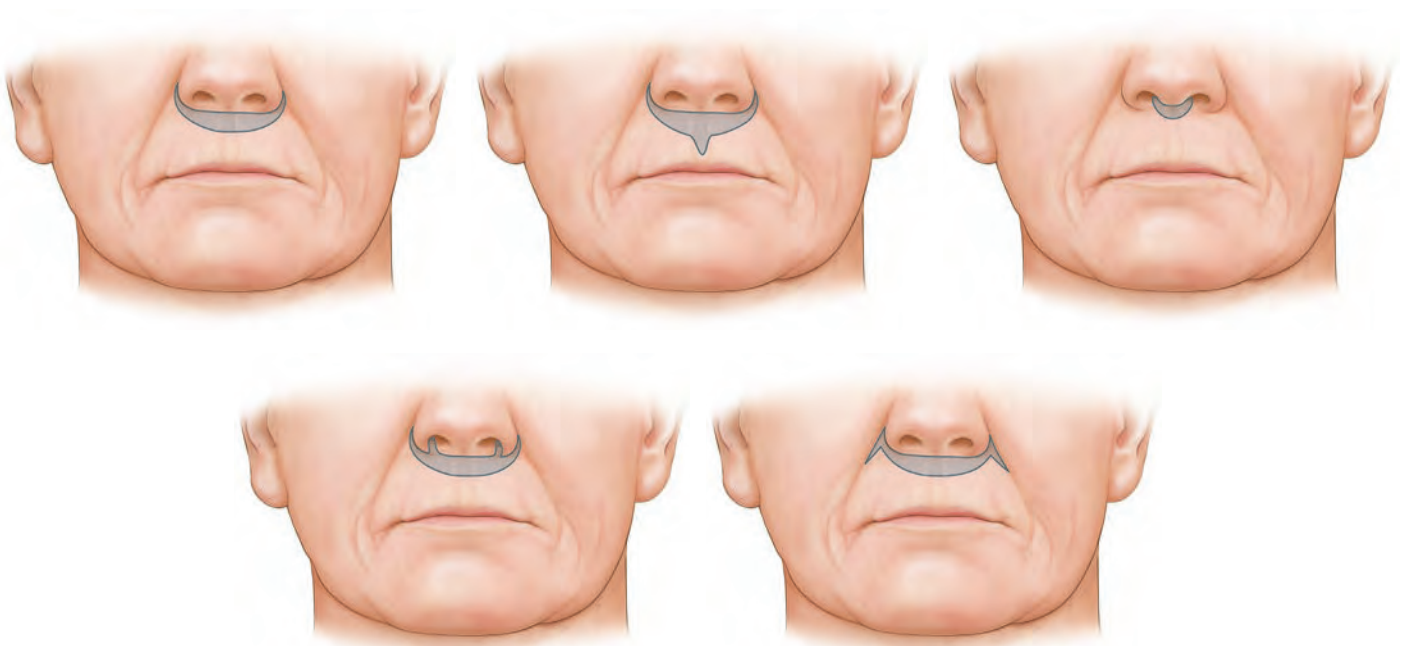
One approach we tried briefly was to directly excise the skin adjacent to the vermilion in a continuous strip. This “upper lip advancement” appeals in theory, because it affords maximal control over the shape of the vermilion border and the contour of the Cupid’s bow. We tried this approach for a time almost 25 years ago and quickly abandoned it because of its nearly 30% contracture rate. Further, when that scar contracts, it is extremely difficult to make an aesthetic surgical revision. In the appropriate patient, we have found it far better to extend a corner mouth lift medially to each apex of the Cupid’s bow and elevate the central lip through a small lip lift.

Lip Lift



We have found an excision under the nostril sill to be a more predictable and controllable solution to a long upper lip. Our founding partner, Harvey Austin, developed the lip lift independently and presented 83 cases in 1986, although others had previously reported it. This lip lift, as we have described it, will shorten the central upper lip and slightly evert it. The procedure was originally designed as a wavy skin excision that leaves the scar in the crease below the nostril sill.

There is no mathematical formula for determining how much to shorten the lip; however, two points are worth making. First, a residual lip length that is shorter than 10 to 12 mm from the nostril sill to the vermilion border will make the lip appear too short. Second, one should overcorrect by a third to allow for postoperative relaxation. Given these caveats, our resections average 5 to 7 mm.



We have performed all of the variations of this excision, and all have utility. Two bear special mention. The first is the one with the central component (*top row, center*). If it takes a certain measure of surgical fortitude to put a scar under the nose, it takes an order of magnitude more to put a scar down the middle of an unscarred upper lip.



Yet this scar heals beautifully, and the subtle narrowing this excision imparts to the upper lip and its enhancement of the Cupid's bow warrant its consideration in the appropriate patient. We have run that central component varying distances down from the labiocolumellar fold, often all the way to the vermilion.

The second variation involves intranasal extensions (*top of page, bottom row, left*). On occasion, a lip lift may give the sense of widening the alar bases. Patients who have real or perceived widening may find their result objectionable for this reason alone. Narrowing the alar verge by simply adding a full-thickness excision intranasally manages this issue.

Outcome and Complications

We have performed more than 1000 lip lifts since 1980, mostly in combination with corner mouth lifts. It has been an extremely reliable procedure with a high rate of patient satisfaction. When problems occur, they usually involve wound healing, asymmetry, or undercorrection. The first two categories are usually handled by revision. We have seen a handful of scars widen beneath the nostril sill. These are usually easily corrected: the tension placed on the skin edges after excising many millimeters of lip skin is now replaced with the slighter tension produced by excising a few millimeters of widened scar. We have seen only a handful of hypertrophic scars (all in Vietnamese patients), and these responded well to injection. Our preferred injection for hypertrophic scars on the face is Kenalog 40 mixed 1:1 with 5-FU. Minor issues with asymmetry often stem from unnoticed preexisting asymmetries and can also be handled with revision.

Although it is straightforward to excise more skin in patients who consider their lips to be undercorrected, overcorrection is more problematic. Of the few we have encountered, most lips have relaxed over time, and the patients have grown comfortable with the result. Time heals many things. Keeping to the excisional parameters outlined earlier and erring on the conservative side in resections should yield excellent results.

Anatomic Variations

Five anatomic variations merit caution:

1. A short upper lip with lack of incisal show
Lengthening the incisors through cosmetic dentistry may be a better solution than further lip shortening.
2. A long upper lip with significant incisal show
Shortening this lip may expose too much incisor.
3. A highly arched lip in which a lip lift could exaggerate the central arch and make the corners appear to turn down
An extended corner lift (discussed later) might be a better solution.
4. A rounded nostril sill that would hide a scar poorly
We have on occasion taken down the nasal spine to make the labiocolumellar angle more acute.
5. A mouth with downturned corners, where a lip lift can further emphasize the downturn
In this instance, it may be better to perform a corner mouth lift concomitantly, or to forego the lip lift altogether.

Downturned Mouth

Around the oral commissure, aging perioral tissues descend and wrap medially, creating a spectrum of anatomic variants of aging over time. The aging mouth can develop an unhappy or even bitter appearance as the lateral lip lengthens, the vermilion rolls inward, marionette grooves form, and the commissure itself eventually descends. Inside the nasolabial folds, indirect approaches to the correction of what we call the *downturned mouth* are remarkably ineffective. Although one might be tempted to elevate this tissue from either a face-lift incision or from the lower lid, we have found any correction to be short lived.

Midface Elevation

Our experience with elevating the midface in an attempt to correct the downturned mouth has been particularly disappointing. Over the years, we have tried different iterations of the procedure (including various combinations of temporal, intraoral, and subciliary incisions). All seem to have some effect on the downturned mouth early after surgery, but as the lift imparted relaxes over time, the ultimate correction is not as pronounced as what might be achieved with a simple corner mouth lift.



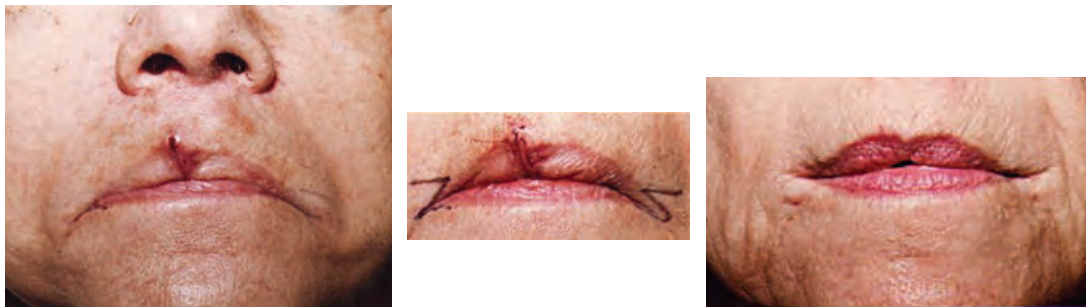
Preoperative

1 week postoperatively

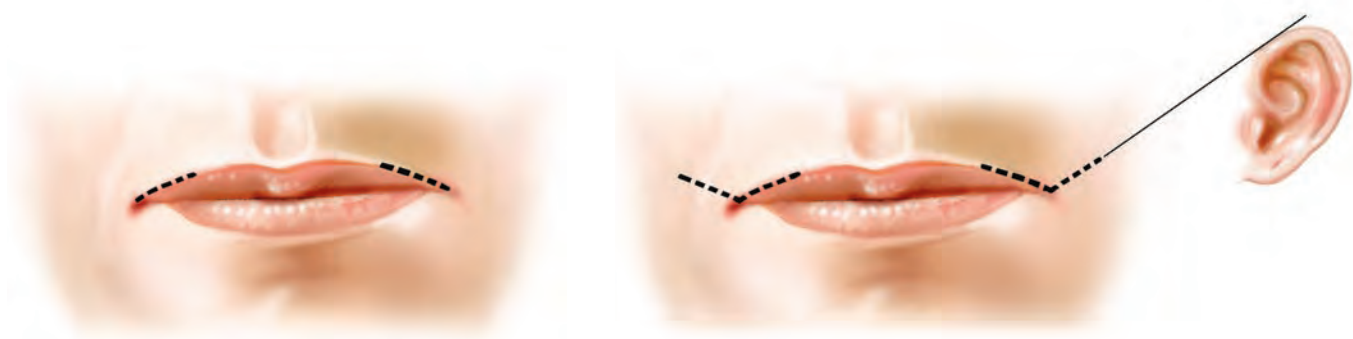
3 months postoperatively

This 45-year-old woman came to us unhappy with her angry, tired appearance. She underwent facial rejuvenation that included midface elevation. The downturned mouth corners appear corrected 1 week postoperatively; however, at 3 months those tissues have relaxed significantly and approximate her preoperative appearance.

Corner Mouth Lift

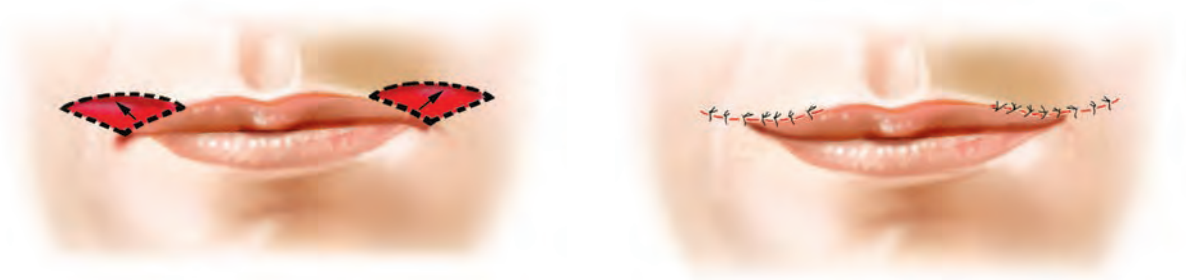


A short upper lip can exaggerate an already downturned mouth. An attempt to solve this problem (in the context of a postcleft whistle deformity) led to the first corner mouth lift by Austin in 1985. His use of a Z-plasty elevated the downturned corners but left rotated tissue below the commissure as an unnatural bulge. Excising this bulge led to its correction and the realization that it was unnecessary. Thus the second iteration of the original corner mouth lift (hereafter referred to simply as a *corner mouth lift*) was developed—a triangular excision of skin designed to rotate the mouth corners cephalad.



To design a corner mouth lift, a mark is first placed at the commissure precisely at the junction of the skin with the vermilion. A line is extended medially along the vermilion border for 10 to 16 mm. If one looks closely, there is often a subtle transition of the three-dimensional curve of the vermilion in this region. If this transition is present, it makes a good place to stop the medial extension.

A second line is then drawn from the commissural mark toward the top of the ear, stopping short of the nasolabial fold.



The ends of the two lines are connected with a third line, the shape of which can be varied to modify the lift of the lateral upper lip vermilion. A slight arc imparted to this third line will evert the lateral lip vermilion more than a straight or concave line will. Most of the third lines have a slight arc to them.

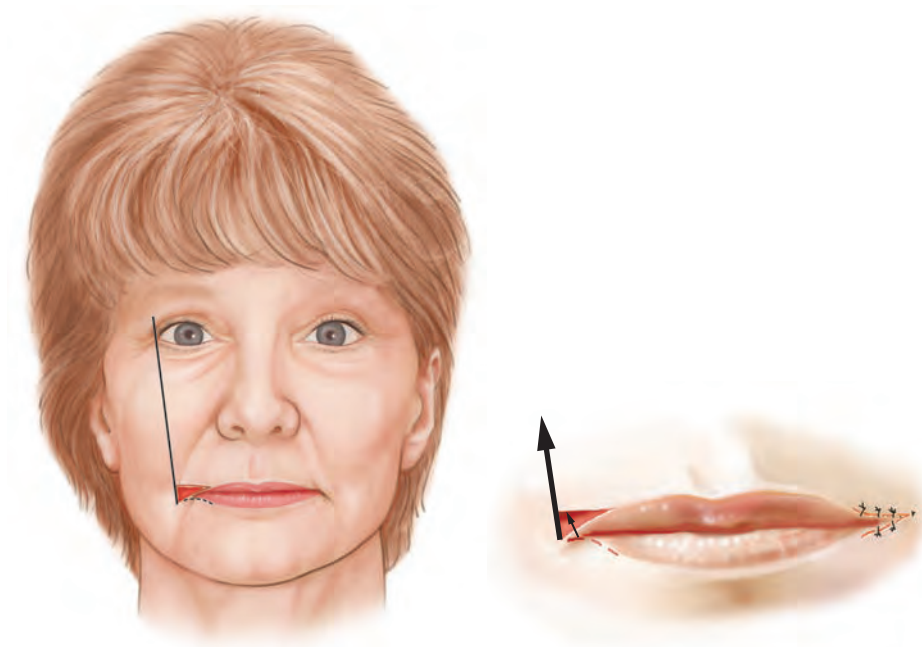


The lift imparted to the corner of the mouth depends on the amount of skin excised. Measured from the commissural mark to the point directly above it on the third line, we have found that 5 to 7 mm of excised skin is our average, 3 to 5 mm gives a small lift, and 7 to 10 mm corrects a more significant downturn.

Wraparound Corner Mouth Lift

One of the disadvantages of the corner mouth lift is the scar. The part of the scar lying along the vermilion border is well concealed, but the portion that lies lateral to the commissure extends onto virgin lip skin and is, to some extent, at the mercy of the vagaries of the healing process. In fact, it is visible in the previous patient's post-operative photo.

To avoid problems encountered with this lateral aspect of the scar, Weston devised the "wraparound" corner mouth lift in 1994. This subtle but important alteration of the corner mouth lift keeps the scar along the vermilion border by wrapping it around the commissure onto the lower lip margin.



Design of the wraparound corner lift begins with the same commissural mark and medially directed line, as described earlier. The second line, however, is directed more vertically than before, toward the lateral canthus rather than toward the tip of the ear.

The third line connects the ends of the other two, as previously described, but now a fourth line is added, running from the commissural mark medially along the lower lip's vermillion border. This fourth line is approximately half as long as its counterpart along the upper lip vermillion, and, with some undermining of the subjacent lip skin, allows the commissural mark to rotate into the apex of the excised triangle of skin.



We have found a deep stitch of 5-0 or 6-0 polyglactin with significant purchase of “perimodiolar” tissue crucial to minimizing the closure tension and ultimate scar, as can be seen in this patient at 3 months postoperatively.

Vermilion Roll-Out

When the commissures require lifting, the wraparound corner mouth lift is an excellent procedure, but it can leave some minor irregularity along the lower lip margin where the excess tissue is worked in. Poindexter realized in 2005 that if the commissure itself does not need lifting (and most do not), a simple excision of skin along the vermilion of the upper lip that stops at the commissure works nicely.



The design of this excision is simpler than that of the other corner mouth lifts. It begins with the same first line (commissural mark to medial endpoint along the vermilion border). The second line then becomes an arc connecting the ends of the first line. This arc ascends sharply from the commissure toward the *medial* canthus, then falls back gradually to meet the medial endpoint of the first line.



Over the past 23 years, we have performed more than 1500 corner mouth lifts and have found it to be one of our most valuable rejuvenative techniques. It has the capacity, more than almost any other single procedure, to alter the overall facial countenance. At its best, it changes sad and angry to almost angelic. Three technical considerations bear mention:

1. The surgeon should err on the conservative side (excisions less than 7 mm). Taking more tissue can lead to secondary effects that become difficult to manage—bulges lateral to the commissure, for example. Keeping resections to this limit also minimizes the problematic depressed scar. Although Juvéderm (Allergan, Santa Barbara, CA) has proved to be a reliable temporary solution, revision has occasionally been necessary.

2. Beware of patients with deep marionette grooves. In these patients, wrapping the corner mouth lift can accentuate these depressions, particularly if the fourth line or lower lip counterincision is not long enough. We have tried undermining and filling the marionette grooves, with varying degrees of success. Their significant presence is one of the indications we still have for a traditional corner mouth lift, and if the grooves are severe enough, they can be improved with a combination of modalities.
3. The skin excision for any version of the corner mouth lift can be extended medially up to the peak of the Cupid's bow without becoming visible. We again caution not to extend the incision to the area between the apexes of the Cupid's bow (as in a full upper lip advancement). At best, this can leave a visible scar with an unnatural, obviously surgical shape. At worst, it can leave a tight band across the central lip. We have found that a better choice is to perform a lip lift to elevate the central lip and a corner mouth lift to elevate the downturned corners.

Nasolabial Region

As an individual ages, the smooth, uncomplicated nasolabial region becomes increasingly complex and difficult to rejuvenate. Initial signs of aging, creases that delineate the fold, serve as tethers for the overlying cheek skin. Tissues thicken and thin around the creases, leading to folds over them and depressions both above (piriform aperture) and below (in the region of the mandibular ligament). How we deal with this area depends on the extent to which the aging process has affected it.

Simple creases in a younger patient often lend themselves to filling alone. We say “often,” because filling creases without somehow exerting a pulling force on them *can lead to unpredictable irregularity in the healing process*. Patients whom it affects—*younger patients who are not quite ready for a face lift, whose adjacent nasolabial skin is otherwise slightly loose and fairly smooth*—are often least able to tolerate this irregularity. These caveats are true for fat injection more than for dermal fillers.

Augmentation of the Nasolabial Folds With Fillers

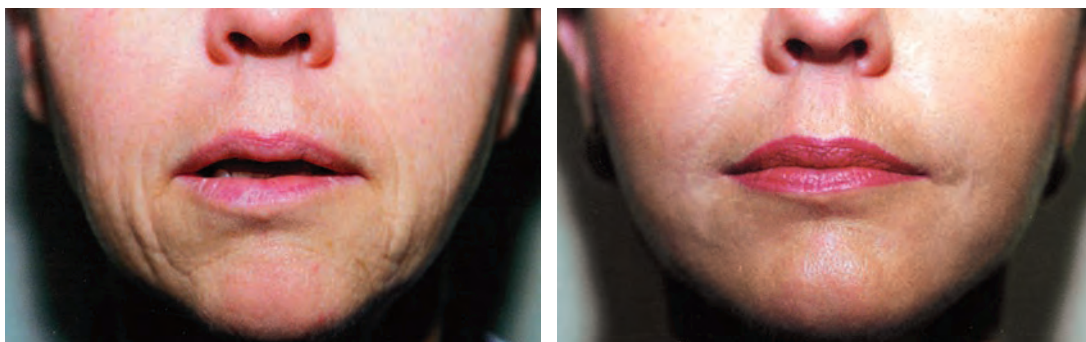
Nevertheless, filling the creases of the nasolabial fold is a fine technique in many younger patients and in combination with a face lift in older ones. Available substances run the gamut from autologous to alloplastic, from long lasting to short term. As a generalization, it seems to us that the material to be used for any augmentation should as much as possible mirror the tissue into which it is being placed. (The main exception to this rule seems to be the lips, where fat remains our filler of choice.) Fat seems to survive best in fat, dermis/collagen seems to distort skin less than other substances, and silicone or Gore-Tex implants seem to do best placed deep, near the

bone. Thus our preferred filler for directly beneath the nasolabial creases is Juvéderm for short-term correction, and strips of fascia for longer-term correction. One benefit of Juvéderm is that hyaluronidase can quickly and easily “erase” overcorrection. The technique for placement of the latter is straightforward and has been previously described.

Direct Fold Excision



As the aging process continues, the looseness around the nasolabial fold increases until filler is no longer effective. Using it in the volumes necessary is financially cumbersome and can be aesthetically undesirable. Some of these patients consider themselves too young for face lifts. In this group we consider performing direct excision of the nasolabial fold, trading the uniformly thin scar that is barely perceptible at conversational distance for the looseness that is visible from across the room.



Combining this direct excision with a lifting procedure is safe and allows a slightly less aggressive face lift, leaving the patient with a more natural appearance.

Our technique for determining the design follows. Placement of the scars is critical: they should be just medial to the nasolabial furrow and extend no farther than is necessary to excise the laxity.



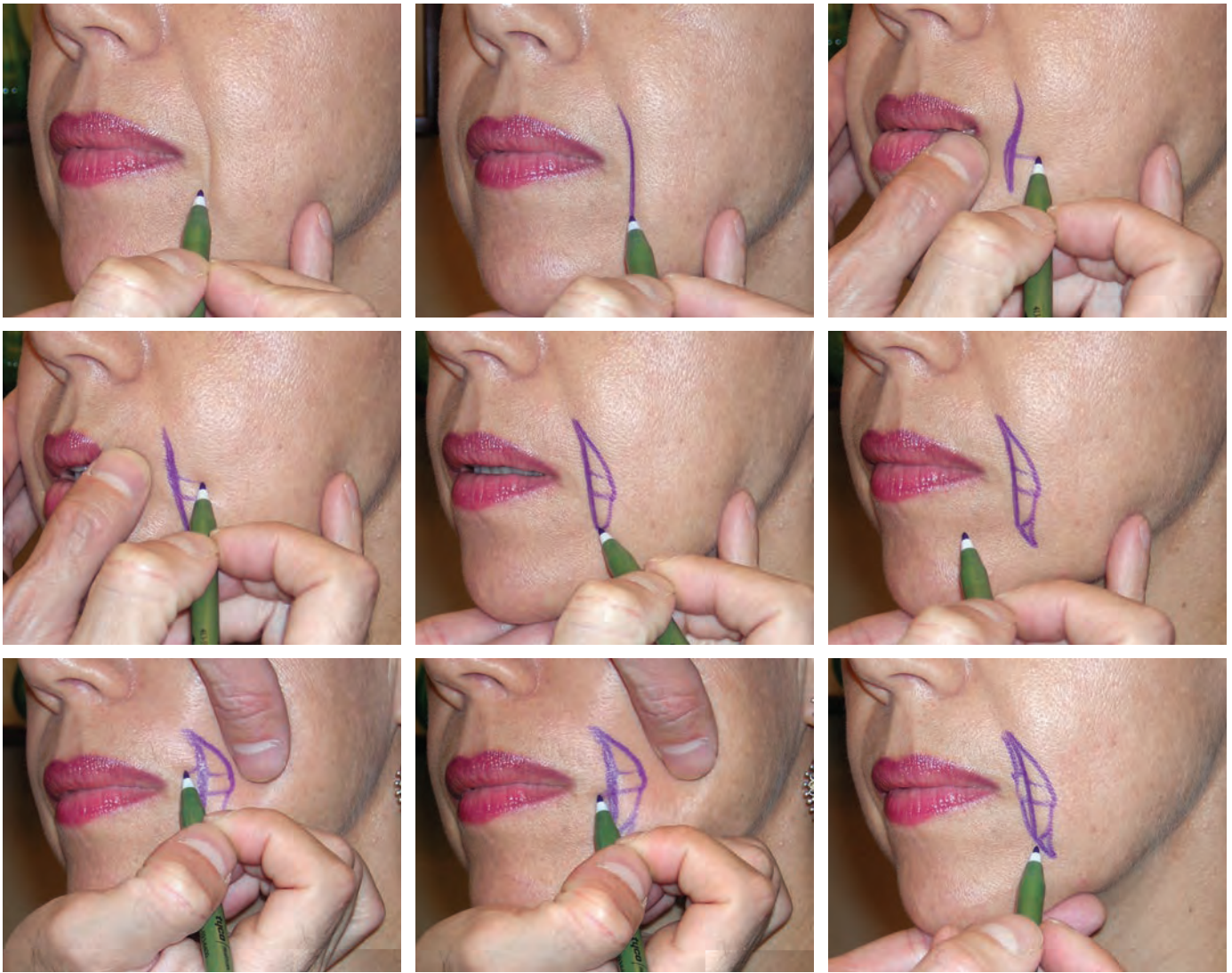
The variations of our different excisional markings illustrated here are determined by the anatomy of the individual.

In 75% of patients, only the lower nasolabial fold is excised.

In 25%, the inferior aspect of that incision is run laterally (as in the blade of a hockey stick).

Less than 5% of the time, the full length of the nasolabial fold is excised, and on rare occasion folds are excised horizontally.

Key Principles



The nasolabial crease is marked for the length to be excised, trying to leave both ends in depressions so that subtle dog-ears will be masked. The pen is placed over the area of most laxity (usually near the center of the drawn crease line), and the skin is pulled medially without moving the pen.

A dot is placed that will mark the lateralmost border of the excision. This medial pull is repeated a couple of times, with marks as needed to help define the arc of excision before connecting them. In this case, the patient's anatomy suggested we draw the lateral (hockey stick) extension.

The pen is placed back over the crease, and this time the skin of the cheek is pulled laterally, again without moving the pen. There will be less movement in this direction. Again a dot is placed, this time marking the medial extent of the excision. The medial dots are connected to form the outline of the total resection.

Direct Fold Excision With Face Lift

Until a surgeon becomes familiar with the operation, it is prudent to perform the direct excision as a secondary procedure. It is easily done with the use of local anesthesia in an examination room if the nasolabial excess remains problematic after a face lift. However, if on preoperative examination the nasolabial region remains lax while the surgeon simulates a face lift by lateralizing the cheeks with the fingers, we often propose combining the two procedures.



A full-length nasolabial excision is shown. When this is performed in combination with a face lift, the nasolabial fold is excised first. If the nasolabial tissue excision is delayed until after the face lift, the residual swelling associated with the face lift may make it appear that the direct excision is unnecessary. Our experience shows, however, that when the swelling and tightness relax after a few days, the need for direct excision again becomes apparent. Note how the intraoperative tightness has relaxed in the photo on the right, taken 1 week postoperatively.

Over the past 25 years we have performed more than 600 direct excisions of the nasolabial folds. It is difficult to recall patients who have ultimately been dissatisfied during that period, although many are concerned during the first 3 months. Once the redness and firmness fade, however, the scars are almost imperceptible. Even minor irregularities are rare and can almost always be adjusted in the office with the patient under local anesthesia.

Nasal Corner

The upper portion of the nasolabial fold is so rarely excised because it usually shows up as a depression on examination rather than looseness or tissue excess. As people age, the soft tissue overlying the piriform aperture thins until the skin at the corner of the nostril feels like it rests almost on bone. *Filling in this vacant nasal corner is an extraordinarily easy and useful adjunct to almost any rejuvenation.* It can be performed in many different ways.

Filling the Nasal Corner



The simplest way to fill the nasal corner is to inject the area with autologous fat or perhaps fascia. Our preference is for the former, usually injecting from 1 to 2 cc, as was done for this patient. A second method is to insert an equivalent volume of SMAS or mastoid fascia into that region through a stab incision usually made just inside the nostril verge. Through that incision a Joseph elevator is used to create a small pocket into which the tissue is inserted. An alloplastic option is to place a small triangle of silicone carved from either a cheek or chin implant along the bone from an incision in the upper buccal sulcus or from the nostril verge. Brink implants (Implantech, Ventura, CA), with or without the connection overlying the nasal spine, are quite useful in this regard.

Resurfacing Procedures

Resurfacing the perioral area is both old and new. Modalities such as dermabrasion, peels, and lasers have been in use long enough to be well understood by most experienced surgeons. However, integrating resurfacing into a comprehensive plan to rejuvenate a harmonious face is something with which we continue to struggle.

Young faces are not wrinkled and are evenly pigmented. Nothing symbolizes an old face more than wrinkles. Rhytids vary from fine to coarse and can either be confined to one area (initially perioral or periocular) or can be distributed more globally. Although often only the perioral area is resurfaced with facial rejuvenation, in a globally wrinkled aged face, consideration must be given to resurfacing the entire face. In the end, the quality of skin in all areas of the face should be consistent.

For fine wrinkling confined to the perioral region, we primarily rely on dermabrasion and the tunable erbium laser (Sciton, Palo Alto, CA). For the former, painting the skin with a light coat of methylene blue and removing it with a coarse diamond fraise (cleaning it frequently with a toothbrush dipped in peroxide to prevent clogging the fraise's interstices) provides a nice margin of safety.



As the rhytids become coarser, dermabrasion and the Sciton laser remain our mainstays. In addition, we almost always undercut the deeper rhytids with an 18-gauge needle and fill that undercut with a drop of autologous fat.

The settings for the Sciton laser vary, but we have found a single pass with 40 microns of ablation will almost universally induce a light peel. As the skin peels, much of the solar dyschromia comes off with it, and at this fluence, this laser appears safe for undermined skin. This becomes important in integrating any deeper central laser treatment (perioral, nasal, and forehead) in one stage with a face lift. By going deeper in the central (not undermined) regions of the face with the laser tuned for coagulation, we are able to erase most fine to moderate wrinkling and still blend the color change in that central area with the rest of the face in one session.



This 64-year-old patient demonstrates this principle. Of note here is the use of fat grafting as an adjunctive modality for treating wrinkles. When the wrinkles are fine and radially oriented, adding fat beneath the vermilion will sometimes stretch the vermilion border enough to obviate the need for resurfacing. Certainly, it is a good adjunct procedure. Botulinum toxin, 2 to 4 units placed intermittently along the upper lip, is also useful in the short term and can be done adjunctively with fat injections.

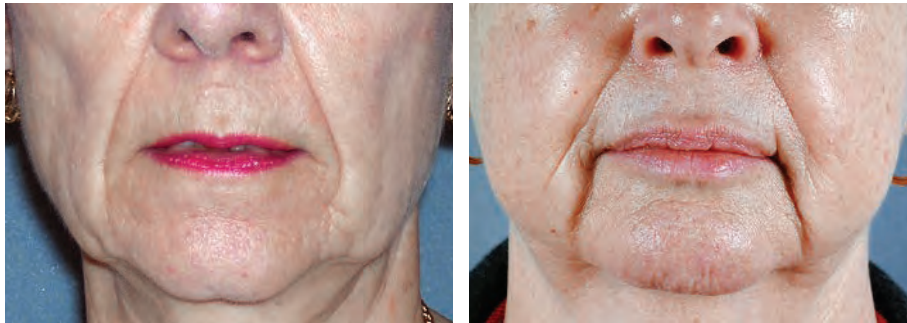
Deeper resurfacing always runs the risk of hypopigmentation, and every surgeon must perform his or her own calculus. Recently, ours has erred on the side of leaving rhytids rather than risking an uncorrectable skin discoloration. One can always perform a secondary wrinkle procedure.

We reserve the use of phenol for the deepest rhytids, which in our practice are relatively rare. Deep resurfacing poses the problem of combining a very powerful resurfacing modality with lifting procedures in one stage. We have used all manner of lasers (CO_2 , tunable, regular erbium, fractionated) and 35% trichloroacetic acid during face lifts and have used them to resurface flaps at the same time. We have yet to resurface an undermined flap with phenol and cannot envision a situation in which we would attempt it. We have therefore used phenol centrally (brow, nose, and mouth) and combined it with other resurfacing agents on the flap, or we simply stage the lifting procedures with a full-face phenol peel.



This middle-aged woman underwent a phenol peel to resurface her perioral region. There is persistent redness following the procedure, which is typical of the prolonged recovery from the deeper peels.

Nasolabial Variants and the Marionette Groove



Folds of tissue around the nasolabial crease can be massed primarily either medial or lateral to the crease itself, the former commonly known as the *marionette groove*. The clinical implication of this distinction is that lateral tissue can be expected to respond better to all modalities (face lifts, skin-tightening resurfacing, and direct excisions) than will medial tissue.



This patient demonstrates both variants; she underwent a face lift with deep central Sciton laser resurfacing and fat grafting. Three months postoperatively, it can be seen that the modalities had less effect on the patient's right side in effacing the marionette groove.



Temporary correction of the marionette groove can be achieved nicely with Juvéderm (less than 1 cc) and/or *botulinum* toxin (4 to 6 units) placed into the depressor anguli oris (identified by asking the patient to exaggerate the marionette groove while the surgeon palpates the area for muscle contraction).



More permanent correction is often best achieved by combining direct excision (or skin tightening laser) of any lateral nasolabial excess with subcision of the marionette groove. For this we use a 14-gauge needle and then inject fat. A horizontal mattress suture of 6-0 Prolene can be used to elevate the subcised tissue during the early phase of healing. Four units of botulinum toxin may be useful during healing.

The Vermilion: Restoring Shape and Volume

The lips thin and roll inward as we age, and the vermilion can virtually disappear, making one look old and bitter. Although the lip lift and corner mouth lift both expose more vermilion, the primary goals of those techniques are to correct a long upper lip and drooping mouth corner, not to correct thin lips or contour the lower lip vermilion. Restoring volume to the lips not only helps re-create the plumpness of youth but also helps to subtly rejuvenate the complex anatomy around the commissures. Advancing the lower lip vermilion is also indicated on occasion, usually in the older patient or aged face.

Fat Grafts

For moderately thin lips, we prefer fat grafting. Although we have found the lips to be one of the places on the face with the most variable “take,” grafting fat remains a workhorse, because of its low cost, availability, and ease of use. The technique can be as accurate as threading tissue grafts; the survival rate in our hands varies from 0% to 70%. We have begun freezing fat for later injection with the patient under local anesthesia. Although cell culture techniques suggest that these cells do not survive without a special culture medium, we suspect additional volume may be achieved through the scarring process.

Alloplastic Fillers

Alloplastic materials are a nice fallback should fat resorb completely or be found objectionable by the patient. Hyaluronic acids have been our favorites. Collagen has a long history, and its strengths and weaknesses are well known. Autologen was a nice idea but was financially impractical and is of historical interest. AlloDerm may have utility, but it is expensive, and we have no experience with its use in the lips. We have found Radiance disastrously lumpy. We have essentially abandoned implanting Gore-Tex in the lips, because too many unnatural results warranted its removal.

Lip Advancement

In aged lips, when the *lower* lip is very thin or has rolled inward significantly, tissue grafts for volume may be inadequate, and lip advancement should be considered. As mentioned earlier, upper lip vermillion advancements done by excision of a continuous strip of upper lip skin, including the prolabial portion between the peaks of the Cupid’s bow, are risky, because they can sometimes contract and flatten the Cupid’s bow. Even the best of scars in this area are fairly noticeable.



As discussed earlier, a better solution is to extend the corner mouth lift up to the ipsilateral peak of the Cupid’s bow and perform a small central lip lift, as was done for this patient. (Fat was also grafted to the lips.)



The lower lip architecture is less complex than that of the upper lip, and lower lip advancement is a reliable way to expose more lower lip vermilion. A strip of subjacent skin is excised from corner to corner, twice as wide as the amount of advancement desired. The scar lands at the vermilion border and is usually imperceptible, even from inches away. When combined with the corner mouth lift, a small gap should be left between the incisions at the commissure to prevent the possibility of scar contraction.

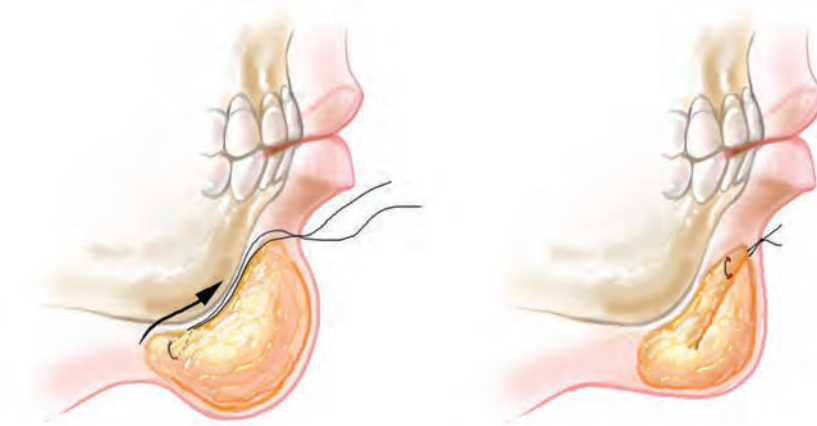
Mucosal Advancement Flaps

Mucosal advancement flaps can also be used to increase mucosal volume and change the shape of the vermilion. We now rarely use them because they lengthen the upper lip, and patients complain about how the mucosal scars feel. We prefer the other procedures described earlier.

Ancillary Procedures

Correction of a Witch's Chin

We have tried many ways to correct a ptotic chin pad, or *witch's chin*, and have found the following technique to be a straightforward and reliable way to go about it.



Through a submental incision, the fat pad of the chin is isolated on a superior pedicle by separating it from the skin above and periosteum below. This dissection must be generous enough, particularly laterally, to allow for the free rotation of the fat flap up under itself. Attaching a “leading” stitch to the apex of the flap and directing that stitch along the periosteum and out the labiomental fold easily accomplishes that rotation. Taping the stitch in place fixes the flap.



This 62-year-old woman was unhappy with her aging face but was particularly focused on her ptotic witch’s chin. She underwent a facial rejuvenation that included correction of her ptotic chin pad by rotation of the superiorly based fat flap. Results are shown at 4 months postoperatively. She is delighted with the improvement.

Reshaping the Philtral Columns

A smooth, round, simian upper lip is simply not youthful. We have discussed ways of recreating vermilion contour (lip lifts and fat grafts) but have only alluded to recreating the subtle anatomy around the philtral columns; a lip lift with a central component will often suggest columns by creating a philtral dimple and, if extended far enough, a “pouty” apex to the Cupid’s bow.

Hills are often hills because they are next to valleys. Creating a philtral dimple is sometimes enough to rejuvenate the philtral region. This can be accomplished by the lip lift with a central component, or by simply undermining the lip lift and taking a partial-thickness “scoop” of orbicularis oris muscle. The resultant cleft mimics the philtral dimple.

The actual creation of philtral columns is a bit more difficult. We have used fat grafting without great success. Fat seems to live poorly in this tight, mobile area. Juvéderm works well, but its effects are relatively short lived. Fascial strips seem to be a good option and are currently our preferred choice when the patient desires a more permanent solution. They are placed by attaching a leading stitch onto the end of the strip, then into a 14-gauge needle that is placed under the skin in the desired location of the philtral column. Austin had found it useful to wrap these strips in polyglactin.

Concluding Thoughts

We have found that surgical rejuvenation of the aging mouth often requires a more direct approach than most plastic surgeons are routinely comfortable with. Our usual trade-off of scar for shape takes on new meaning when the scar might lie along the vermilion border, on the nostril sill, or along what was a nasolabial crease. Nevertheless, in more than 80 combined years of practice and in more than 3000 patients, we have found that trade-off not only worthwhile but a wonderful adjunctive solution to difficult rejuvenative problems.

Clinical Caveats

At least 10 to 12 mm of upper lip should be left after a lip lift.

It is better on the conservative side for corner lifts; lip lift excisions should be less than 7 mm.

If the commissure itself is in good position and does not need lifting, a vermilion roll-out should be considered.

The surgeon should beware of a patient with deep marionette grooves. In these patients, wrapping the corner mouth lift can accentuate these depressions, particularly if the fourth line or lower lip counterincision is not made long enough.

Caution should be exercised when combining a lip lift with an open rhinoplasty.

Annotated Bibliography

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The author focuses on a seldom-considered sign of aging—lengthening of the upper lip. He presents his technique for correction: excision of a wavy ellipse of lip skin and hiding the scar up under the nose. A vertical midline component may be added. The scars are minimal, and the results have been excellent in 83 patients.

Austin H, Weston G. Rejuvenation of the aging mouth. *Clin Plast Surg* 19:511-524, 1992.

By viewing the face as a series of three concentric rings, we can successfully rejuvenate the outer ring with the usual face lift, blepharoplasty, and brow lift. However, insufficient attention has been paid to the middle and inner rings. This article discusses the technique for mouth rejuvenation in both of these rings.

Suggested Readings

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CHAPTER 52



Refinements in Otoplasty Techniques

BRUCE S. BAUER, NETA ADLER

Despite recognized standards of idealized facial proportions and anthropometric measurements for each facial feature, the sought-after “look” of the moment tends to change, depending on which new fashion model or celebrity is hot, or which individuals are currently revered in today’s media. Strangely, when wishing to depict an oddball character, a less intelligent individual, or a “funny-looking kid,” the media often portray individuals with large, prominent, or oddly shaped ears. Regardless of what we may later learn about these characters, we initially assign a level of low intellect or immaturity to them. The fact remains that without calipers or other instruments of measure, and without memorizing a set of standards, we visually recognize when facial features appear to be in balance, and few if any features elicit such negative responses as ears that are prominent, overly large, or misshapen. Like it or not, we tend to attribute these negative traits to these unfortunate individuals.

The literature in plastic surgery and otolaryngology abounds with approaches to correct these deformities, many described as the “definitive procedure.” Yet the failure to properly analyze each deformity and modify the technique to fit the specific features of each ear is likely to lead to an unfavorable outcome. Although the vast majority of otoplasty patients are extremely pleased with the outcome of their surgeries, there are few patients more distraught than those whose previously attention-grabbing ears are now less prominent—but just as unsightly.

In this chapter we will outline the evolution of our current technique for correction of the prominent ear. We will demonstrate how the technique has been modified to make it flexible enough to correct a wide variety of deformities, from simple ear prominence to an accompanying deformation of the helical rim, excessive prominence of the lobule, and moderate degrees of constriction. To master the technique, surgeons must understand how to properly balance and subtly position the varied ear contours to obtain an outcome that “looks right” and that does not immediately tell the observer that the ears have been operated on. Although the final ear position and shape are critical, the exact measurements are not.

Indications and Contraindications

Many of the patients presenting for otoplasty are easy to spot in a crowded waiting room, but not every person with large, prominent ears wants to change his or her appearance, and many, even if teased in childhood, have become comfortable with their appearance. That being said, experience has demonstrated that many of the parents bringing their children in for correction of prominent ears are strongly motivated by the desire to spare their child the embarrassment and teasing that they themselves endured. More than a few have subsequently elected to undergo otoplasty after their child has had surgery. In these cases the satisfaction rate and feelings of relief are a constant feature of their recovery.

These issues come into play in deciding the appropriate timing for the surgery, and whether the decision should be made based on the parents' concerns or whether the surgery should be postponed until the child expresses concern. Such a decision needs to be made case by case, but by the time children approach 5 years of age, they may well have been teased, even if the teasing has not started to affect the way they feel about themselves. Once the discussion is initiated, the child will express willingness to go through the surgery to avoid this teasing.

The growth patterns of the ear also factor into the timing of surgery. According to Adamson et al, the external ear reaches 85% of its adult size by the time a child is 3 years of age. Growth continues until adulthood, but little change in width or distance from the scalp occurs after 10 years of age, and for all practical purposes the normal ear is almost fully developed by 6 years of age. Farkas reported slightly different data, with the ear reaching 85% of full size by 8 years of age, 90% by 9 years, and 95% by 14 years.

Although it is quite possible to correct a protruding ear before 5 years of age with no effect on the growth of the ear, it has been our experience that children younger than 5 years of age are rarely perceptive enough about their appearance, or comments made about them, to feel that correction is urgent. Experience has demonstrated that young children may have significant difficulty cooperating with postoperative routines, such as dressings and limitations on activity. The ear cartilage at ages younger than 5 years may be softer and more pliable, and thus the risk is greater that some degree of protrusion will recur. Taken together, with very rare exceptions, age 5 is the low end of our patient spectrum.

More subtle cases of ear prominence, distortion of ear shape, or ear asymmetry may not spark the desire for correction until a child is older, more concerned about overall appearance, or eager to adopt a different style and wear his or her hair back or cut short. In each case, the ear or ears that may have been kept well hidden are now exposed for all to see.

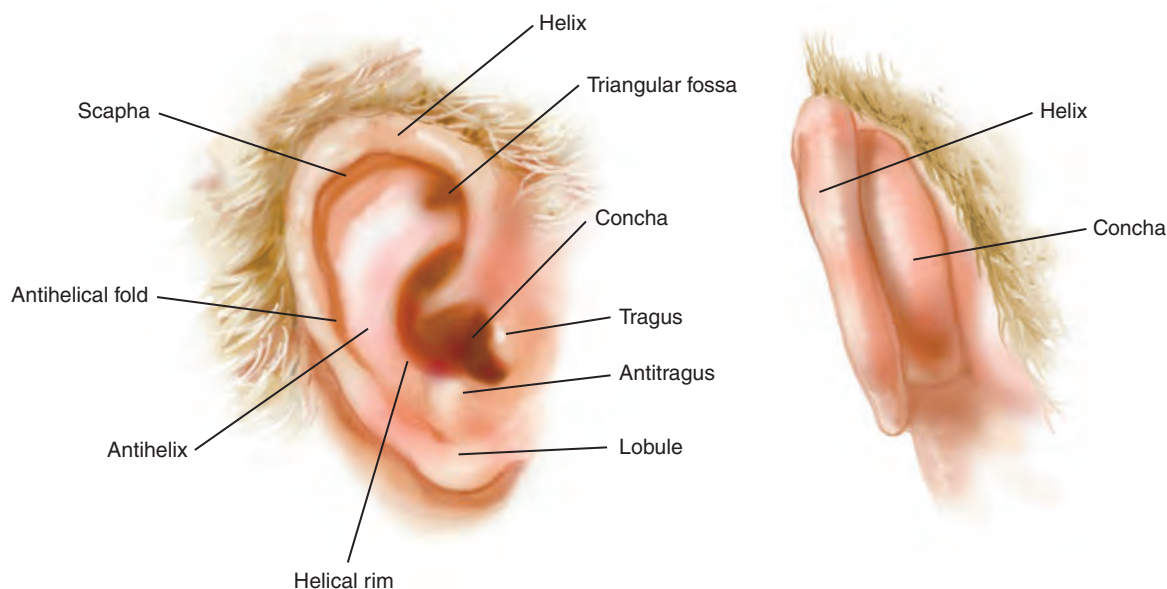
There are very few contraindications to otoplasty. In the pediatric population, surgery is appropriate and extremely well tolerated if the child does not strongly resist the idea of surgery. If a younger child begins to act out or becomes excessively worried about going to the doctor for a preoperative discussion or going to the hospital, it is best to delay the surgery until the child requests the procedure. Another contraindication is a history of chronic ear infection and ear drainage that has not been thoroughly investigated and corrected. It is not uncommon for children to have previously undergone myringotomy and placement of a pressure equalization tube. If there is no active infection or significant drainage, otoplasty can be performed safely.

At the other end of the age spectrum, adults seeking changes in ear shape, size, or prominence must, as with any aesthetic surgery candidates, be able to express their

reasons for seeking a change at this stage and demonstrate realistic expectations of what the change will mean for them. Careful case selection is critical, and never more important than when the deformity is a minimal or subtle one. Although beyond the scope of this chapter, the same is especially true in patients who have previously undergone one otoplasty and are dissatisfied with the outcome.

Pertinent Anatomy

Anatomy of Ear Prominence



Although the majority of otoplasty techniques have historically concentrated on the effaced antihelical fold as the main cause of ear prominence, failure to fully appreciate all the elements distorting the ear position and shape is a recipe for an unfavorable outcome. Experience has revealed that the vast majority of prominent ears demonstrate some degree of conchal hypertrophy, and the concha may be the cornerstone to the treatment of the prominent ear.

Causes of Ear Prominence

Correct analysis of each deformity is the most important step in otoplasty. Ear prominence results from one or more of the following features: (1) effacement or a deficient antihelical fold, (2) conchal hypertrophy or abnormalities in conchal shape, (3) deformity of the underlying skeletal anatomy, and (4) macrotia, or generalized overgrowth of the ear. The first two of these features are accentuated when seen in combination with the decreased radius of curve of the helical rim in a constricted ear. We will look at each of these elements separately.

Antihelical Fold

Effacement or deficiency of the antihelical fold ranks foremost in most discussions of the prominent ear. This deformity presents as a spectrum from a totally indistinguishable antihelix, with a confluent concavity from antihelix to scapha and the helical rim projected outward and forward, to loss of definition of only the superior antihelix with prominence of the upper pole of the ear.

Conchal Size and Shape

Although less attention has been given to the importance of the concha in overall shape and projection of the ear, it makes sense in considering the three-tiered configuration of the auricular cartilage framework that because the more delicate antihelix and helical complex are mounted on the sturdier concha, changes in conchal size and shape will profoundly influence the overlying tiers. In our experience, it is rare to see ear prominence that does not have some conchal element.

There appear to be three ways in which the concha affects the prominence of the ear: (1) overall enlargement of the concha, which projects the ear away from the mastoid surface, (2) an extension of the helical crus across the concha, which creates a firm “cartilage bar” that pushes the ear outward, and (3) the effect of the angulation of the cartilage at the junction between the cavum concha and the sweep of cartilage up to the antitragal prominence, which affects the position and prominence of the lobule and lower third of the ear. The first of these is well recognized. Little attention has been drawn to the second, but once seen, it is easy to understand. The third element, once recognized, leads to an understanding of the approach to the isolated lower pole and lobule prominence.

Conchal shape, although not the only cause of prominence of the lobule, appears to play a key role. As the cartilage angle between the concha cavum and antitragus becomes more acute (that is, as the antitragus tips closer toward the concha), this supporting structure projects the lower third of the ear and lobule outward. We think that this feature has a greater influence on lobule position than the commonly described helical tail does.

Anatomy of the Underlying Skeleton

Little attention has been drawn to the affect of the underlying skeleton on ear prominence, but it should be recognized and taken into account in planning correction of a prominent ear. The external ear is mounted on the bony base of the underlying temporal bone. Anomalies in skeletal shape and skeletal asymmetries can affect one or both ears. Perhaps the most recognizable example of this relationship is the change in ear position and projection associated with positional, nonsynostotic plagiocephaly. With the parallelogram deformation of the cranial vault, the ear on the side of occipital plagiocephaly is projected forward and is often more prominent. In more subtle cases of this deformity, the ear prominence may become more evident when

the individual is older, with ears that are asymmetrically positioned, and residual occipital flattening and mild facial asymmetry may not be readily apparent on first view. This effect of head shape on ear position is clear when viewing illustrations of Ely's description of his otoplasty technique in 1881.

A less subtle example of the influence of the skeleton on ear position is the effect of deficient temporal bone and medial positioning of the temporomandibular joint in hemifacial microsomia. In more severely affected patients without microtia, the normal ear may seem to be "sheered off the head," with the upper half of the ear projecting outward and the lower half canted medially toward the hypoplastic face. An additional example with some similarities is the small group of patients whose general craniofacial shape includes a relatively broad head, with a narrow face and mandible. Seen from the frontal view, there is a triangular configuration to the head and face. This slope from head to face may project the upper ear outward, creating ear prominence, but showing otherwise normal and proportional ear features.

Macrotia

There are wide variations in ear size and a broad spectrum of "normal," but some patients have overall enlargement of the ear, out of proportion to the other facial features. This may occur as a result of congenital overgrowth in isolation, or in combination with hemihypertrophy of the face. It may also occur as a result of a disease process, such as neurofibromatosis, or a vascular anomaly. The ear, while enlarged, may be normal in shape, or show elements of the above-mentioned features. Each of these anomalies is relatively rare. Less rare, and not true macrotia, is an isolated congenital enlargement of the lobule, with the lower third of the ear projecting outward from the face.

Preoperative Assessment

In the majority of cases, if the patient is a child at an appropriate age to undergo a procedure, the preoperative assessment is completed with the initial evaluation and one subsequent preoperative visit (usually within the week before surgery). For children too young for surgery, or not presently concerned with the deformity, a return visit is planned for the appropriate age. For an adult patient, particularly one requesting a secondary procedure, the surgeon may elect to meet an additional time to ensure that the patient's expectations are appropriate and can be fulfilled. All patients require routine history-taking and a physical examination (plus a laboratory workup in adults) to be completed by the primary physician. Photographs are taken preoperatively and reviewed to ensure that all appropriate views are documented.

The specifics of the deformity are discussed with the patient or family, taking care to point out any asymmetries that may exist between the two ears. The surgical pro-

cedure is discussed in detail, including a review of the options for anesthesia (a general anesthetic is used in the majority of pediatric cases; possibly a local anesthetic with or without sedation in minor cases or in adults), discussion of incisions, dressings, and postoperative care. Such risks as infection, chondritis, and hematoma are discussed, as well as their implications and treatment. The surgeon also discusses the fact that there may be minor asymmetry or a partial recurrence in younger patients that can be corrected through a minor revisional procedure with a local anesthetic when the child is ready and comfortable with this.

In most cases, and particularly in children, it is helpful to review photographs of a series of otoplasty cases illustrating a variety of prominent ear deformities. With some of the more atypical deformities of the helical rim or with a constricted ear, this will help to clarify the potential limitations of the surgery while still demonstrating its benefits.

Preoperative Planning

Proper assessment of the patient's deformity is the key element of preoperative planning. Our current approach to correction of the prominent ear evolved from the Stark-Saunders technique, which combined posterior thinning (dermabrasion) of the proposed antihelical fold and suture fixation; our technique emphasizes chondrocutaneous conchal resection as the cornerstone of correction of the prominent ear, combined with posterior suture shaping and fixation of the antihelical fold. Our current approach totally avoids any thinning or potential irregularities in the antihelix seen with many of the cartilage-scoring techniques, while still minimizing the risk of recurrence that may be seen with suture techniques alone. The integrity of the antihelical cartilage is maintained because the perichondrium overlying both surfaces of the antihelix is left undisturbed, yet the cartilage spring is diminished as a result of the "break" at the conchal level.

This evolution in our approach followed assessment of our own postoperative results as well as critical evaluation of a reasonably large series of patients seeking revision otoplasty. In the latter group, most demonstrated an overaccentuation of the antihelical fold and failure to recognize conchal hypertrophy as the underlying cause of the initial ear prominence. Addressing conchal hypertrophy in these patients, alone or in conjunction with ancillary techniques, has produced consistent and reproducible outcomes that are satisfactory to both the patient and surgeon.

The goals of otoplasty should be to (1) correct the protrusion, (2) correct the prominently visible helix and antihelix while leaving a visible helical rim (3) create a smooth antihelical fold, (4) avoid disturbance of the postauricular sulcus, and (5) avoid a "plastered down" or "pinned back" look. To achieve these goals, each deformity must be critically evaluated and the technique modified to correct subtle differences in the two sides.

Whereas emphasis had previously been placed on the importance of correcting the antihelical effacement, this approach emphasizes the concha's role in the prominent ear. This results in a treatment plan that readily achieves each of the above goals while guaranteeing that a sharp, irregular antihelix and pinned-back look will be avoided. The technique is also readily modified to suit the correction needs of a whole host of unusual or atypical deformities.

With the exception of the rare cases in which there is no visible conchal component to the deformity, the procedure begins with an anterior conchal incision, and excision of a crescent of cartilage with a smaller skin component. For a lesser degree of cartilage resection, no skin may be excised. Although minor degrees of conchal prominence can be handled by creation of a new antihelical fold or by setback with conchal mastoid suture, most patients with conchal hypertrophy require cartilage excision. The choice of an anterior or a posterior approach to cartilage excision is one of personal preference. In our opinion there is considerably more control with the anterior approach, and in cases with wider resection of 1 cm or more, the extra skin left from the use of a posterior approach may not shrink down enough. The fold created in the conchal floor can be much more noticeable than a finer anterior conchal scar that is rarely visible by 1 year after otoplasty.

After repair of the concha, the surgeon turns attention to the postauricular surface, where skin excision and exposure of the posterior perichondrium over the scapha, helical sulcus, and helical tail are followed by suture placement. Sutures are tied to correct the prominence, and closure of the inferior incision sets the shape and correction of the lobule. Next the surgeon performs adjunctive procedures, such as correction of helical rim deformities, excessive prominence of the antitragus, and additional reduction of lobule size. Corrections of adhesion or defects of the helical rim may make use of the resected conchal cartilage as a graft.

Operative Technique



52-1 Otoplasty

Although we will make every effort in this section to describe the nuances of each step, the indications and benefits of each maneuver will become readily evident as one gains more experience with the procedure and better appreciates the flexibility inherent in this approach. With rare exceptions, which will be noted, the techniques used are similar for children and adults.

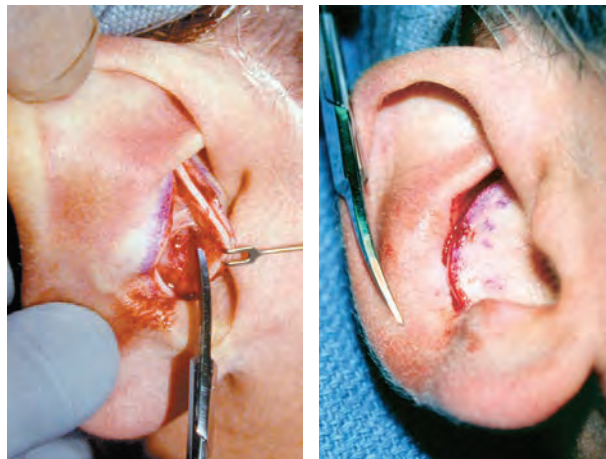
General anesthesia is induced with a reverse airway endotracheal tube, or intravenous sedation is used. The face and both ears are sterilized with a green soap solution and draped with a standard head drape. Stray hairs are secured with Tegoderm or another clear sterile drape. A solution of 0.5% lidocaine with 1:200,000 epinephrine is infiltrated into the anterior and posterior surfaces of both ears. Bilat-

eral great auricular nerve blocks with 0.25% bupivacaine are also injected for postoperative analgesia. A broad-spectrum antibiotic is given intravenously after placement of the IV line.



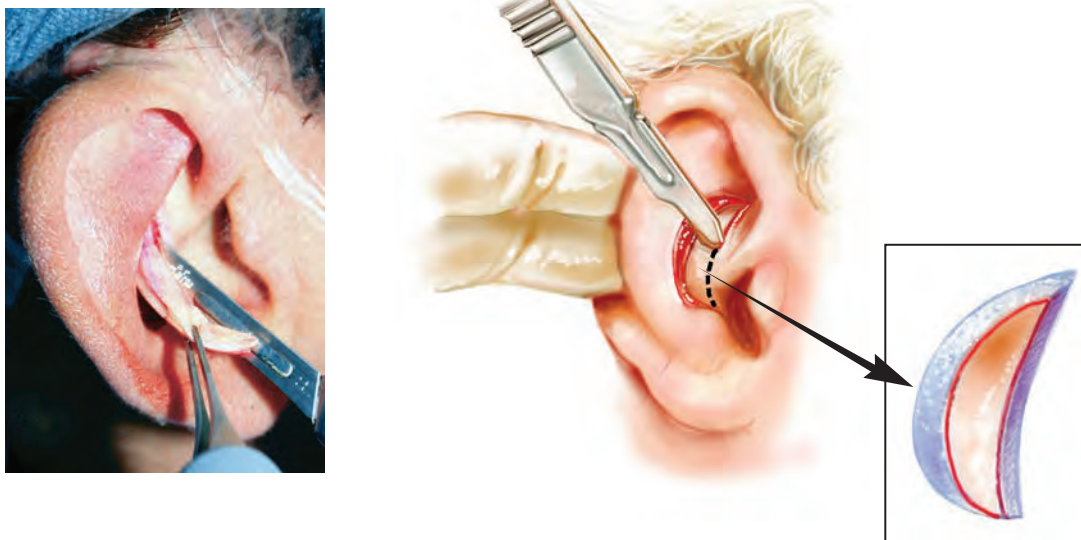
The procedure typically begins on the more prominent side and starts with the incision on the anterior surface of the concha. The incision is placed at the junction of the posterior conchal wall and “floor” of the concha. It begins in the cymba concha and continues along the cavum concha to a point below the antitragus, but not as far as the external auditory meatus.

This incision is deeper in the concha than the incision described by Elliott. Placing the incision too high in the concha will decrease control of the antihelical fold, allowing the cut edge adjacent to the antihelix to spring forward when the antihelix is shaped. The incision is carried through both the anterior skin and conchal cartilage, stopping shy of the posterior conchal skin.

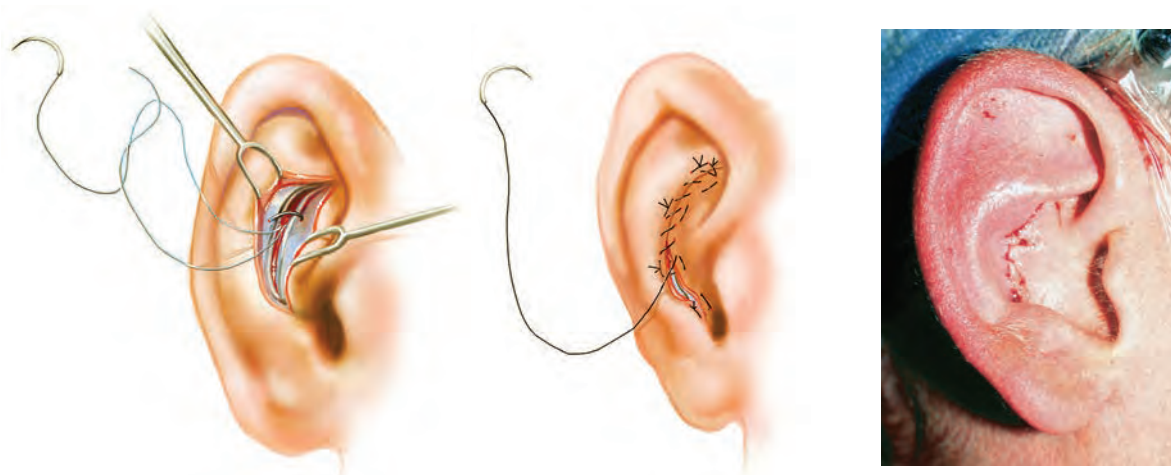


Sharp dissection in the loose areolar plane behind the concha (not in the subperichondrial plane) frees soft tissue and skin from the posterior surface of the conchal bowl.

A gentle setback of the antihelix with finger pressure will accurately estimate the degree of conchal hypertrophy and the amount of cartilage and skin resection needed to create an aesthetically pleasing position for the ear.

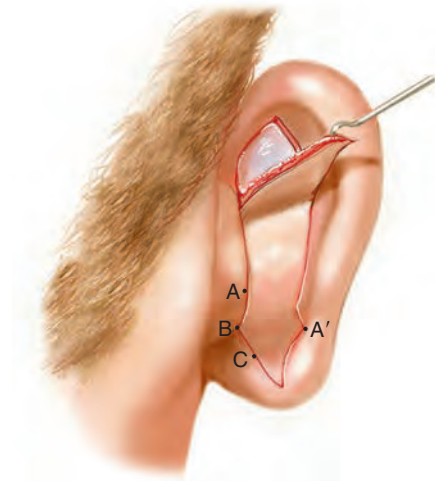


Usually a crescent-shaped chondrocutaneous segment is excised. To ensure a tension-free closure, more cartilage is typically resected than skin, particularly along the inferior concha deep to the antitragus (where excessive resection would tend to pull the antitragus upward and increase prominence of the lower pole of the ear and lobe).



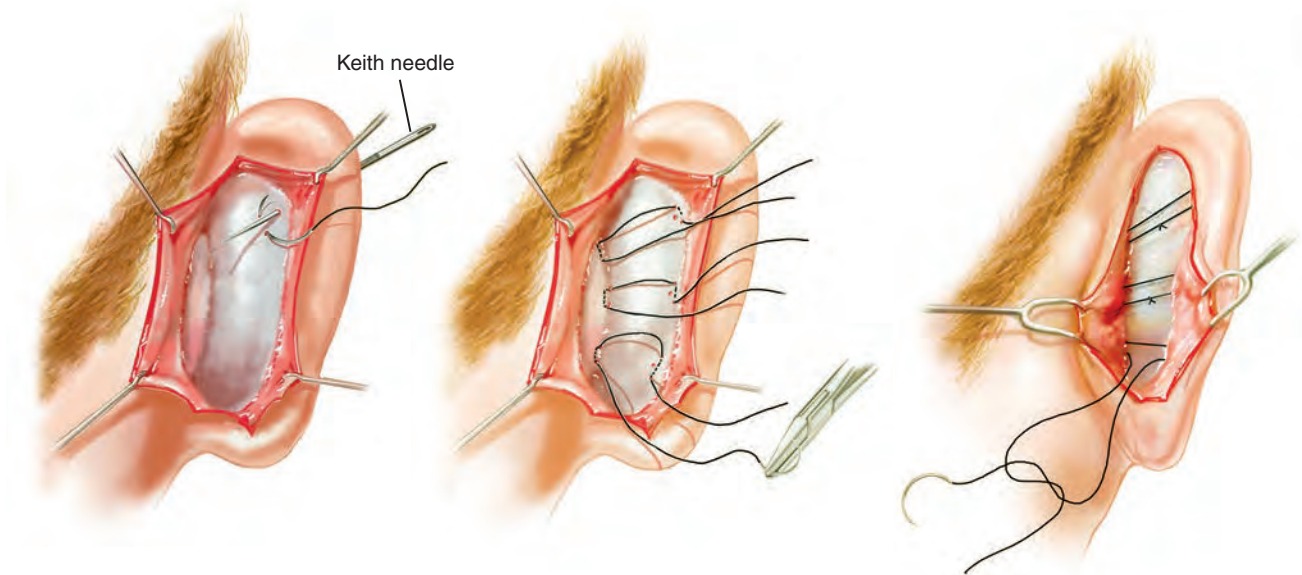
The edges of the conchal cartilage are then approximated with three or four interrupted 5-0 clear nylon sutures. How the most inferior suture is placed, at the junction of cavum concha and antitragus, will adjust the angle between these landmarks and strongly influence the cartilage support to the lobule. A slight overlapping of cartilage (antitragal segment over conchal segment) will tip the lobule posteriorly.

Once the cartilage is repaired, the anterior skin is closed with a combination of 5-0 chromic gut, with horizontal mattress sutures, followed by a running 6-0 mild (fast-absorbing) chromic gut. With these maneuvers completed, the helical rim and ear may at first seem more prominent, but gentle pressure applied to the antihelix will demonstrate a relaxing of the tension needed to bend the antihelix back to its desired correction.



Correction of the effaced antihelix and prominence of the lobule first begins with a retroauricular “squid”-shaped skin excision down to the perichondrium. This squid-shaped excision (which, in essence, is the typical dumbbell-shaped ellipse with the inferior end widened to a diamond shape) is designed to allow access to the posterior surface of the scapha and helical sulcus for suture placement and to assist in correction of the lower pole prominence. The diamond-shaped inferior extension of the “squid” is positioned with its maximal width at the point of maximal lobule prominence. When designing the squid-shaped excision, failure to taper the skin excision in its midportion may result in a postoperative “telephone-ear” deformity in which the upper ear and lobule protrude, resulting in an ear shaped somewhat like the hand-set of a telephone. Exposure of the posterior surface of the conchal bowl and scapha is achieved without dissection of any perichondrium off the cartilage. Preserving the perichondrium is essential to lessen the possibility of subsequent sutures pulling through the cartilage. As the dissection proceeds to expose the posterior surface of the cartilage, care is taken to identify and free the helical tail. The latter is seen as a duplication of cartilage extending inferiorly from the middle to the lower third of the helical rim. This dissection must not free the cartilage of the tail from the skin overlying its anterior surface, because this would diminish the effectiveness of correcting the prominence of the lobule. The final dissection proceeds onto the mastoid surface, freeing the soft tissues sufficiently to ensure that later sutures can be securely placed into the mastoid fascia. Bipolar cautery is used throughout to ensure hemostasis.

Before placing sutures that will further correct the ear prominence, the surgeon gently puts pressure on the helical rim and antihelix to again demonstrate that the spring (resistance of the cartilage to further shaping of the antihelix) is significantly decreased, and now the reshaping can be accomplished without any sharpening of the antihelix. Surgeons must recognize this key point of this otoplasty technique, because even a limited amount of conchal resection will still result in this lessened spring and increased ease of shaping the antihelix. With the current exposure of the posterior surface of the concha, if additional sutures are needed to complete an accurate closure of the conchal defect, they can be placed now before the key posterior shaping sutures are done.



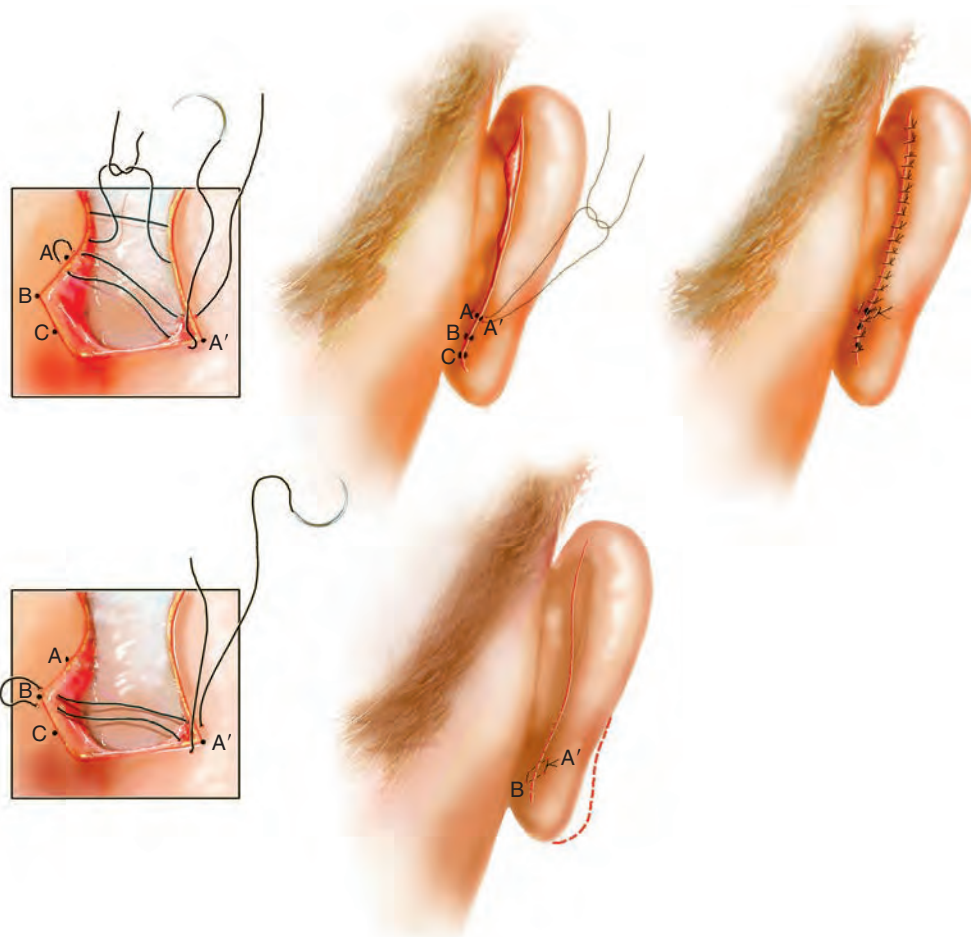
Two or three 4-0 clear nylon sutures are placed from the scaphal cartilage and helical sulcus cartilage to the mastoid fascia to correct prominence of the upper and middle third of the ear. The third superiormost suture may be placed from the region of the triangular fossa to the temporal fascia. The proper placement of these permanent sutures is confirmed by applying pressure to the desired points on the anterior surface of the ear with a straight Keith needle, then passing the point of the needle through the selected spot so it can be visualized on the posterior surface of the cartilage.

The nylon suture is then placed at each specific point without the need of tattooing the cartilage. As the suture is placed, the Keith needle is withdrawn. The sutures are then passed through mastoid or temporal fascia.

Once all sutures are placed, beginning with the scaphal suture, they are tied to the proper tension to create a smooth antihelical fold. Before cutting each suture, the surgeon uses a forceps to grasp the knot and slide it down against the mastoid surface to minimize any risk of later extrusion of sutures. As these sutures are tied, care should be taken to observe the relationship of the reshaped antihelix and the helical rim to ensure that the helical rim remains visible from the frontal view. A triangular fossa-to-temporal fascia suture is required only if there is a need to pull the helical root closer to the head. This is best determined by looking at the superior helical rim from the anterior view to see if there is a gentle slope downward from the apex of the helical rim toward the helical crus. If the rim bulges forward after the superior suture has been placed from scapha to mastoid, then this additional suture is required.

In adult patients, in whom there may be less flexibility in the cartilage of the antihelix, one or two additional sutures may be required to shape and round the antihelix. These sutures are placed from scapha to the cut edge of the concha, deep to the inferior crus, and from the helical sulcus to the cut edge of the concha at right angles to the antihelix. These sutures are placed before the ones described above to

“preshape” the antihelix before further correction of the prominence. This maneuver is in lieu of other otoabrasion techniques that, even if done carefully, may still result in irregularities on the anterior surface of the antihelix.



Once the upper and midauricular prominence is corrected the lobule position is addressed with closure of the posterior squid-shaped defect using 5-0 chromic gut. With the diamond-shaped inferior portion of the squid designed as described previously, the appropriate contour, shape, and projection of the lobule are produced by varying the initial suture position, with A' (the point of the diamond at the point of maximal lobule prominence) sutured to either A, B, or C (most frequently A' to A rather than A' to B). Once this initial suture is placed, the closure is completed with a running 5-0 chromic suture. Correction of the more prominent side first allows a symmetrical setback by providing a guide for placement of the sutures that will define the antihelix and lobule prominence.

The most common adjunctive procedures include reduction of prominence of the antitragus and correction of irregularities in the helical rim in the area of Darwin's tubercle. Each of these procedures is accomplished through a small incision parallel to the border of the prominence (within the concha for the antitragus, lateral to

the helical rim for helical rim adjustment), followed by direct exposure and resection of the excess cartilage. Closure is done with an interrupted and running 6-0 mild chromic suture. (Additional procedures to treat major deformities of the helical rim, or reduction of excessively large lobule, are reviewed later, with specific examples.) Small degrees of lobule enlargement can be addressed with a small wedge resection within the lobule, whereas larger resections are best placed at the lobule-midthird (helix-antihelix) junction, where the splice can be stair-stepped at the splice point. These procedures are the exception, not the rule.

Macrotia

Cases of true macrotia require reduction of the overall ear size in addition to correction of ear prominence. In general, reducing the vertical height of the ear is most easily accomplished with an excision at the junction of the middle and lower thirds of the ear in conjunction with helical rim advancement using a posteriorly based chondrocutaneous flap. The excess skin and cartilage are excised from the scaphal region, the rim is advanced along, and additional skin and cartilage are excised just inferior to the helical tail. This approach affords an excellent view for either further development of the helical fold or additional conchal reduction.

Dressings and Postoperative Care



The ears are dressed with bacitracin ointment, Xeroform gauze, and fluff dressings secured with a stretch net head wrap. The dressing is left undisturbed for 6 or 7 days postoperatively and then removed. Broad-spectrum antibiotic coverage is continued for 4 or 5 days postoperatively. After the dressing is removed, the patient wears a

stretch terry sport headband for an additional 2 weeks, at night only. Physical activity must be minimized for 3 weeks after surgery. After the dressing is removed, the patient's hair should be washed daily with mild shampoo and the ears cleansed gently. This is continued until the sutures have dissolved. Patients are typically reevaluated at 6 and 12 months postoperatively.

Outcomes

Despite the preponderance of techniques describing accentuation of the antihelical fold as the key component of correction of the prominent ear, our experience has led to the conclusion that the prominent ear has many and varied etiologic factors, but the common denominator is hypertrophy of the concha. The degree of conchal hypertrophy does not need to be great to have a positive impact when employing chondrocutaneous resection as the cornerstone of the otoplasty technique. Recognizing this fact is imperative, but at present it is underappreciated. Even with limited resection and resuturing of the cut concha, the antihelix yields to the posterior placement of sutures with a soft, smooth, rounded shape, unmarred by any sharp irregular surfaces. Despite concerns expressed by some authors, and criticism of the anterior approach to the concha as a potential source of a keloid scar, we have not seen unsightly scarring in any of these cases, nor in a much larger series of conchal donor sites for composite grafts used for ear reconstruction. This approach can readily be adapted to the treatment of less common deformities and can be applied to correction of deformities seen in group I and II constriction (where the deformity is bilateral and significant increase in ear height is not required).

Although a small number of patients will have minor asymmetries in the upper pole correction or in lobule shape or prominence, the adjunctive procedures mentioned earlier are now applied more routinely at the initial procedure to avoid these issues. To date, all revisional procedures, even in younger children, have been done in a single procedure with local anesthetic in the office setting.

Results

The versatility of this approach is illustrated in the following patient examples, ranging from typical ear prominence to varied deformities of the helical rim and moderate constriction of the ear.



This 14-year-old girl's ear prominence resulted from a mild degree of underdevelopment of the antihelical fold, with conchal hypertrophy playing a greater role in the prominence, particularly on the more prominent left side. She is seen 9 months postoperatively. The smooth contour of the antihelix is apparent in the lateral views.

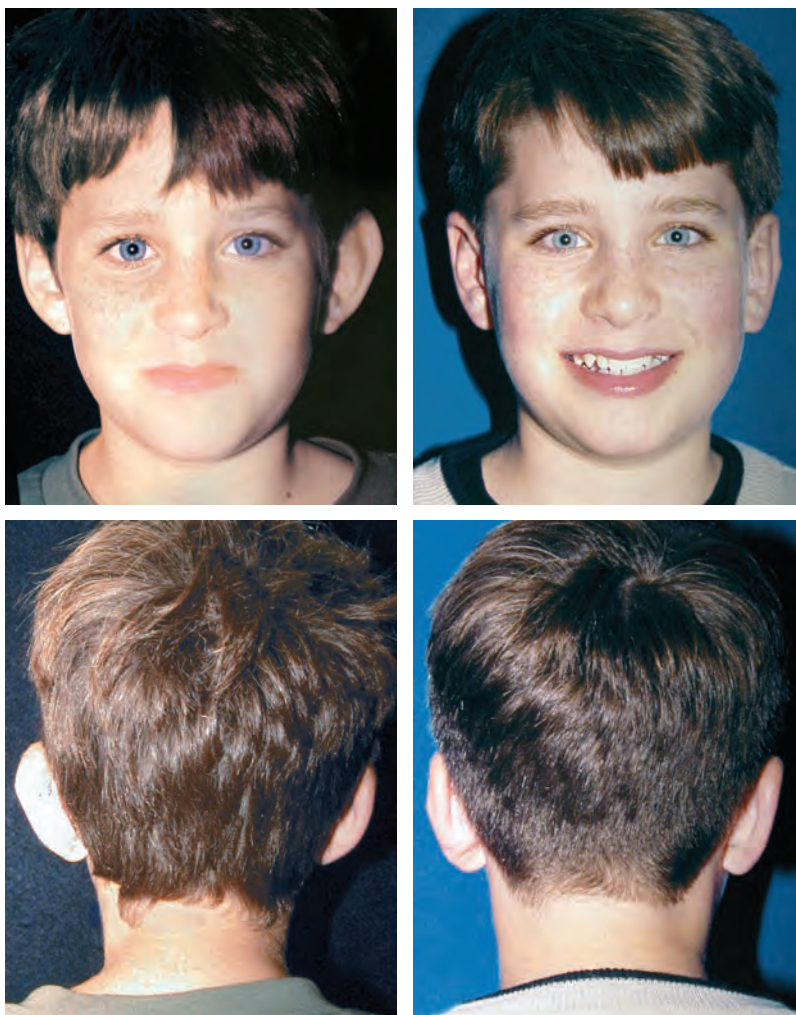


The antihelical folds were barely visible in this 13-year-old with prominent ears, and there was significant conchal hypertrophy. The superior antihelical fold was barely developed, and the prominence was greater on the left side. The postoperative results at 1 year after correction demonstrate excellent symmetry, clearly visible helical rims on frontal and posterior views, and smooth antihelical folds on the lateral view.



This 37-year-old woman had relatively symmetrical bilateral ear prominence, with a mild degree of conchal hypertrophy, a relatively well-developed lower segment of the antihelical fold, and primarily upper pole prominence. In the preoperative views, an additional deformity of the helical rim can be seen on the right side in the region of Darwin's tubercle. Our surgical approach was similar to the technique described

earlier, with a small conchal reduction followed by posterior placement of sutures to correct the upper pole deformity. The helical rim deformity was approached through an incision paralleling the helical rim, and the cartilage of the rim was exposed. The cartilage was found to be relatively normal, with the deformity primarily resulting from an excess of skin and subcutaneous fat in the region. The latter was resected, correcting the deformity. The patient is shown 13 months postoperatively. The subtle degree of conchal reduction allowed correction of prominence without sharpening the lower and middle region of the antihelix. The superior antihelical fold is better defined, and the helical rim deformity is corrected.



This 6-year-old boy with “skip hemihypertrophy” had enlargement of the structures on the left side of his face and right side of his trunk and extremities. Although both ears were prominent, as seen on frontal and posterior views, the left concha was larger, the antihelical fold less defined, and the overall ear size was larger. Correction of the prominence involved bilateral conchal reduction combined with reduction of the size of the left ear. This was accomplished with additional resection of a segment of the scapha through an incision parallel to and within the helical

curve, which released the helical rim to allow advancement and resplicing at the junction with the lobule.

The 1-year postoperative frontal and posterior views show excellent symmetry, natural shape and visibility of the helical rim, and an undisturbed postauricular sulcus.



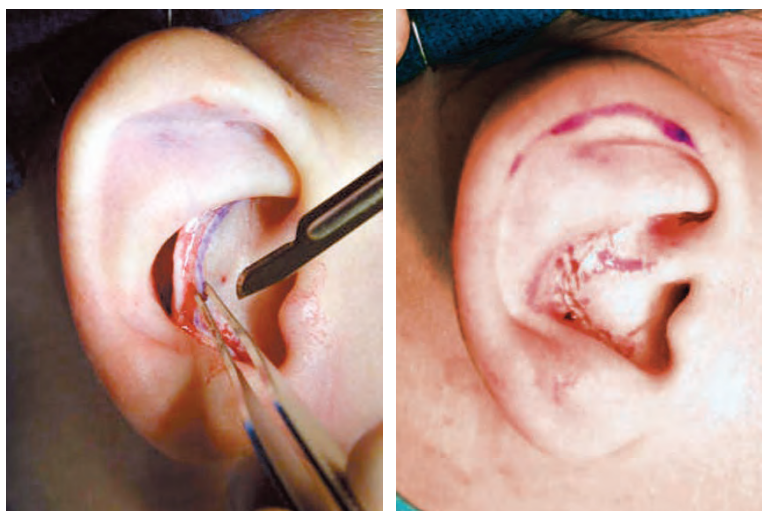
Closeup lateral views show good symmetry in shape; scars from the ear reduction are well hidden beneath the helical rim and within the helical sulcus. Careful inspection shows the small scar at the splice point of the midhelical rim and lobule.



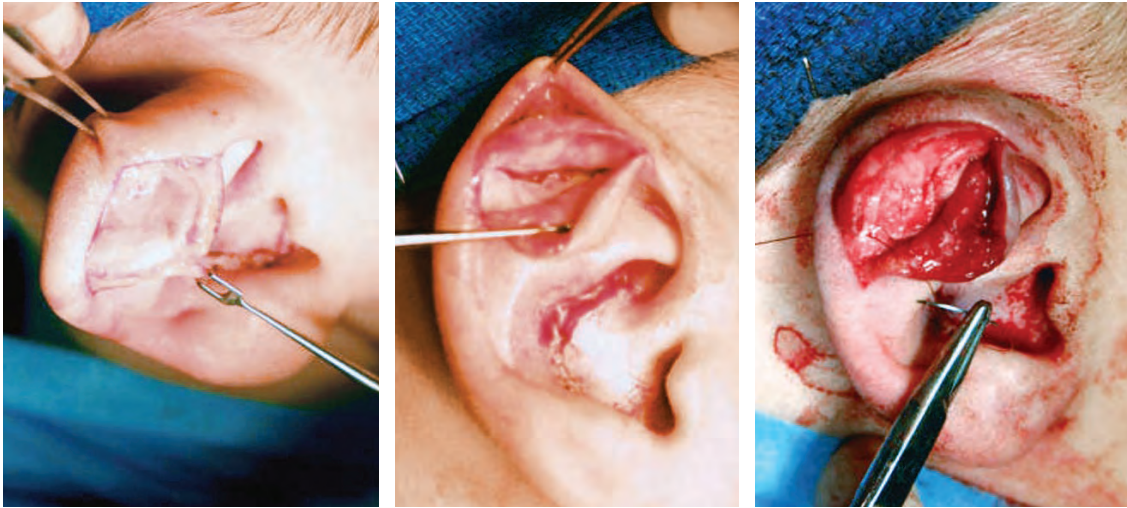
This young boy's prominent ears resulted from the combined effects of conchal enlargement and deformity of the scapha and helical rim on the right side. The deformity of the right ear differed from the typical constriction in that the antihelical fold was well formed, but the midscapha was sharply folded on itself and the helical rim was tipped forward, with a lack of support to the upper pole of the ear and a degree of lidding as well.



Lateral views demonstrate the difference in the support to the upper pole of the ear and the slight counterclockwise rotation of the right ear in comparison to the left ear.



The concha was reduced initially, as describe previously, and the incision was closed. This first intraoperative view shows the acute fold in the scapha as well as the lid-
ding of the helical rim. The helical rim incision followed the line of the future helical rim, exposing the distorted cartilage.



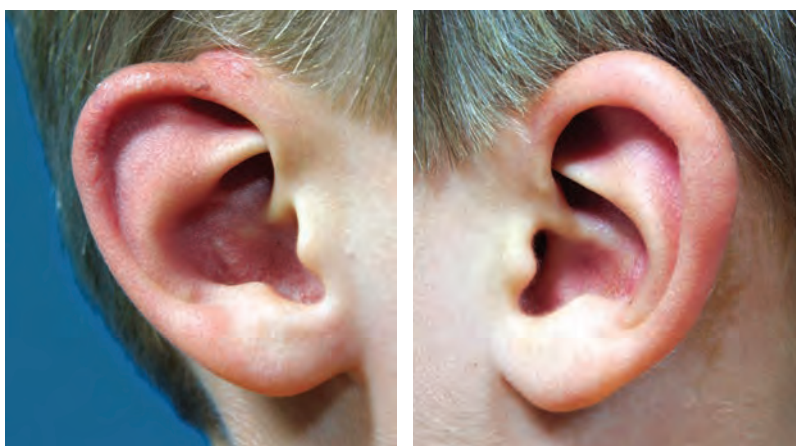
While the cartilage of the upper pole of the ear was skeletonized, dissecting both posterior and anterior to the helical rim, all adhesions were released. In this case, the cartilage was split through the acute fold, releasing the entire upper pole cartilage to be reshaped and advanced into a natural position by overlapping the cartilage medial to the fold and realigning the helical rim.



After suture fixation, the newly shaped upper pole of the ear was well supported with intercartilaginous sutures, and sutures were placed from scapha to mastoid. The skin was redraped and the slight excess of skin along the helical rim resected. Through-and-through sutures reattached the skin envelope securely to the reshaped cartilage.



The prominence of the left ear was addressed as described, concentrating on the conchal hypertrophy. Although the results at 3 months postoperatively demonstrate a small size discrepancy between the two ears, the natural shape, and symmetrical projection mask this difference.



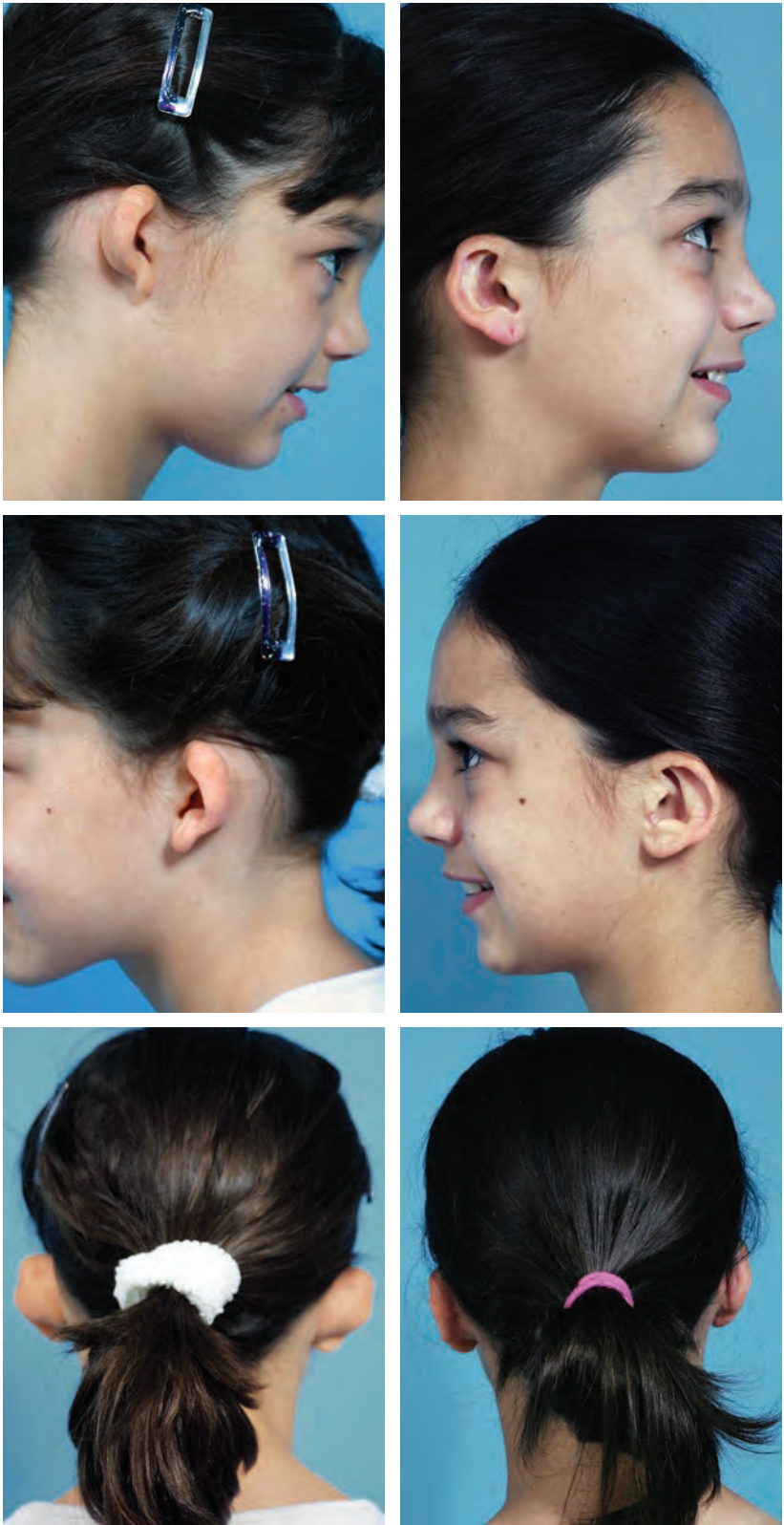
Closeup lateral views demonstrate the smooth, natural configuration of the antihelix and the well-hidden scars.



This patient illustrates the application of this technique to a moderate constriction. The combined effects of lidding, constriction of the helical rim, and vertical shortness of the ear are evident in group 2B constriction. Although this group of constricted ears characteristically demonstrates shortages in both skin and cartilage, the presence of a bilateral deformity allows correction without concern for the fact that the restructured ear may be relatively small, because the two ears will still match in size.

The approach used in this patient was as described on pp. 1842 through 1845, with initial conchal resection, followed by correction of prominence through the posterior suture placement, then final reshaping of the upper helical rim by a direct anterior approach to the helical lid and constricted rim. Because some additional suture placement from scapha to mastoid may be required in this reshaping of the upper pole, the final posterior closure is delayed until the former area is fully corrected.

The patient is shown 3 years postoperatively with a symmetrical increase in the size of her ears and a pleasing correction of the distorted cartilage shape. The final results of the combined otoplasty procedure illustrate her excellent outcome.





This 10½-year-old girl is shown preoperatively in a candid frontal view and lateral views and at 1 year after otoplasty. The preoperative frontal view shows marked bilateral prominence caused by bilateral conchal hypertrophy and an effaced antihelical fold on the right. The overall ear size bordered on macrotia. There was a prominent Darwin's tubercle on the left, which was excised through a small rim incision following correction of the prominence, as described earlier. Although her ears were asymmetrical and had different underlying cartilage anatomy, the postoperative frontal view shows excellent final symmetry.





This 23-year-old woman presented with concerns related specifically to the prominence and abnormal folding of her upper ear. The preoperative views show atypical lidding and crimping of the helical rim. The mid and lower ears were symmetrical. During correction of an upper pole deformity it is important to avoid changing the shape of the helical rim in the middle third of the ear and secondarily leaving a hidden helix. Using an approach similar to that shown on pp. 1842 through 1845, the upper pole of the ear was approached directly with release of adhesions, reshaping of the helical rim, and support of the new shape with a conchal cartilage graft. Seen 1 year after surgery, the ear has a natural, unoperated appearance with excellent symmetry, correction of the upper pole prominence, and no evidence of overcorrection of the midhelical rim. Lateral views in particular show how the correction of the upper pole deformity not only rounded the curve of the superior helical rim, but also increased the vertical height of the ear.





This 13-year-old girl was frequently teased about her prominent ears and tried to keep her ears as well hidden as possible with her hair. Six weeks after otoplasty, it is apparent how the combined otoplasty approach adapts to treatment of the varied causes of prominence on the two sides.



The closeup views show slight differences in the position of the conchal incision and how the procedure has resulted in a smooth, near-identical antihelical fold on both the side on which it was already formed (*left*) and the side on which it was absent (*right*).

Concluding Thoughts

Ear deformities, even those of a minor degree, can have profound effects on an individual. These effects may persist years after teasing by classmates ceases. Unless all aspects of the deformity are addressed in a systematic manner, correction can result in secondary deformities that are even more disturbing. This chapter presents an in-depth look at how the conchal shape represents the cornerstone of prominent ear deformities and how, coupled with other modifications of the helical rim, conchal release and resection allows correction of the antihelical effacement in a manner that avoids the secondary distortions that trades one deformity for another. Following the approach illustrated in this chapter, one will find the procedures not only more reproducible than others currently in vogue, but also readily applicable to virtually all other nonmicrotia ear deformities.

Clinical Caveats

Correct analysis of each ear deformity is the most important step in otoplasty.

Failure to fully appreciate all elements distorting the ear position and shape (particularly the role of conchal hypertrophy) is likely to result in an unfavorable outcome.

Otoplasty techniques that involve scoring or abrasion of the cartilage all run the potential risk of producing visible cartilage irregularities and a sharp antihelical fold.

Placing the incision for conchal resection too high in the concha will decrease control of the antihelical fold, allowing the cut edge adjacent to the antihelix to spring forward when the antihelix is shaped.

To ensure a tension-free closure of the concha, more cartilage is typically resected than skin, particularly along the inferior concha deep to the antitragus.

Excessive resection of skin or cartilage will pull the antitragus upward and increase prominence of the lower pole of the ear and lobe.

When designing the “squid”-shaped excision, failure to taper the skin excision in its midportion may result in a postoperative telephone-ear deformity.

Preserving the perichondrium on both surfaces of the cartilage will lessen the possibility of subsequent sutures pulling through the cartilage with resultant partial recurrence of the deformity.

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Bauer BS. Congenital and acquired deformities of the ear. In Bentz ML, Bauer BS, Zuker RM, eds. *Principles and Practice of Pediatric Plastic Surgery*, vol 2, St Louis: Quality Medical Publishing, 2008.

This chapter discusses the full spectrum of both congenital and acquired ear deformities, demonstrating otoplasty techniques for treating the range of abnormalities from more commonly recognized nonmicrotia ear problems (constricted ear, cryptotia, and Stahl's ear) to rare and unnamed deformities that plastic surgeons may encounter. It also demonstrates how these techniques can be applied to the reconstruction of acquired ear deformities with similar cartilage and skin deficiencies.

Elliott RA. Otoplasty: a combined approach. *Clin Plast Surg* 17:373-381, 1990.

This paper describes the need to assess both conchal size and antihelical definition to properly address the individual case. It did not describe the combination as a "standard" approach to otoplasty. The conchal incision is also placed considerably higher on the lateral conchal wall.

Erol OO. New modification in otoplasty: anterior approach. *Plast Reconstr Surg* 107:193-202; discussion 203-205, 2001.

This paper describes a combined approach to otoplasty with both conchal resection and reshaping of the antihelix, but does the latter by undermining over the antihelix, scoring of the cartilage, then suture fixation. The scoring is seen to result in irregularities of the antihelix.

Mustarde JC. The correction of prominent ears using simple mattress sutures. *Br J Plast Surg* 16:170-178, 1963.

This classic paper describes suture fixation techniques for correction of ear prominence. The relatively high recurrence rate with this procedure alone underscores the added benefit of the initial conchal resection described in this chapter.

Stark RB, Saunders DE. Natural appearance restored to the unduly prominent ear. *Br J Plast Surg* 15:385-397, 1962.

This article was a predecessor of the authors' technique that described a combination of otoabrasion of the posterior surface of the antihelix to soften the folding with posterior suture fixation. As with other otoabrasion techniques, even with great care, irregularities were still occasionally seen on the surface of the antihelix. There was also a higher recurrence rate than seen with the current technique described in this chapter. Experience with this technique did demonstrate the accessibility of the posterior approach to allow fine tuning of correction through varied suture placement.

Stenstrom SJ. A "natural" technique for correction of congenitally prominent ears. *Plast Reconstr Surg* 32:509, 1963.

This is the classic paper on otoplasty describing anterior scoring of the antihelix to stimulate the folding and shaping of the cartilage. It typifies the type of procedure that can risk irregularities on the surface of the antihelix.

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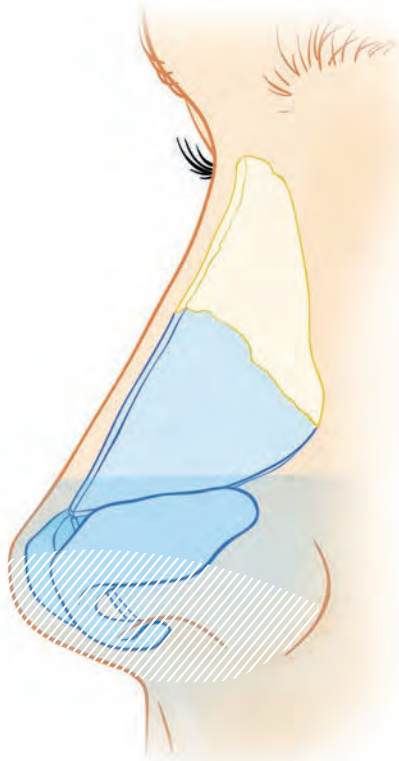
PART X

RHINOPLASTY



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CHAPTER 53



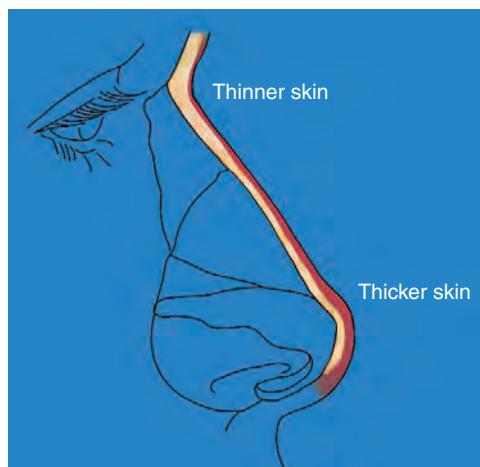
Applied Anatomy of the Nose

ROD J. ROHRICH, WILLIAM P. ADAMS, JR.,
JOEL E. PESSA, JACK P. GUNTER

The nose consists of three elements: framework, support, and external cover. The nasal framework consists of the skeletal components of cartilage and bone. Support is provided by connective tissue and ligaments that hold the framework together. The skin and soft tissue provide the external covering of the nose. These components are intricately related and must be anatomically visualized in every step of the rhinoplasty sequence. In this chapter we will review the clinically relevant anatomy encountered in rhinoplasty.

Principles that must be adhered to in the anatomic sequence of a rhinoplasty include the following:

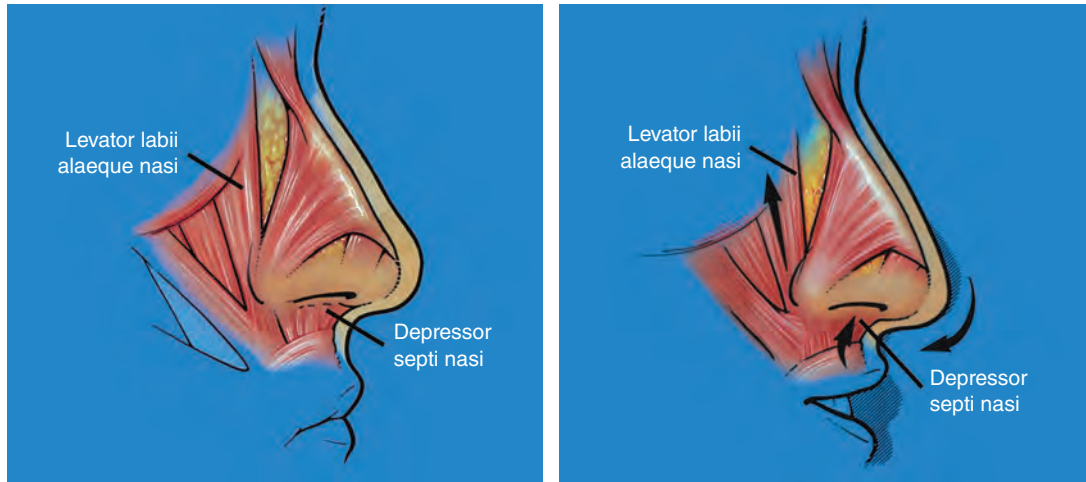
1. Precise definition of anatomic goals preoperatively
2. Adequate anatomic exposure of the nasal deformity
3. Preservation/restoration of the normal anatomy
4. Correction of the specific deformity using incremental control
5. Maintenance/restoration of the nasal airway



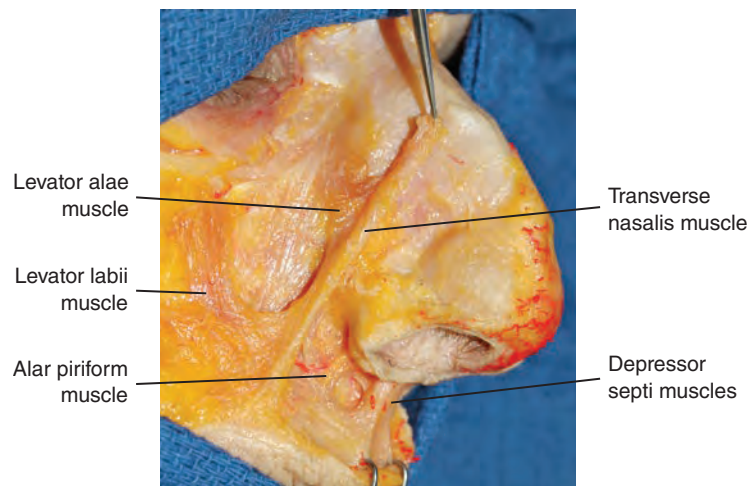
The skin is thinner and more mobile in the upper two thirds of the nose and thicker and more adherent in the distal third in the nasal lobule.

Vessels and nerves pass within the subcutaneous tissue above the muscle. It is important to note the type, texture, and sebaceous content of the skin, because these will affect the final result. Overzealous alteration of the underlying framework in a thin-skinned tip may have a long-term adverse outcome. In contrast, in a patient with thick sebaceous skin, more aggressive alteration of the underlying framework is possible, and necessary, to obtain significant tip definition.

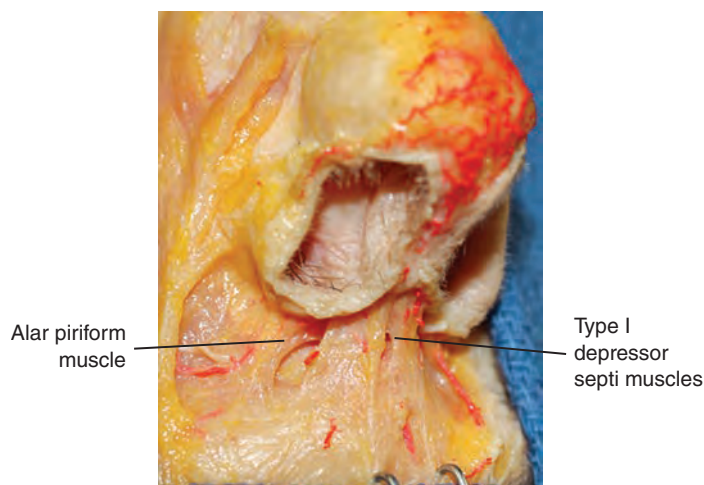
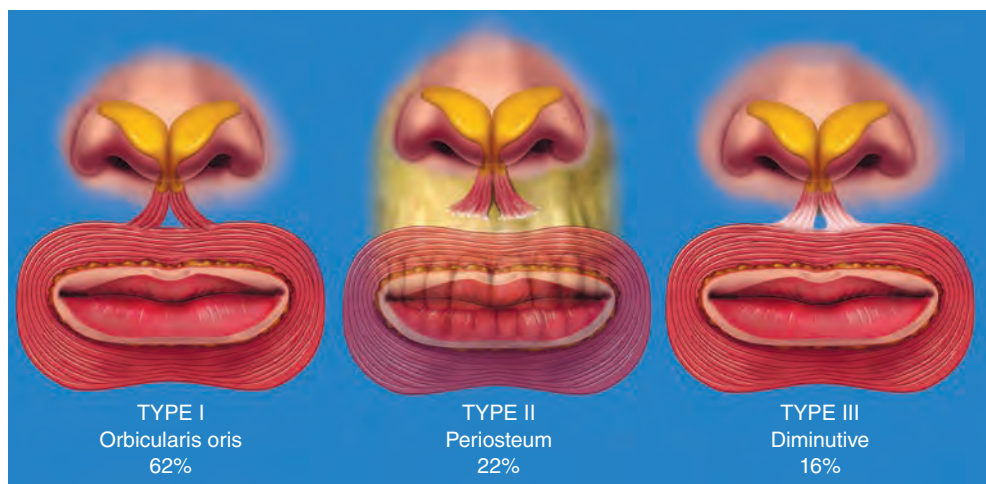
Muscles



Although there are several nasal muscles, two are most clinically significant: the levator alae and depressor septi muscles. The levator labii alaeque nasi assists in keeping the external nasal valve open and can cause functional nasal obstruction with facial paralysis if alar flaring is impaired. The depressor septi nasi, when clinically significant, shortens the upper lip and can decrease tip projection on animation.



The nasal muscles interconnect so that animation of one affects the others. For example, contraction of the lip elevators pulls the transverse nasalis. This has the effect of opening the internal valve by distracting the upper lateral cartilages. Nasal airway patency is therefore also a function of dynamic muscle activity, in addition to proper skeletal and cartilaginous support.



In a cadaver study to define the anatomic variations of the depressor septi muscle, we identified three types of depressor septi muscles. Type I depressor septi muscles (62%) are visible and identifiable and can be traced to full interdigitation with the orbicularis oris from their origin at the medial crural footplate.

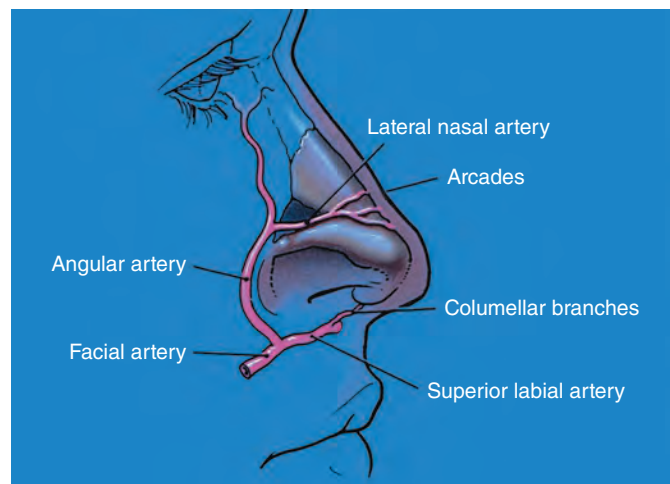
Type II muscles (22%) are visible and identifiable, but unlike the first group, these muscles insert into the periosteum and demonstrate little or no interdigitation with the orbicularis oris. In type III muscles (16%), no muscle or only a rudimentary depressor septi muscle is visible.

Routine preoperative examination of rhinoplasty patients should easily identify those who demonstrate a drooping nasal tip and shortened upper lip on animation, particularly when smiling. In such patients (types I and II) dissection and transposition of the distal depressor septi muscles and suturing together of the cut ends reliably and effectively correct this dynamic facial deformity. Dissection and transposition rather than excision of tissue provide fullness to the central upper lip. Follow-up of up to 2 years shows well-maintained aesthetic results without signs of relapse. Specifically, the technique achieves the following goals:

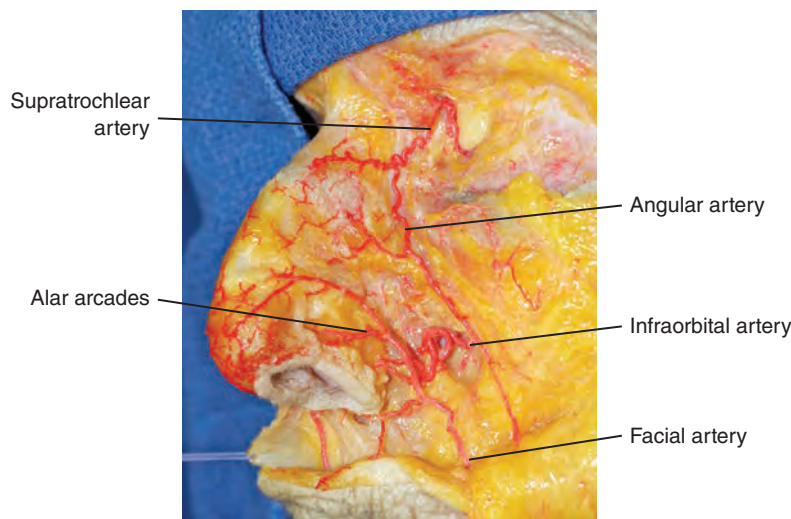
- Enhancement of the tip-lip relationship
- Relative upper lip lengthening
- Relative fullness to the upper lip
- Maintenance of tip rotation/projection on animation

Blood Supply

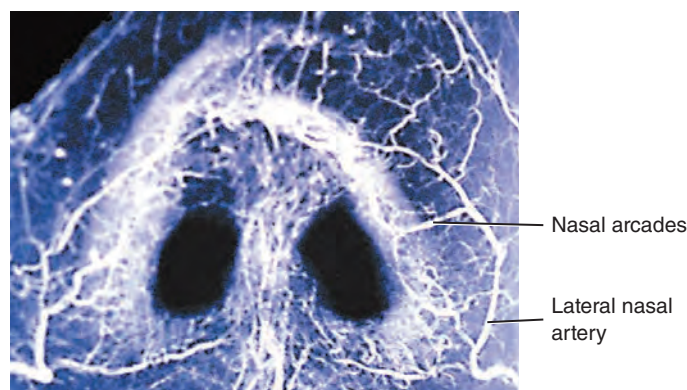
There has been concern, especially with the growing popularity of the external approach to rhinoplasty, that the transcolumellar incision may compromise the blood supply to the nasal tip. However, one must take into account the considerable blood supply to the nose, with contributions from both the internal and external carotid arteries.



The ophthalmic artery and its branches, anterior ethmoids, dorsal nasal, and external nasal arteries supply the proximal portion of the nose.



The nasal tip area is supplied primarily by branches of the facial artery, including the superior labial and angular vessels, with the lateral nasal branch coursing above the alar groove, and the columellar branches, which are branches of the superior labial vessels. In this dissection, one can see that even the infraorbital artery provides collateral supply to the tip via the nasal arcades.



This vasculature has been confirmed by an angiographic study in 22 fresh cadaver heads injected with lead oxide dye. The lateral nasal vessels were consistently identified 2 to 3 mm above the alar groove in this study. The columellar and lateral nasal arteries arise deep at the nasal base and end in the subdermal plexus at the nasal tip area. The lateral nasal artery was consistently present either bilaterally or unilaterally (100%). The presence of the columellar branches was noted 68.2% of the time; however, there was a predictable crossover arcade between the lateral nasal and columellar branches in 10 specimens in which a transcolumellar incision was made before the dye was injected.

The clinical relevance of this study is twofold. First, it is excessive defatting that jeopardizes the nasal tip supply. In nasal tip procedures the surgeon should reconstruct the underlying framework to redefine the tip rather than defatting the nasal tip, which is anatomically dangerous. The other clinical point is that collateral blood supply enters the nose via the alar arcades. Prior incisions in this region can jeopardize collateral supply to the nasal tip in secondary procedures.

Nasal Vaults



There are three nasal vaults: the bony, upper cartilaginous, and lower cartilaginous vaults.

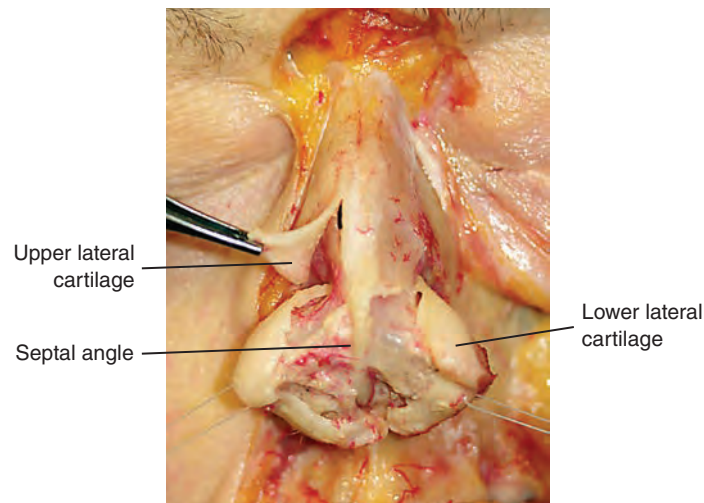
Bony Vault



The bony vault consists of paired nasal bones as well as the ascending frontal process of the maxilla, which make up the proximal third to half of the nose.

The bones are comparatively narrow and thick above the canthal level. The clinical correlation is that osteotomies are rarely indicated above the canthal level, because it is quite narrow and the bone is thick.

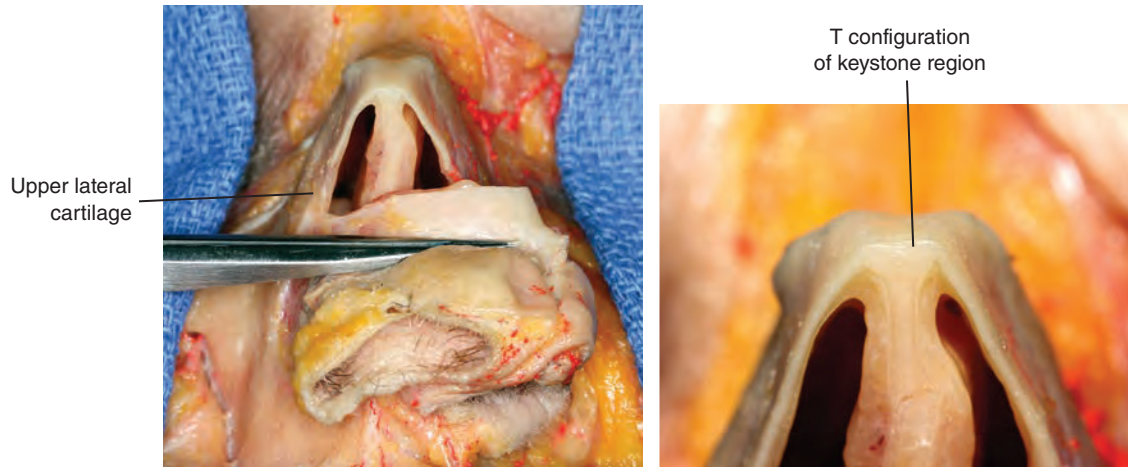
Upper Cartilaginous Vault



The upper lateral cartilages underlie the nasal bones for 6 to 8 mm as well as the lower lateral cartilages in the scroll area between the upper and lower lateral cartilages.

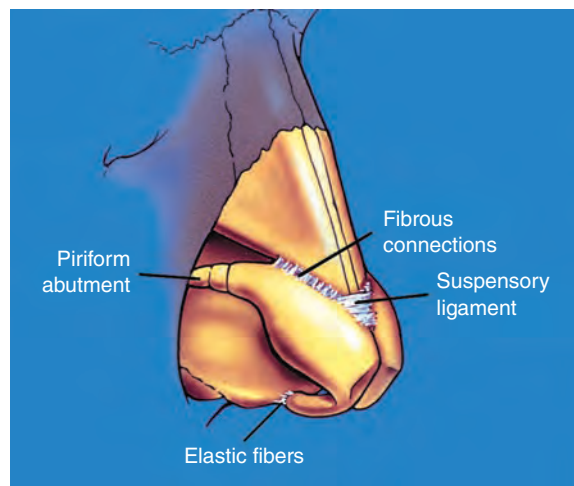


The keystone area is defined by the junction of the upper lateral cartilages with the nasal bones and the septum. It is important to stress the relationship of the upper and lateral cartilages to the septum, especially at the keystone area, where the contour is T-shaped.



Loss of these intricate relationships results in the loss of the dorsal aesthetic lines and a potential inverted-V deformity, as seen on frontal view.

Lower Lateral Cartilaginous Vault



The lower cartilaginous vault comprises the medial, middle, and lateral crura of the lower lateral cartilage.

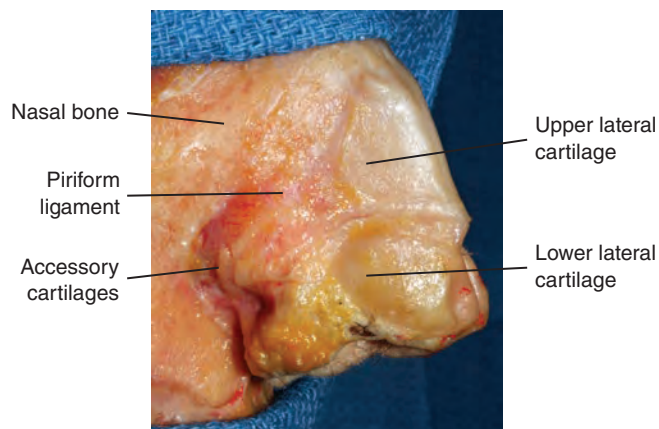
The support factors for tip projection are:

- Length and strength of lower lateral cartilage and piriform abutment
- Domal suspensory or piriform ligament
- Fibrous connections between the upper lateral and lower lateral cartilage
- Medial crural ligaments
- Anterior septal angle

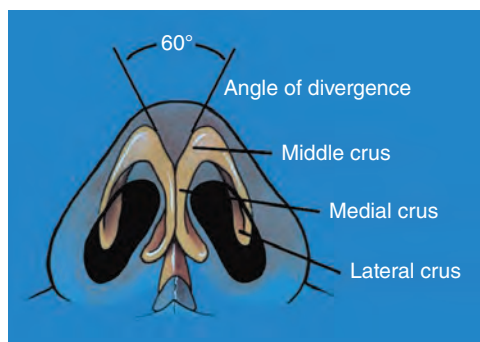
In a fresh-cadaver study, Adams et al reported the clinical significance of different structures for nasal tip support using open versus closed rhinoplasty techniques. Multiple nasal manipulations using fresh cadaver heads, including cephalic trim,

cephalic trim and interruption of the lower lateral cartilages, dorsal hump resection (1 to 4 mm), submucous resection of the septum, and complete septal removal, were performed using both the open and closed rhinoplasty approaches. Changes in nasal tip support were recorded.

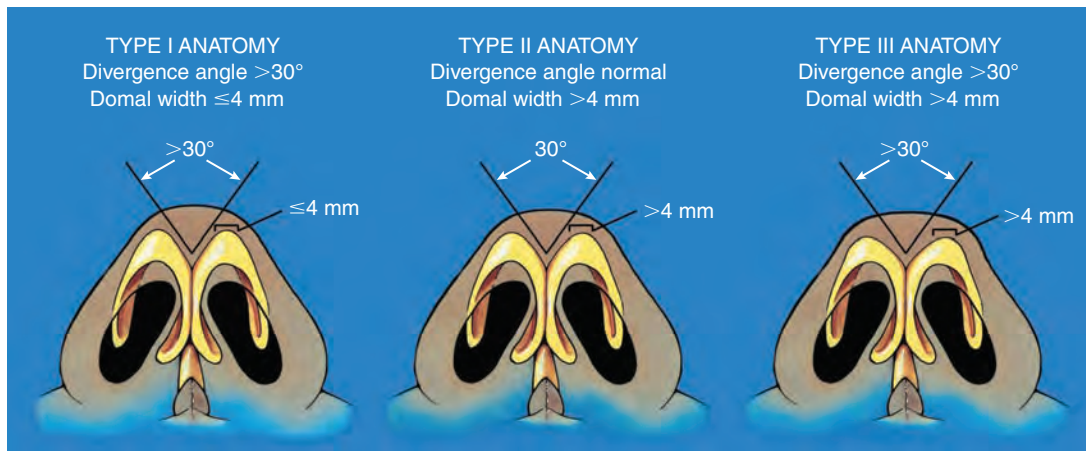
Comparing similar procedures, the mean loss of tip projection for the open approach was 3.43 mm versus 1.98 mm for the closed approach ($p < 0.001$). There was a significantly larger loss of tip projection for the open versus the closed procedure for cephalic trim, cephalic trim plus interruption of the lower lateral cartilage, and cephalic trim/interruption of the lower lateral cartilage/septum removal (all three $p < 0.001$). The differences between the open and closed approaches were attributed to an increase in ligamentous disruption using the open approach. Manipulation of the septum in general resulted in greater losses of tip support for both the open and closed approach.



The combination of skin, ligaments, and cartilage ultimately provides tip support. As progressively more of these structures are disrupted, greater loss of tip projection occurs.



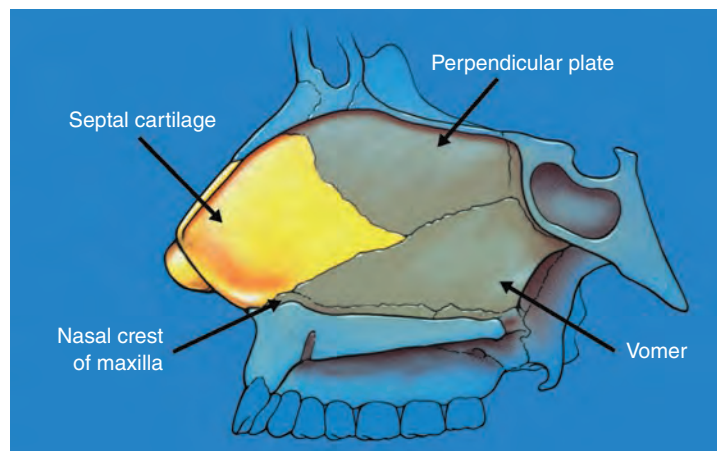
Sheen subdivided the lower lateral cartilage into the medial, middle, and lateral crura. The angle of divergence is formed by the domal angulation of the middle crus.



This is an important factor in determining tip type, specifically whether there is a bulbous versus a boxy tip. The tip-defining points are important: these consist of two equilateral triangles from the supratip area to the apex of the domes to the columellar lobule angle. The surgeon must use these reference points in assessing tip definition and identifying tip asymmetries. Furthermore, a classification system based on the angle of divergence of the middle crura and the width of the domes can aid in the diagnosis and treatment of nasal tip deformities.

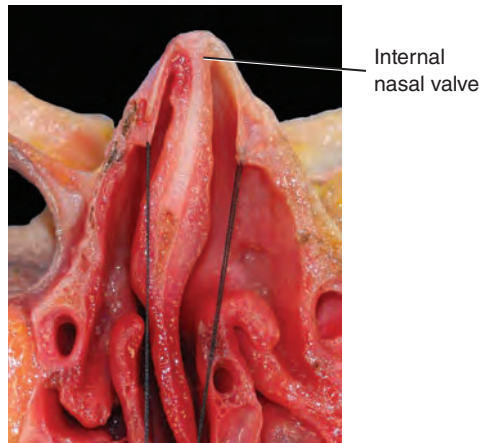
Nasal Function

The functional portion of a nose comprises three areas: the septum, nasal valve areas, and turbinates. The septum includes three primary components: the quadrangular cartilage, the perpendicular plate of the ethmoid, and the vomer.



The bony septum is made of the perpendicular plate of the ethmoid, which is in continuity with the cribriform plate. When performing a septal reconstruction and removing posterior septal deviations, the surgeon must perform a sidewise frac-

ture/separation removal of the bony part of the perpendicular plate of the ethmoid so as not to remove or dislodge the cribriform plate, which can cause cerebrospinal fluid rhinorrhea. The most projecting part of the premaxilla is the nasal spine, and it very infrequently needs to be removed or altered. In contrast, the caudal portion of the septum is the most protruding part of the columella and may need to be altered if there is an alar-columellar discrepancy.



The internal nasal valve is defined as the junction between the septum and the caudal border of the upper lateral cartilage. This angle is usually 10 to 15 degrees. This must be preserved or reconstructed with a spreader graft in a primary or secondary rhinoplasty.

Of the three turbinates, the inferior turbinates are the most significant functional component in nasal airway breathing, and this occurs in the lower third of the nasal airway. Submucous resection of the turbinate is indicated for airway correction and yields excellent functional results.

Concluding Thoughts

Nasal anatomy is well defined, and knowledge of this anatomy enables the surgeon to analyze nasal form and shape precisely. Operative goals can be defined to restore normal anatomic relationships, preserving function while improving nasal aesthetics.

Clinical Caveats

Excellent rhinoplasty results can only be obtained if the surgeon has a thorough knowledge of nasal anatomy and understands the surgical relevance of alteration of the anatomic structures.

The type of framework modification is closely related to the skin type.

An active depressor septi muscle can be identified on preoperative clinical analysis, and its modification intraoperatively can enhance the tip-lip complex.

Following the open rhinoplasty approach, the blood supply to the nasal tip is derived primarily from the lateral nasal arteries 2 to 3 mm above the alar groove.

The nasal dorsum is widest at the keystone region.

Multiple structures contribute to nasal tip support, including the strength of the lower lateral cartilage, anterior septal angle, upper lateral cartilage/lower lateral cartilage ligaments, medial crural ligaments, and nasal skin. Clinically one must account for surgical disruption of these structures, taking specific measures to provide nasal tip support, particularly in open rhinoplasty.

The most common cause of functional nasal airway obstruction is inferior turbinate hypertrophy; however, septal deviation or internal or external nasal valve abnormalities must also be considered.

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Adams WP Jr, Rohrich RJ, Hollier LH, et al. Anatomic basis and clinical implications for nasal tip support in open versus closed rhinoplasty. *Plast Reconstr Surg* 103:255-261, 1999.

The purpose of this study was to quantitate, using fresh cadavers, the critical elements for nasal tip support with open versus closed rhinoplasty techniques. Multiple nasal manipulations were performed using fresh cadaver heads and using both the open and closed rhinoplasty approaches. In the end, the authors found that the open approach for rhinoplasty results in a significantly increased loss of tip projection when compared with the closed technique because of the larger disruption of ligamentous support.

Gunter JP, Rohrich RJ. The external approach for secondary rhinoplasty. *Plast Reconstr Surg* 80:161-174, 1987.

A systematic approach, using the external rhinoplasty technique, is presented to aid the plastic surgeon in obtaining improved aesthetic and functional results in patients with postoperative nasal deformities. In over 100 external rhinoplasties, there were no problems with the stairstep transcolumellar incision used to provide complete visualization of the underlying nasal framework. Three case reports are presented to demonstrate the indications and versatility of the external approach in secondary rhinoplasty.

Janeke JB, Wright WK. Studies on the support of the nasal tip. *Arch Otolaryngol* 93:458-464, 1971.

This is one of the first articles to delineate the support structure of the nose. They define four areas of support: the intercartilaginous ligament, the sesamoid complex, the ligamentous sling between the lower lateral cartilages, and the attachment of the medial crura to the caudal septum.

Rohrich RJ, Gunter JP, Friedman RM. Nasal tip blood supply: an anatomic study validating the safety of the transcolumnellar incision in rhinoplasty. *Plast Reconstr Surg* 95:795-799, 1995.

The nasal tip blood supply was studied through anatomic dissections and microangiography in 31 fresh cadaver specimens. Transcolumnellar (external rhinoplasty) incisions were performed in 11 of these cadavers before dye injection. A consistent crossover flow (100%) was seen from the lateral nasal artery arcades to the distal aspect of the transected columellar branches. We conclude that nasal tip blood supply is derived primarily from the lateral nasal arteries, with a variable contribution from the columellar arteries. Collateral flow to the nasal tip may be provided by branches of the ophthalmic artery. The external rhinoplasty transcolumnellar incision does not compromise nasal tip blood supply unless extensive tip defatting or extended alar base resections (above the alar groove) are performed.

Sheen JM. Achieving more nasal tip projection by use of a small autogenous vomer or septal cartilage grafts. A preliminary report. *Plast Reconstr Surg* 56:35-40, 1975.

Sheen's classic article describes the relationship of the nasal tip to the dorsum, emphasizing the supratip break and tip projection. He introduces the use of small pieces of autogenous cartilage and vomer and the shaping required to re-create the proper dorsum-tip relationship, a clinical application of Peer's early work on the transplantation of autologous tissues.

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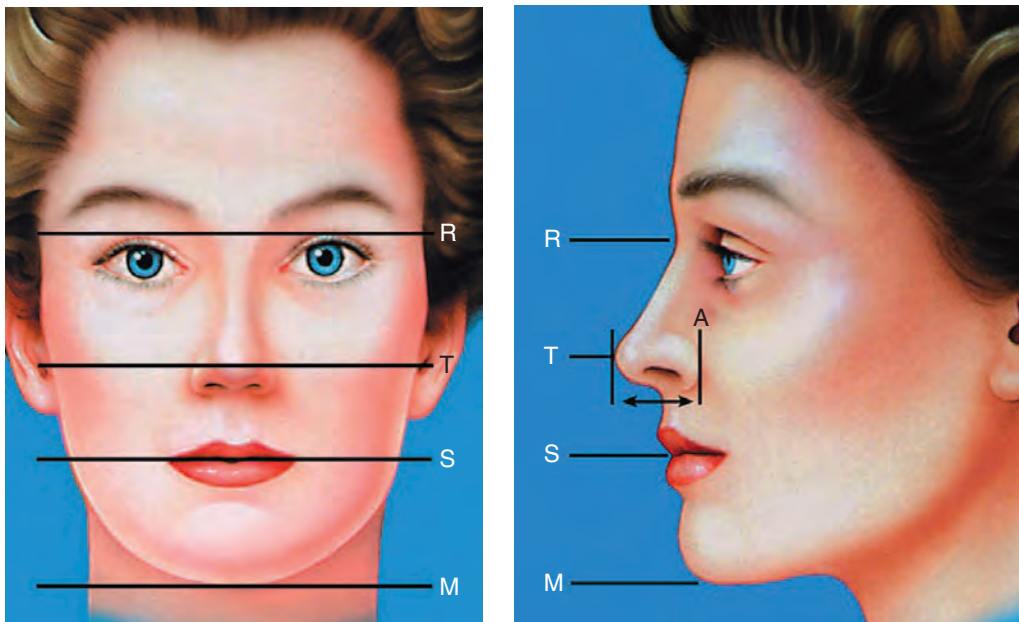
Hilger JA. The internal lateral osteotomy in rhinoplasty. *Arch Otolaryngol* 88:211-212, 1968.

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CHAPTER 54



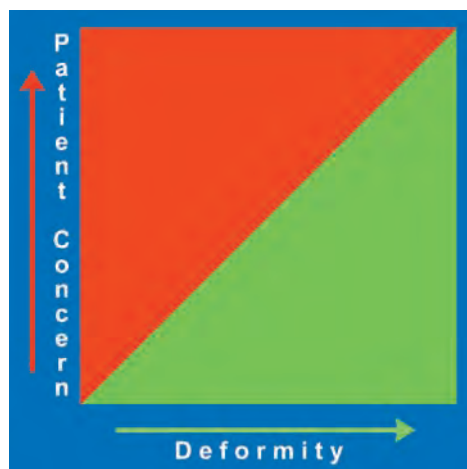
Clinical Decision-Making in Rhinoplasty

JEFFREY E. JANIS, JAMIL AHMAD, ROD J. ROHRICH

Evaluation

When initially evaluating a potential patient for rhinoplasty, we resist the temptation to immediately launch into a comprehensive facial analysis, and instead concentrate on evaluating the patient's desires and expectations. Proper patient selection is vital to a successful outcome. Some patients will be dissatisfied with their postoperative result regardless of how well surgery has been executed. This emotional dissatisfaction supersedes technical failure as the most common cause of poorly perceived results in our practice. (See Chapter 55 for additional discussion.)

To preoperatively identify potential problem patients, we ask patients to first elucidate what issues they have. We encourage them to be as specific as possible, listing their concerns in order of importance, and to do so in their own words. A handheld mirror is useful in aiding them to pinpoint their areas of concern. The patient's desires are then documented verbatim in the chart. Frequently the patient will state his or her desires in general terms: "I just want a better nose. What would you do?" This has been a red flag in our practice, because it usually is a reflection of general dissatisfaction, poorly thought-out desires, or a poor self-image. We politely redirect these patients in an attempt to ascertain what specifically bothers them about their nose.



The surgeon should be wary of patients who express a disproportionate concern about a minimal deformity. Regardless of the degree of deformity, however, if the skill and expertise required to correct the deformity lie outside the surgeon's technical ability, the patient should be referred to another surgeon who possesses the appropriate knowledge and skill.

Other red flags in rhinoplasty include patients who desire a result that cannot be predictably or reliably delivered or is outside the realm of the “aesthetic norm,” those who appear to be angry or litigious as a result of a previous rhinoplasty, or where a connection is not made between the surgeon and patient. This last criterion is admittedly vague, but we place a tremendous amount of stock in the development of an interpersonal relationship with our patients, and if that relationship cannot be forged, for whatever reason, then we decline to perform the operation. In other words: *Do not operate on a patient you don’t like.*

Nasal History

A full and complete nasal history should be obtained, including any history of trauma, previous nasal/septal/sinus surgeries, allergies and/or sinus problems, tobacco use, and illicit drug use. A list of current medications should also be obtained (both nasal and nonnasal medications). Nonsteroidal antiinflammatory drugs (NSAIDs), certain herbal supplements, and fish oil may increase bleeding complications after surgery and should be discontinued at least 7 to 10 days before a rhinoplasty procedure.

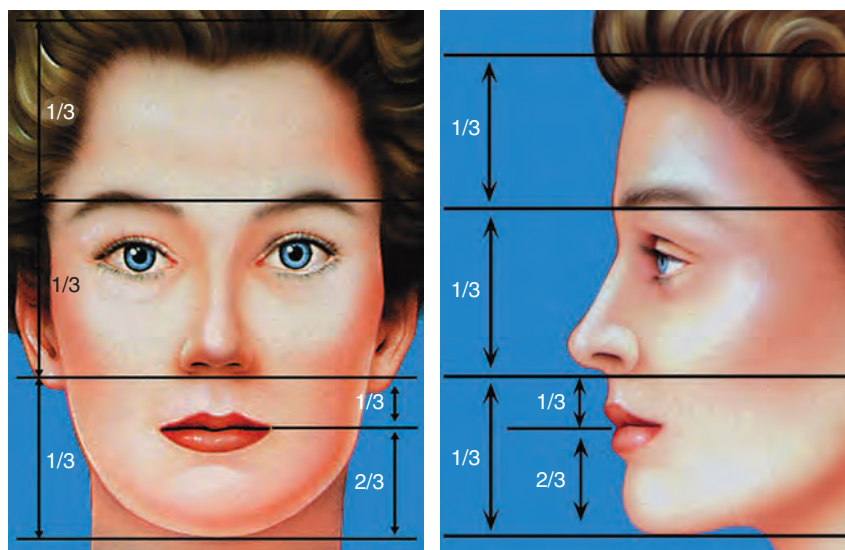
Anatomic Features

Proper nasofacial analysis is paramount to a successful result. This not only includes the nose proper, but also the nose within the context of the face, especially the lip-chin complex. Each individual’s nose is different; therefore each operative plan should be individualized. The development of the operative plan depends on native nasal anatomy and morphology, its relative relationship to the rest of the face, and the patient’s goals and desires. Computer imaging is routinely used to help demonstrate the potential outcome as well as to identify preoperative asymmetries for the patient. However, it should be made clear to the patient that computer imaging does not guarantee a specific result.

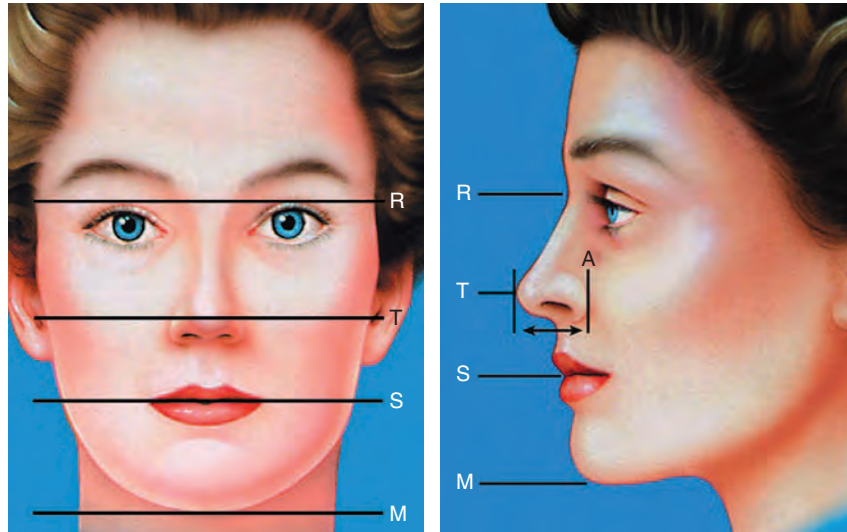
Nasal Analysis for Rhinoplasty

- Assess the level of patient concern versus the deformity.
- Identify potential problem patients.
- Assess the patient’s skin type, skin thickness, and skin texture.
- Analyze the relationship of the nose to the face based on anteroposterior, lateral, and basal views.
- Perform an intranasal examination to assess functional aspects of the nose.

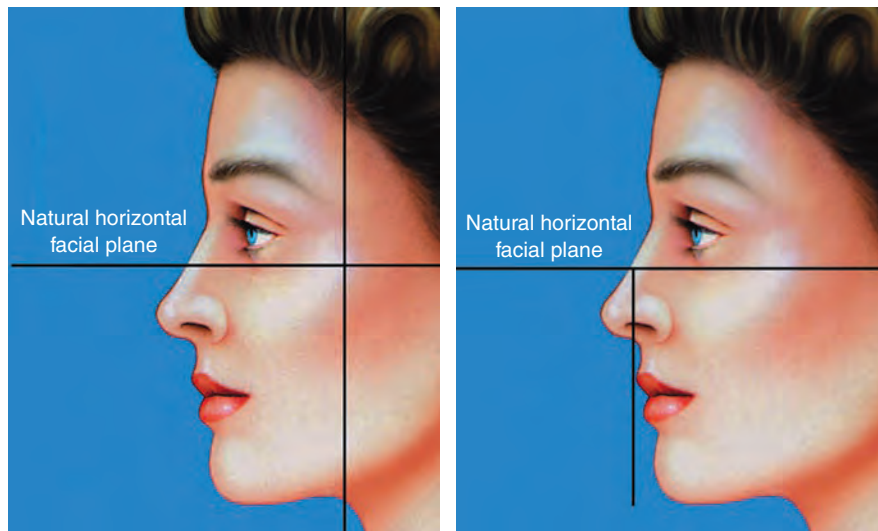
The type, thickness, and texture of the patient's skin are assessed first. Thicker skin tends to camouflage changes to the underlying osteocartilaginous framework and thus may necessitate more aggressive manipulation of the underlying framework to produce an appreciable change. Conversely, thinner skin tends to reveal even minor changes to the underlying framework. We have found thinner-skinned patients more challenging in general than thicker-skinned patients, because there is less room for error. Patients with thicker, more sebaceous skin tend to have more postoperative edema, especially in the tip or lobule area. This assessment of native skin quality will factor into the development of the operative plan and the power of the techniques selected to achieve the desired result (such as the use of grafts versus tip suturing alone).



Next, a meticulous systematic analysis of the nose and face is performed. Initially we evaluate potential anomalies of the underlying facial skeleton, including the maxillomandibular relationship. The face is divided into thirds using horizontal lines adjacent to the hairline, brow (at the level of the supraorbital notch), nasal base, and *menton*. The upper third is the least important, because it is the most variable. The lower third of the face is then subdivided into thirds by visualizing a horizontal line between the oral commissures (*stomion*). The upper third of this subdivision lies between the nasal base and the oral commissures, and the lower two thirds between the commissures (*stomion*) and the *menton*. If disproportions exist, the patient may have underlying craniofacial anomalies (such as vertical maxillary excess) that may need to be addressed.



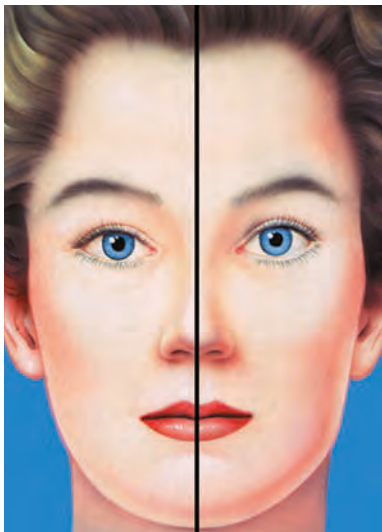
The nasal length (radix-to-tip distance, or RT) should be equivalent to the stomion-to-menton distance (SM), as described by Byrd and Hobar.



A natural horizontal facial plane is determined by drawing a line perpendicular to a plumb line superimposed over the head in repose and the eyes in straightforward gaze. This will be used as a future reference for further analysis.

The lip-chin relationship is assessed by dropping a vertical line from a point one half the ideal nasal length tangential to the vermilion of the upper lip. The lower lip should lie no more than 2 mm behind this line. The ideal chin position varies with sex, with the chin lying slightly posterior to the lower lip in women, but equal to the lower lip in men. If there is a discrepancy in these relationships, orthodontics, orthognathic surgery, or a chin implant may be necessary to improve facial harmony.

Nasal Deviation



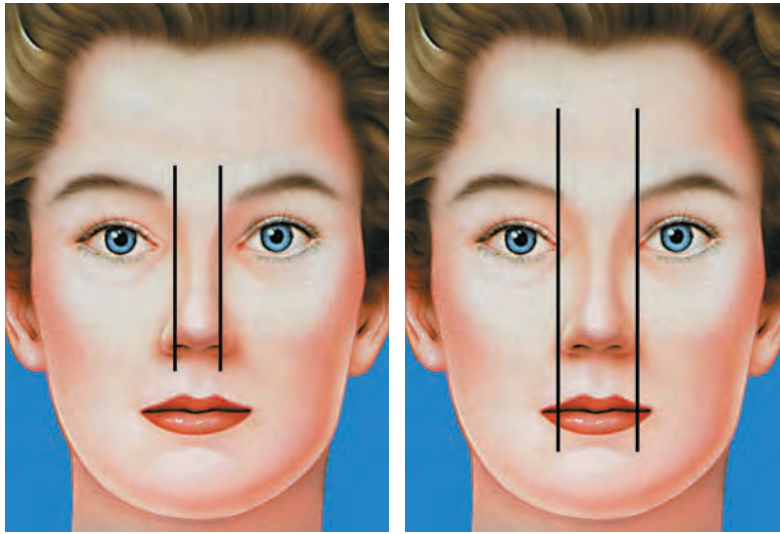
Nasal deviation is then assessed by drawing a line from the midglabellar area to the menton, bisecting the nasal ridge, upper lip, and Cupid's bow. In patients with normal occlusion, this line will also pass between the central incisors. Any deviation of the nose from this line typically indicates an underlying septal deviation that will need to be addressed during surgery to correct the deformity.

Dorsum



The nasal dorsum is then assessed on anteroposterior or frontal photographs of the patient. The curvilinear dorsal aesthetic lines are traced from where they originate at the supraorbital ridges to the tip-defining points, slightly diverging from each other along the dorsum during their course. Ideally, the width of the dorsal aesthetic lines should match the width of either the tip-defining points or the interphiltral distance. These lines may be ideal, narrow, wide, asymmetrical, or ill defined.

Bony Base



The width of the bony base relative to the alar base is then assessed. The bony base width should be 80% of the normal alar base width, and a normal alar base width is equal to the intercanthal distance, or the width of the palpebral fissure. If the bony base is greater than 80% of the alar base width (assuming the alar base width is normal), it is likely that osteotomies will be required to narrow the bony base. Because men tend to have a wider bony base than women, it is important not to make the dorsum overly narrow in men, because this could feminize the nose.

Alar Base



The alar base itself is analyzed as well as the alar rim morphology. If the alar base width is greater than the intercanthal distance, it must be determined whether this is the result of a narrow intercanthal distance, a true increased interalar width, or alar flaring. If the intercanthal distance is smaller than one eye width, it is better to maintain a slightly wider alar base. If there is true increased interalar width, a nostril sill resection may be indicated. If the increase in width is secondary to alar flaring (more than 2 to 3 mm outside the alar base), an alar base resection should be considered. The alar rims should also be assessed for symmetry and should flare slightly outward in the inferolateral direction.



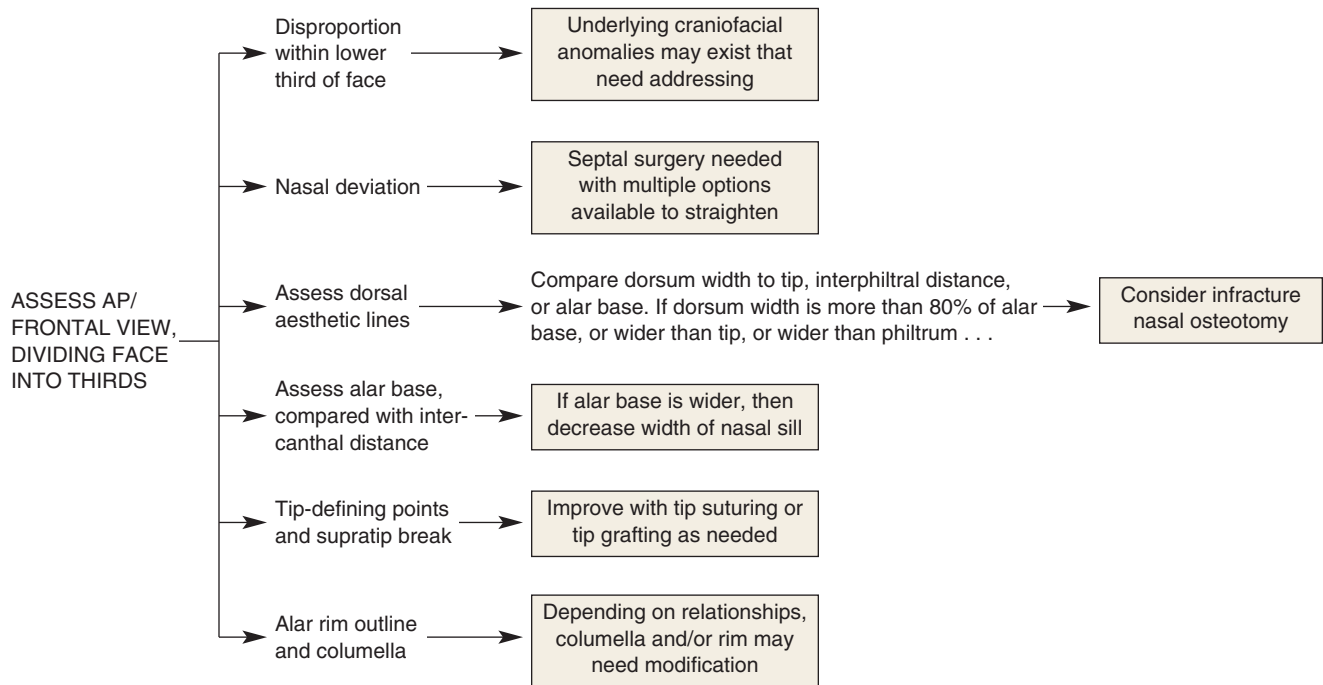
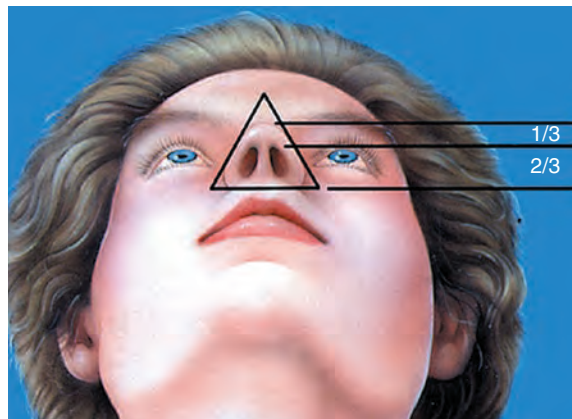
While the frontal view is still being addressed, the tip is assessed to determine the supratip break, the tip-defining points, and the columellar-lobular angle. These points serve as landmarks to draw two equilateral triangles with their bases opposed. If these triangles are asymmetrical, the underlying reason should be investigated, and the patient will likely require tip modification.

Alae



The final assessment on frontal view is of the outline of the alar rims and the columella, which should resemble a seagull in gentle flight, with the columella lying just inferior to the alar rims. If the curve is too steep, the patient likely has an increased infratip lobular height that will need correction. On the other hand, if the curve is flattened, it is likely the patient has decreased columellar show, which may require columellar augmentation or alar rim modification. Facets of the soft tissue triangles should be noted, because these may require alar contour grafts to prevent alar notching.

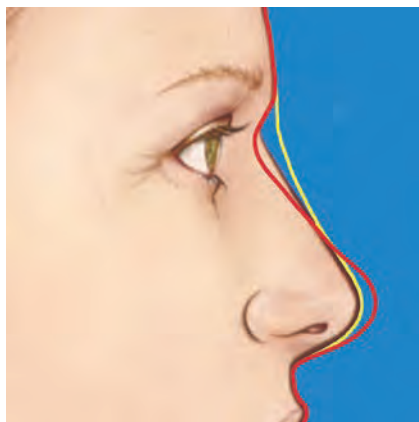
ANTEROPOSTERIOR/FRONTAL ASSESSMENT OF THE NOSE AND FACE

*Basal View*

The basal view of the nose is addressed next, with the outline of the nasal base describing an equilateral triangle with a lobule-to-nostril ratio of 1:2. The nostril itself should have a teardrop-like geometry, with the long axis from the base to the apex oriented in a slight medial direction.

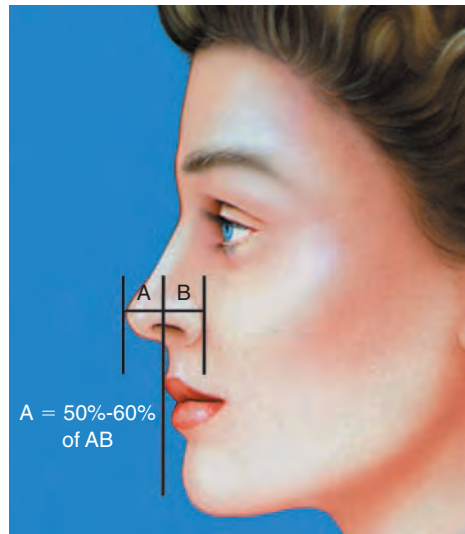
Lateral View

The lateral view is analyzed, beginning with the position and depth of the nasal root at the radix. The nasofrontal angle connects the brow and dorsum through a soft concave curve. The apex of this angle should lie between the upper lid eyelashes and the supratarsal fold, with the eyes in a natural horizontal gaze. Although this angle can vary from 128 to 140 degrees, it is ideally 134 degrees in women and 130 degrees in men. Other important reference measurements from this view include the nasion–medial canthal distance, which should be approximately 15 mm, and the nasion–corneal plane distance, which is approximately 11 mm.

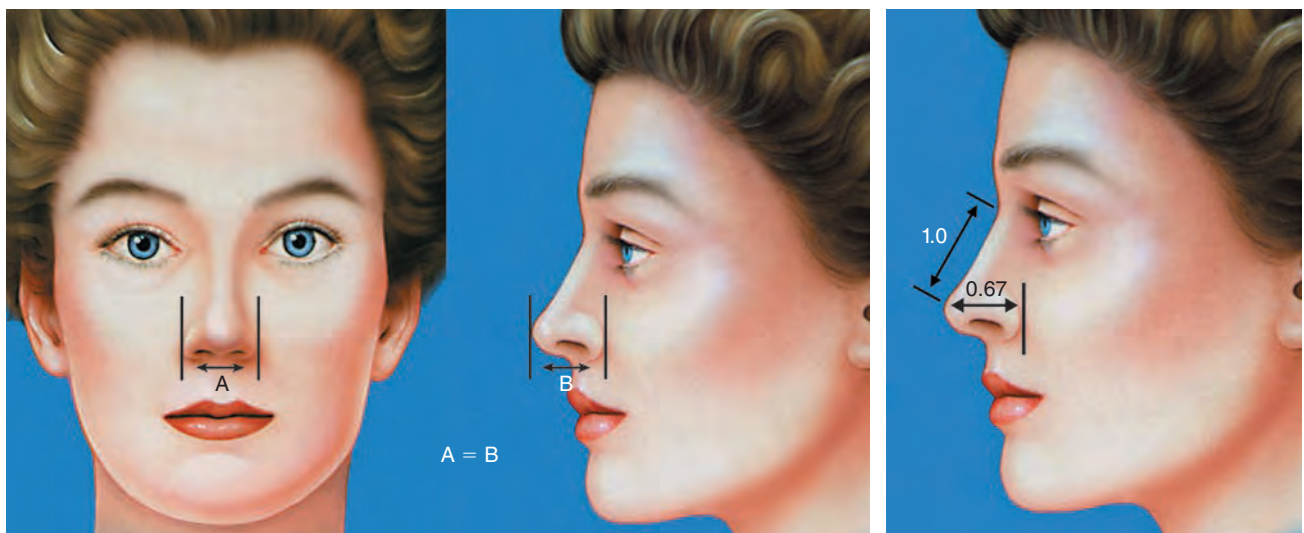


While still concentrating on the lateral view, the surgeon must remember that the perceived nasal length and tip projection can be altered by the position of the nasofrontal angle. For instance, if the nasofrontal angle is positioned more anteriorly and superiorly than normal, the nose will appear elongated, the nasofacial angle will be decreased, and the tip projection will appear diminished (*yellow line*). On the other hand, if the nasofrontal angle is positioned too posteriorly and/or inferiorly, the nose will appear shorter, and the tip more projecting (*red line*). Ideally, the nasofacial angle (as defined by the junction of the nasal dorsum with the vertical facial plane) should measure 32 to 37 degrees.

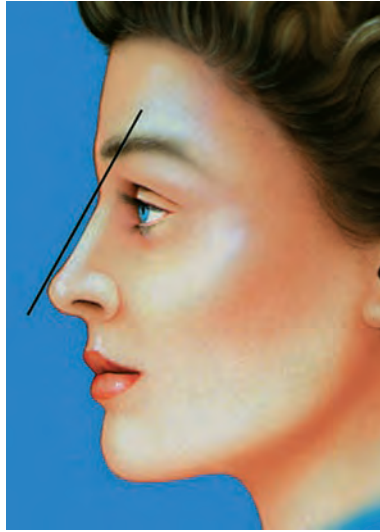
Tip Projection



The examiner addresses tip projection next, while looking at the lateral view. Although several methods have been described to assess this, we prefer the following two ways. In a patient with normal upper lip projection, we begin by drawing a line from the alar-cheek junction to the tip of the nose. The tip projection is considered normal if 50% to 60% of the tip lies anterior to a vertical line adjacent to the most projecting part of the upper lip. The tip is considered to be overprojecting if more than 60% of the tip lies anterior to this reference line and may therefore require deprojection. Conversely, if less than 50% of the tip lies anterior to the line, the projection may need to be augmented (in any number of ways).

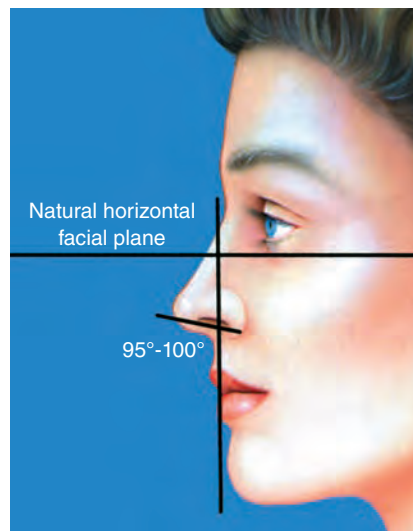


The second method we use to help assess tip projection is to compare it with the alar base width (they should be equal) (*left*), and compare the ratio of nasal length (radix-to-tip, RT) to the tip projection (alar base-to-tip). In the latter, the ideal tip projection is $0.67 \times \text{RT}$ (*right*).



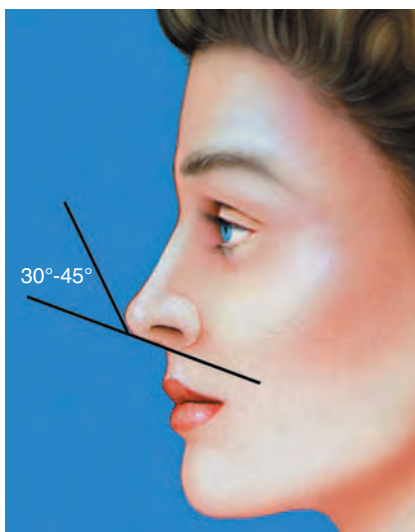
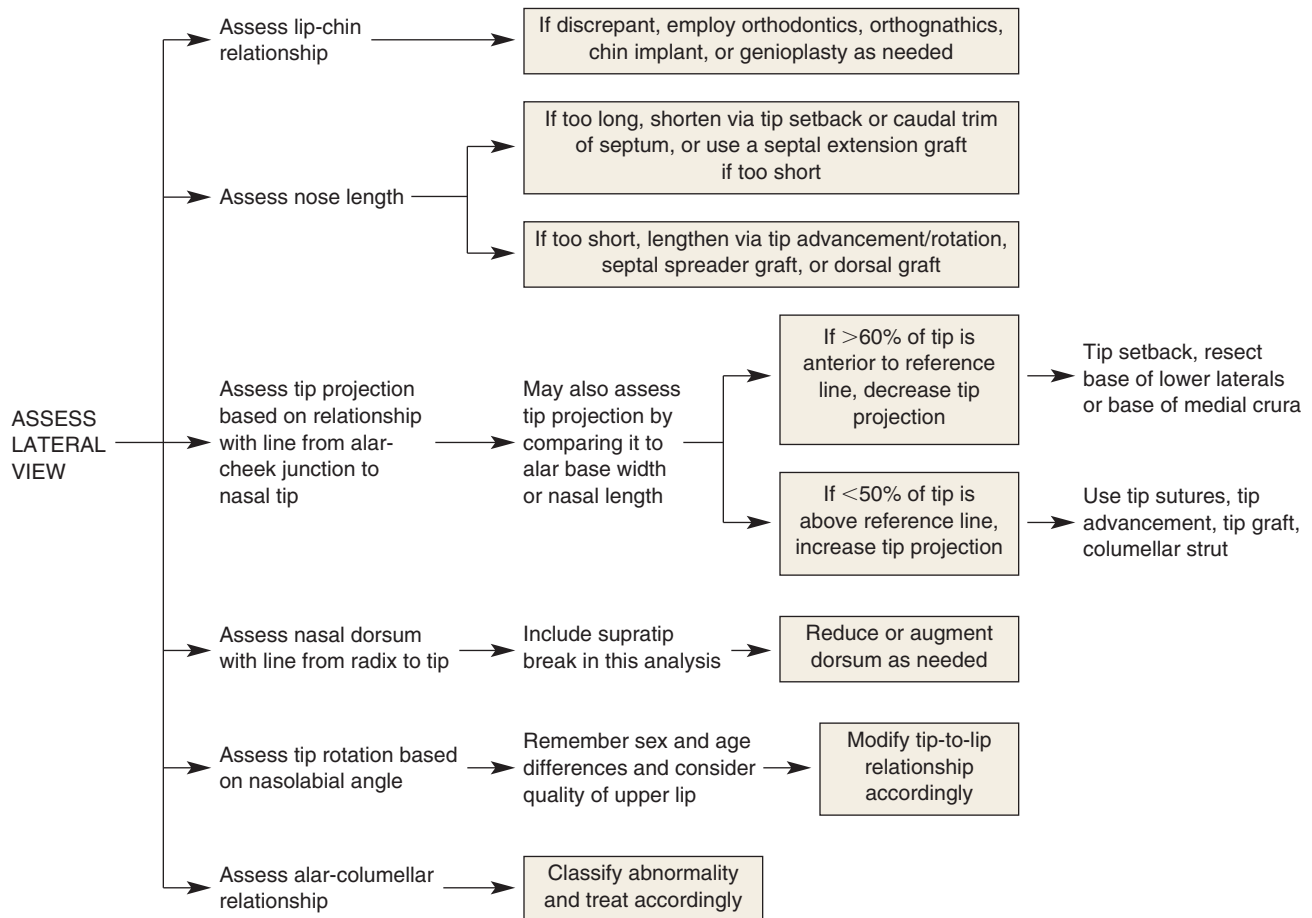
After the tip projection is assessed, the dorsum is analyzed. The aesthetic nasal dorsum should lie approximately 2 mm behind and parallel to a line from the radix to the tip-defining points in women, but in men it should be slightly higher to avoid feminizing the nose.

The degree of supratip break is appraised when the nasal tip projection and dorsum are evaluated. A slight supratip break is preferred in women but not in men. This gives the nose more definition and distinguishes the dorsum from the tip.

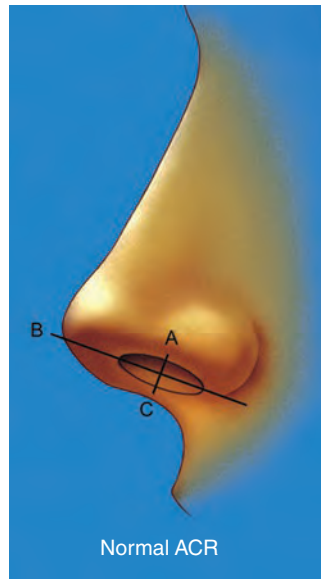


The nasolabial angle is used to determine the degree of tip rotation. This angle is obtained by measuring the angle between a line coursing through the most anterior and posterior edges of the nostril and a plumb line dropped perpendicular to the natural horizontal facial plane. This angle should be 95 to 100 degrees in women and 90 to 95 degrees in men.

LATERAL ASSESSMENT OF THE NOSE

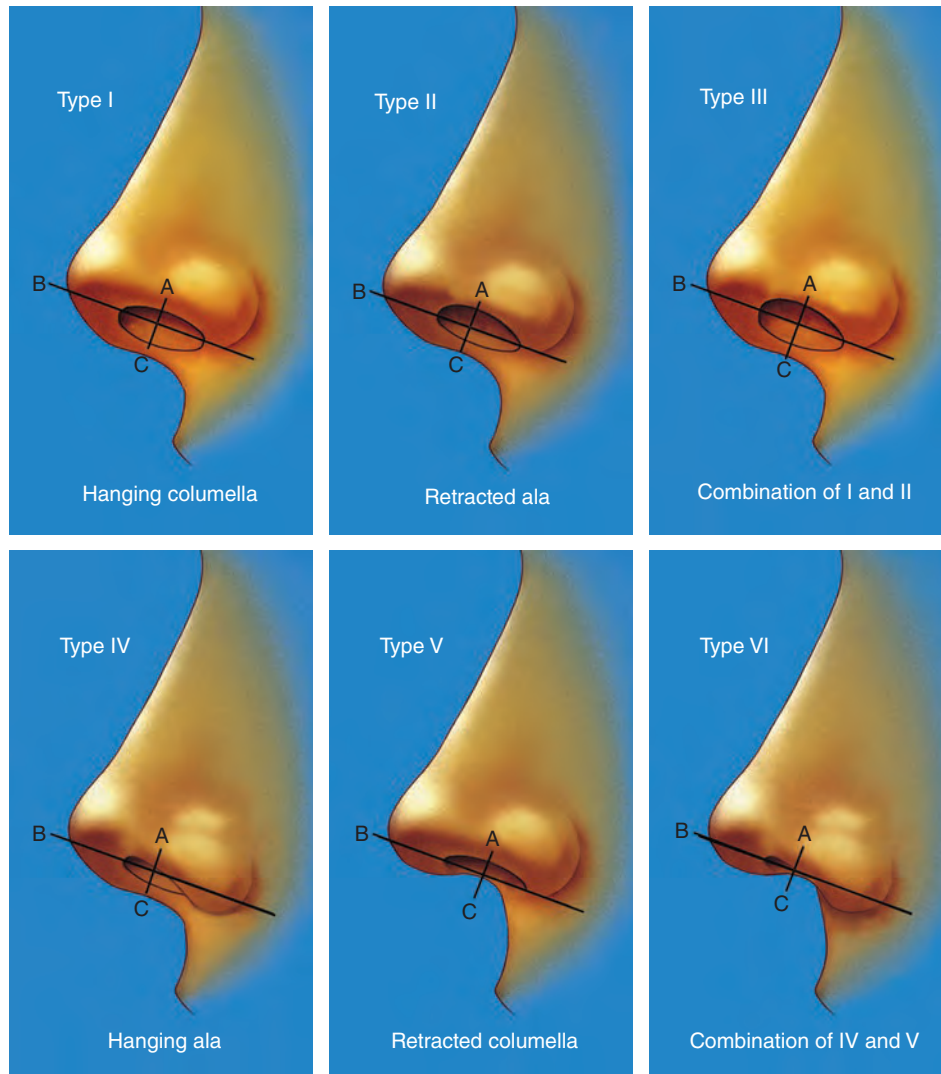


The nasolabial angle should not be confused with the columellar-labial angle, which is formed at the junction of the columella with the upper lip/infratip lobule. Increased fullness in this area is usually caused by a prominent caudal septum and gives the illusion of increased rotation, even though the nasolabial angle is normal. This angle is normally 30 to 45 degrees.



The alar-columellar relationship is then assessed (lateral and frontal views). A line is drawn through the long axis of the nostril, and a perpendicular line is drawn from the alar rim to the columellar rim that bisects this axis. The distance from the alar rim (point A) to the long-axis line (point B) should equal the distance between the long-axis line and the columellar rim (point C) if the alar-columellar relationship (ACR) is normal ($AB = BC \approx 2 \text{ mm}$).

If these measurements are not normal, the deformity can be categorized into six classes. Classes I to III describe increased columellar show, whereas classes IV to VI demonstrate decreased columellar show. These may be treated differently, depending on the class of deformity.



The above proportions generally apply to white women. Generally, the male face tends to have a squarer, less rounded appearance, with stronger, more pronounced features. The key differences in men are as follows:

The male dorsum tends to be straighter and wider, with decreased concavity at the superciliary ridges.

The male nasal dorsal profile should hug a line drawn from the radix to the tip-defining points instead of falling 2 mm behind and parallel to this line, as seen in women.

There should be no supratip break.

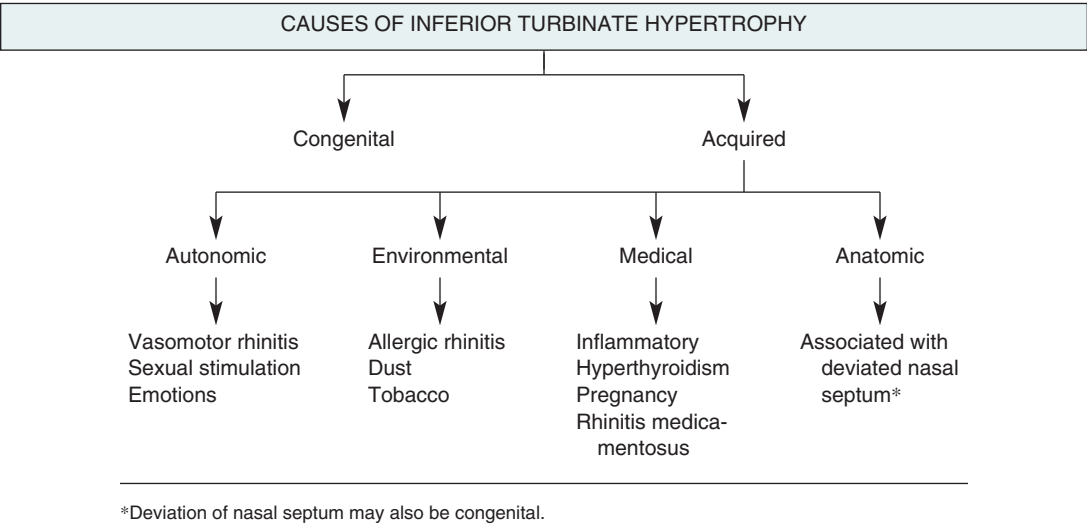
The tip rotation in men is slightly less than in women (90 to 95 degrees versus 95 to 100 degrees in women), inasmuch as men have less nostril show as a result of a longer nasal dorsum.

Men have a stronger chin, abutting the plumb line drawn tangential to the upper lip (versus 2 to 3 mm posterior to this line in women).

In general, men have a broader, more bulbous nasal tip.

Male skin is usually thicker, masking the amount of change that can be seen.

NOTE: These proportions are general guidelines and will vary within sex and race. They are only meant to be used as a systematic method of analysis of general proportions and relationships. The plan for each nose should be individualized to the patient’s facial structure and tempered by the patient’s desire to create nasofacial harmony and balance.



Systematic Approach to Rhinoplasty Planning*

A thorough history should be taken, with emphasis on past facial or nasal surgery, facial/nasal trauma, nasal function, and ease of breathing.
 The patient's desired nasal shape and aesthetic outcome are systematically delineated.
 An intranasal examination is done with a headlight and speculum.
 Imaging is performed: anteroposterior, lateral, and basal views.
 The images are reviewed with the patient, emphasizing what is and is not surgically possible.
 A systematic, surgeon-directed review of imaging forms the basis of a line-by-line surgical plan.
 The surgical plan is reviewed with the patient before surgery.
 The surgical plan is carried out.

*All secondary and posttraumatic rhinoplasties are performed using an open approach; a closed approach is considered for isolated dorsal deformities or minor tip modifications.

Surgical Approach

There are two basic incisional approaches to rhinoplasty: the open technique and the closed, or endonasal, technique. Each has its staunch proponents, and each has been used successfully in the practice of rhinoplasty.

Choosing the Best Option

	Open Approach	Endonasal Approach
Binocular visualization	+++	++
Evaluation of complete deformity without distortion	+++	+
Precise diagnosis and correction of deformities	+++	+
Direct control of bleeding	++	+
Nasal incision	+	+++
Operative time	+	++
Prolonged nasal tip edema	+	+++

Degree of effectiveness indicated by the number of pluses.

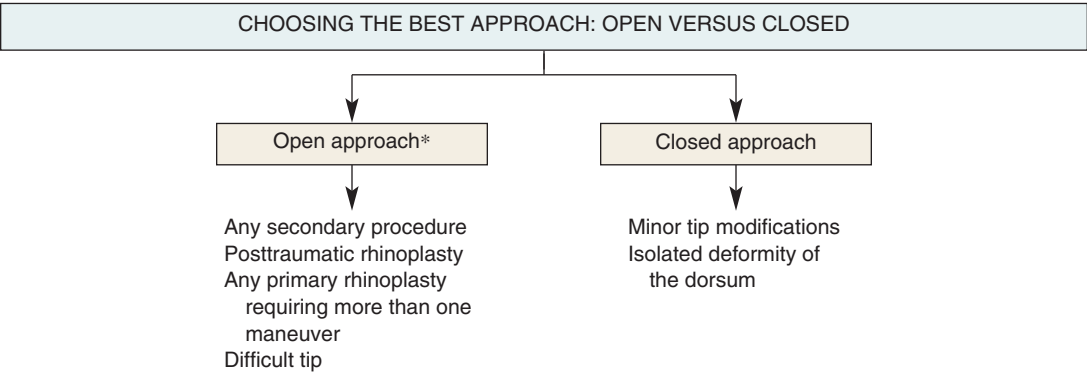
The open approach involves a transcolumellar incision, which can assume varying geometries, depending on the surgeon's preference. We prefer a stairstep configuration, because it lends itself well to realignment and facilitates reapproximation while

breaking up the scar (preventing contracture deformities and camouflaging the result). The open approach also involves skeletonizing the underlying osteocartilaginous framework, which gains enormous exposure for its manipulation and correction of deformities.

The closed, or endonasal, approach can be performed using a cartilage delivery approach or a nondelivery approach. The delivery approach involves an intercartilaginous incision, a marginal incision, and either a transfixion or hemitransfixion incision with subsequent transposition of the lower lateral cartilages to a location outside of the skin envelope. A nondelivery approach uses either a transcartilaginous incision or an eversion (retrograde) incision, with the lower lateral cartilages remaining in their native positions. Manipulation and modification of the osteocartilaginous framework are then carried out, although the skin envelope is not reflected, as in the open approach.

We perform the vast majority of our operations using the open approach, because it affords excellent exposure and control, grants the ability to manipulate the osteocartilaginous framework under direct visualization, and has minimal negative consequences, other than an external scar and occasional prolonged tip edema, which resolves in virtually all of our patients. We are able to obtain predictable and reproducible results using this type of approach. Furthermore, we think the tradeoff of increased accuracy and versatility using the open approach is worth the tradeoff of an external scar that typically heals very well. We rarely have a patient who objects to the transcolumellar scar, since it usually is invisible at conversation distances.

We reserve a closed approach for isolated deformities of the dorsum or when minor tip modifications are necessary. However, all secondary rhinoplasties and posttraumatic rhinoplasties are performed exclusively with the use of the open approach in our hands.



*Open approach affords excellent exposure of all major components of the nose.

Concluding Thoughts

The evolution of rhinoplasty has been long; advances in analysis and techniques have led to the ability to produce a predictable result, yet rhinoplasty remains one of the most challenging procedures in all of plastic surgery. Just as there is a fine line (perhaps only 1 or 2 mm) between an excellent result and a good one, the line is just as fine between an acceptable and an unacceptable result. The surgeon must become familiar with nasal anatomy and the limitations of techniques used to manipulate that anatomy. Complications may result (either from iatrogenic injury or from adverse cicatricial formation) that will require secondary revision. The surgeon should be able to address these complications as well, or at least know his or her own limitations and refer the patient to someone who can rectify the problem.

Much has been made about the incisional approach throughout this evolution. At one point, most rhinoplasties were performed using the closed approach. The pendulum swung to favor the open approach and now has settled somewhere in between, as is the case with most concepts in plastic surgery. In the end, the surgeon should choose the approach that he or she is most comfortable with. Furthermore, it cannot be overemphasized that *the proportions and relative relationships introduced in this chapter must be individualized to every patient*. There is no cookie-cutter or cookbook approach to rhinoplasty. The ultimate successful result will be determined by proper patient selection, the ability to accurately diagnose the deformity and generate an operative plan, and the capacity to execute that plan in a predictable, reliable, and reproducible fashion based on the principles described here.

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An excellent article that describes nasofacial analysis using objective reference points.

Gorney M, Martello J. Patient selection criteria. *Clin Plast Surg* 26:37-40, 1999.

A useful review of patient selection criteria and the features characteristic of poor candidates that should be avoided.

Gunter JP, Rohrich RJ, Adams WP Jr, eds. *Dallas Rhinoplasty: Nasal Surgery by the Masters*, 2nd ed, vols I and II. St Louis: Quality Medical Publishing, 2007.

A comprehensive text on all aspects of rhinoplasty. Renowned contributors make this an essential reference for rhinoplasty surgeons of all experience levels.

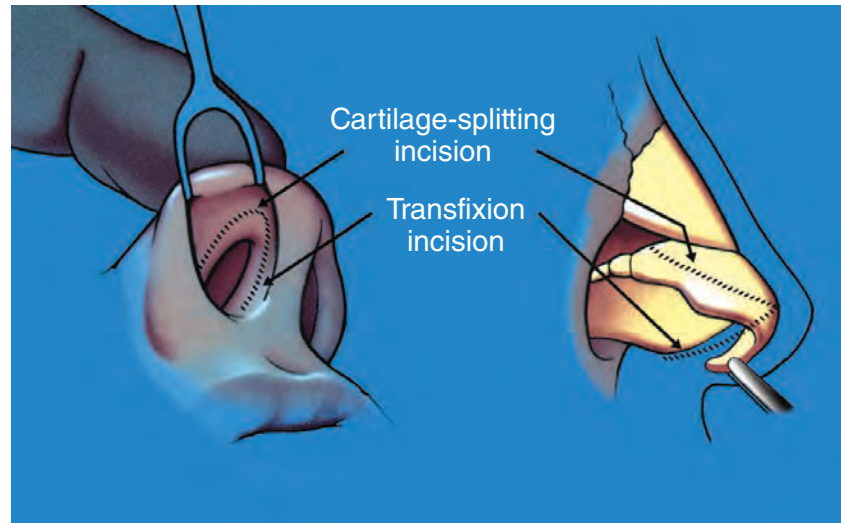
Rohrich RJ, Janis JE, Kenkel JM. Male rhinoplasty. *Plast Reconstr Surg* 112:1071-1085; discussion 1086, 2003.

A comprehensive discussion of proper evaluation of the male rhinoplasty patient, surgical planning, intraoperative techniques, and postoperative treatment.

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CHAPTER 55



Primary Rhinoplasty

JEFFREY E. JANIS, JAMIL AHMAD, ROD J. ROHRICH

Rhinoplasty is one of the most complex and challenging operations in plastic surgery. The rhinoplasty surgeon must have a thorough understanding of the three-dimensional anatomy of the nasal region, a proficiency in nasal and facial analysis, and a firm grasp of the core concepts in manipulating nasal soft tissues, cartilage, and bone. The surgeon must also be able to visualize the dynamic interplay between these structures and have an aesthetic eye to craft a result that will produce a balanced, harmonious nose in relationship to the rest of the face. The initial operation is critical to the long-term result, because the tissues are virginal and undistorted by prior operative procedures.

Evolution of Technique

Aesthetic rhinoplasty has its roots in nasal reconstruction. The first recorded treatment of nasal injuries dates back to approximately 3000 BC, as recorded on the Egyptian Edwin Smith surgical papyrus. Reconstructive surgery for nasal deformities is described as early as 600 BC by Sushruta. After a long period of quiescence during the Dark Ages, descriptions of nasal reconstruction again appeared as the Renaissance brought forth advances in science and medicine. The Indian methods for nasal reconstruction with forehead and cheek skin were practiced and modified by Italian surgeons into the Italian method, using arm skin to reconstruct the nose. In the early nineteenth century, German surgeons including Carl von Graefe and Johann Friedrich Dieffenbach continued to develop methods for nasal reconstruction; Dieffenbach was one of the first to describe nasal surgery for aesthetic improvement of the nose.

John Orlando Roe, an American otolaryngologist, is credited with describing the first aesthetic rhinoplasty and introducing the endonasal approach. In 1887, Roe published “The Deformity Termed ‘Pug Nose’ and Its Correction, by a Simple Operation” and in 1891, “The Correction of Angular Deformities of the Nose by a Subcutaneous Operation.” Roe’s descriptions preceded those of Jacques Joseph, a German orthopedic surgeon often regarded as the father of modern rhinoplasty, given his contribution to the analysis, classification, and repair of various nasal deformities, outlined in his two-volume textbook on plastic surgery of the nose.

In the first half of the twentieth century, the emergence of plastic surgery as a specialty was spurred forward by experience gained reconstructing devastating war injuries. The second half of the twentieth century saw significant contributions to the rhinoplasty literature, with gains in preoperative assessment and diagnosis, management of the nasal airway, cartilage-grafting techniques, and popularization of the open approach to rhinoplasty. The open approach was first described by Aurel Réthi

of Budapest in 1921 but did not gain popularity. In the 1960s his approach was rediscovered by Ante Sercer of Zagreb and introduced to North America by his associate, Ivo Padovan, in 1970. William Goodman of Toronto was the first North American to adopt the open approach, and this technique has gained in popularity since the 1980s.

Indications and Contraindications

Rhinoplasty can be performed for many indications, which fall along a spectrum from purely functional to purely aesthetic. However, each individual's nasal anatomy must be taken into account when deciding whether the patient is a good surgical candidate, and what approach should be used to address the problem. No single approach is appropriate for all situations.

Obviously, there can be great advantages for the patient when rhinoplasty is properly performed. Patients who suffer from nasal airway obstruction can achieve significant amelioration, if not total eradication, of their symptoms. Frequently these patients have had difficulty breathing for several years. Whether the deformity is congenital or traumatic, patient satisfaction is extremely high after corrective surgery is performed.

Similarly, a patient who undergoes rhinoplasty for purely aesthetic reasons stands to benefit significantly with respect to self-image and self-esteem after a successful rhinoplasty. One must be wary, however, of patients who perceive a significant deformity in themselves when the deformity appears minor to the surgeon. Such patients may never be satisfied with the outcome, no matter how well the rhinoplasty is executed (see Chapter 1). Multiple preoperative visits are necessary to completely understand not only what the patient desires, but also to confirm whether the patient's expectations are realistic.

The Open Versus the Endonasal Approach

In modern rhinoplasty, both the open and the endonasal (closed) approach have their staunch proponents. The open approach continues to gain in popularity over the endonasal approach for both primary and secondary rhinoplasty. There are advantages and disadvantages to both techniques, with the correct approach determined by the patient's anatomic deformity and the surgeon's experience. Clearly, what is performed to alter the underlying anatomy is far more important than the type of incision used.

Open Rhinoplasty Approach Rationale

Distinct Advantages	Potential Disadvantages
Binocular visualization	External nasal incision (transcolu- mellar scar)
Evaluation of complete deformity without distortion	Prolonged operative time
Precise diagnosis and correction of deformities	Protracted nasal tip edema
Allows use of both hands	Columellar incision separation
More options with original tissues and cartilage grafts	Delayed wound healing
Direct control of bleeding with electrocautery	
Suture stabilization of grafts (invisible and visible)	

Despite the disadvantages to the open approach, in our experience we have not had patient dissatisfaction related to these specific factors, other than prolonged nasal tip edema. As long as the expectation level is set preoperatively, this has not proved to be a problem.

Those who favor the endonasal approach to rhinoplasty submit that the advantages offered by the open approach are outweighed by its disadvantages.

Endonasal Approach

Advantages	Disadvantages
Leaves no external scar	Requires experience and great reliance on accurate preoperative diagnosis
Limits dissection to areas needing modification	Prohibits simultaneous visualization of the surgical field by a teaching surgeon and students
Permits creation of precise pocket so graft material fits exactly without need for fixation	Does not allow direct visualization of nasal anatomy
Allows percutaneous fixation when large pockets are made	Makes dissection of alar cartilages diffi- cult, particularly in cases of malposition
Promotes healing by maintaining vascular bridge	
Encourages accurate preoperative diagnosis and planning	
Produces minimal postsurgical edema	
Reduces operating time	
Results in fast patient recovery	
Creates intact tip graft pocket	

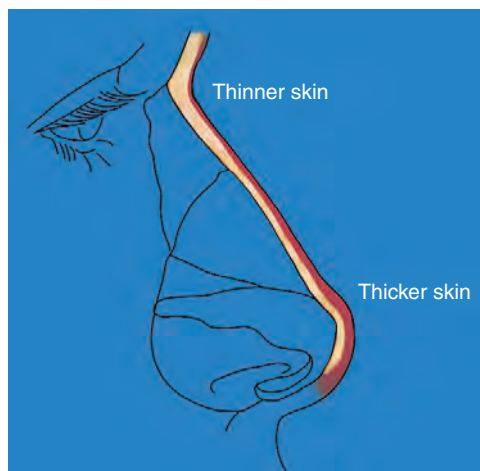
We prefer the open approach, in general, because it provides full visualization of the nasal framework to more accurately diagnose the cause of the nasal airway obstruction or the aesthetic deformity. Manipulation of the various structures, from the dorsum to the septum to the tip, can be done with precision and can yield reproducible results. We strongly recommend the open approach when addressing a posttraumatic deformity or in secondary/revisional surgery, as well as when complex tip modifications are necessary.

We find the endonasal approach to be advantageous in patients with an isolated dorsal hump deformity or when minimal modification of the tip is required. In these instances, we prefer access through a marginal incision (approximately 1 mm cephalad to the caudal margin of the lateral crus). We combine this with an intercartilaginous incision in cases of minor tip refinement to allow adequate cartilage delivery and exposure. If the caudal septum needs to be corrected as well, we perform a concomitant hemitransfixion or transfixion incision.

Pertinent Anatomy

As in every other area in plastic surgery, thorough knowledge of anatomy is paramount to obtaining a superior result. The nose is divided into external skin and soft tissue, the underlying osteocartilaginous framework, and ligamentous support. Rhinoplasty surgeons must be familiar with each structure's native morphology and its variants and must have an appreciation for the dynamic interplay between the components.

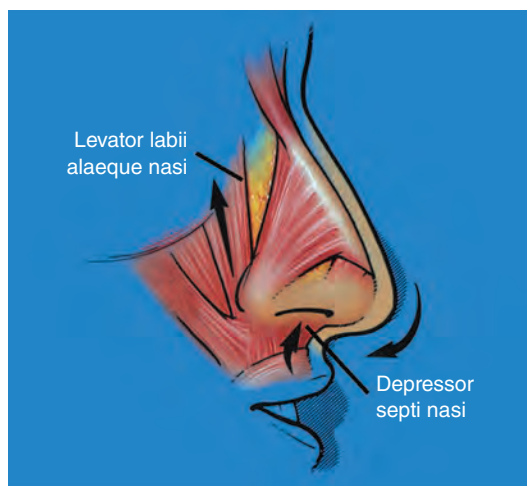
Skin



The thickness, mobility, and sebaceous character of the nasal skin vary along its length, with the upper two thirds being thinner, more mobile, and less sebaceous than the inferior third. The nasal dorsum thickness averages approximately 1300 microns, whereas the lobule skin thickness averages 2400 microns. A straight dorsum actually has a slight underlying convexity of its osteocartilaginous framework in the cephalic area; therefore a straight dorsal profile is actually produced by the combination of this convexity in the osteocartilaginous framework with the variation in dorsal skin thickness.

Some ethnic subgroups, such as those of African descent, Hispanics, and those of Mediterranean descent, can have thicker, more sebaceous skin. These differences are important, because the skin over the underlying nasal framework can either reveal or mask changes depending on its characteristics. For instance, it is advisable to err on the conservative side when operating on a white woman with thin skin compared with a man of African descent with thick, sebaceous skin. More dramatic manipulation to the underlying nasal framework will be necessary in the patient with thick skin to obtain an appreciable change in the external appearance.

Muscle

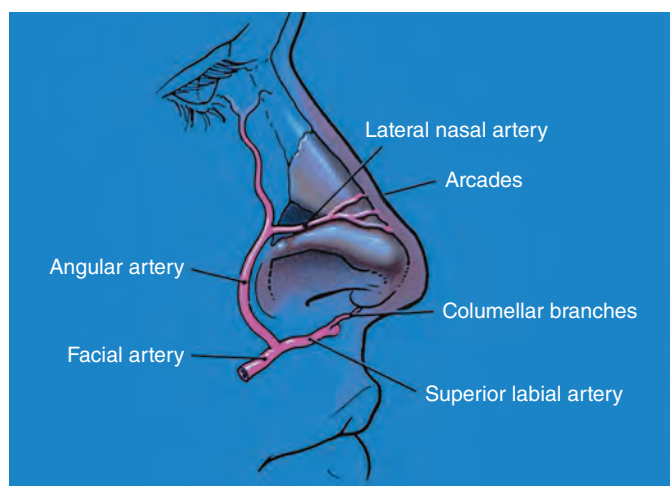


Two muscles, in particular, are important in rhinoplasty—the levator labii alaeque nasi and the depressor septi nasi. The levator labii alaeque nasi helps to maintain the patency of the external nasal valve, whereas the depressor septi nasi, if overactive, can shorten the upper lip, cause a transverse upper lip crease, and alter tip projection.

Evaluation of the depressor septi nasi is routine in our preoperative assessment. Its effect on depressing the nasal tip and shortening the upper lip can be appreciated in some patients on animation (especially when smiling). In the subgroup of patients in whom this muscle significantly alters the nasal appearance, we dissect and transpose the muscle. By doing so, several goals are achieved:

1. Enhancement of the tip-lip relationship
2. Relative upper lip lengthening
3. Relative fullness to the upper lip
4. Maintenance of tip rotation/projection on animation

Blood Supply



The blood supply to the nose is derived both from branches of the ophthalmic artery and branches of the facial artery. It is important to note the vascularity to the nasal tip because an open rhinoplasty approach using a transcolumellar incision will transect the columellar vessels (when present), leaving the lateral nasal and dorsal nasal arteries as the remaining blood supply. In our 1995 study, we found the lateral nasal arteries to be present (either singularly or bilaterally) in 100% of cases, with the columellar branches present 68.2% of the time. Since the lateral nasal vessels are found approximately 2 to 3 mm above the alar groove, extended alar resections to this level are prohibited, because injury to these vessels after the transcolumellar approach would severely compromise blood flow to the nasal tip. Furthermore, one must be extremely cautious when debulking the nasal tip after an open approach, because the subdermal vascular plexus connecting the dorsal nasal and lateral nasal blood supplies may be damaged, leading to a similarly disastrous result, with necrosis of the nasal tip skin.

Tardy and Toriumi studied the vascular and lymphatic anatomy of the nose and determined that the transcolumellar incision itself did not compromise major venous or lymphatic outflow. Furthermore, they recommend dissection just above the perichondrium in the deep areolar plane, leaving the musculoaponeurotic layer intact, which preserves the major arterial vascular supply and avoids damage to the venous and lymphatic vasculature that lies in a more superficial (subcutaneous) plane. In this way, bleeding and postoperative edema are minimized.

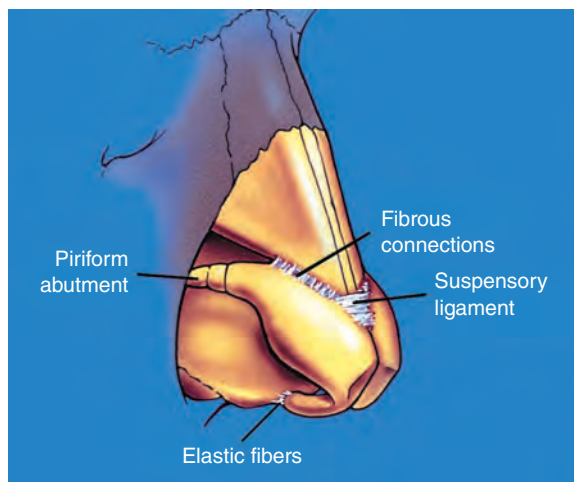
Nasal Vaults



The osteocartilaginous nasal framework can be subdivided into three separate vaults: bony, upper cartilaginous, and lower cartilaginous. The bony vault constitutes the upper third to half of the nose and is made up of the paired nasal bones and the ascending frontal process of the maxilla. It is important to note that the nasal bones are narrowest and thickest above the level of the medial canthi. As a result, osteotomies are rarely indicated above this level.

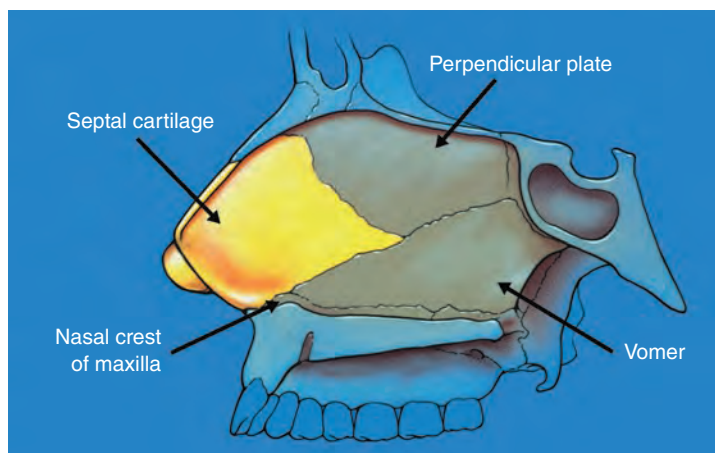


The upper cartilaginous framework begins where the nasal bones overlap the upper lateral cartilages (ULCs) and septum for 4 to 6 mm, creating what is known as the keystone area. This area should be the widest part of the dorsum, and resembles a T shape in cross-section. The remainder of this vault is composed of the paired ULCs and dorsal cartilaginous septum. Overresection during dorsal hump reduction in this area can lead to deformities such as the inverted-V deformity and/or disruption of the dorsal aesthetic lines. A component dorsal hump reduction is advised to avoid these complications.



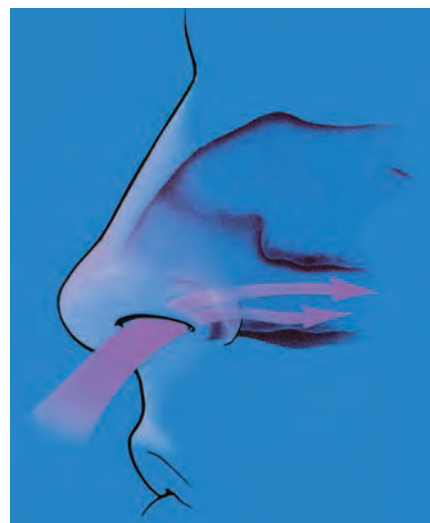
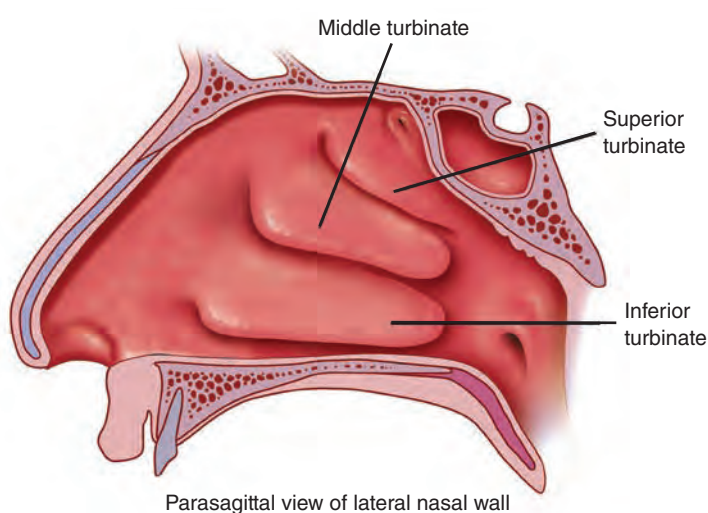
The lower cartilaginous framework begins where the ULCs interdigitate with the lower lateral cartilages (LLCs) in what is called the scroll area. The lower lateral cartilages comprise the medial, middle, and lateral crura. These cartilages are connected to each other, the ULCs, and the septum by fibrous tissue and ligaments. Disruption of these ligaments can result in diminished tip projection during rhinoplasty. Thus if these structures are violated, maneuvers that increase tip support (for example, columellar struts, extended spreader grafts, batten grafts, suture techniques) may be necessary.

Nasal Function

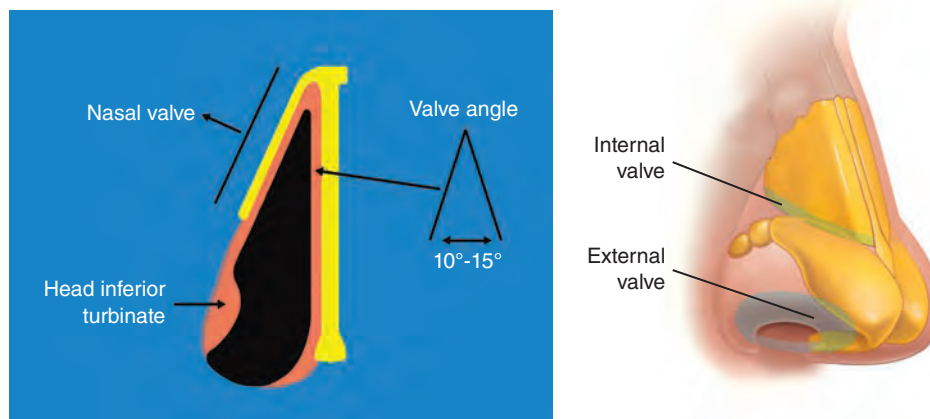


The septum, turbinates, and internal and external nasal valves serve as the anatomic functional foundation for the nose, contributing to respiration, filtration, humidification, temperature regulation, and protection. The septum is made up of the septal cartilage, the perpendicular plate of the ethmoid, the nasal crest of the maxilla, and the vomer.

Deformities in the septum can lead to significantly impaired airflow through the nose, as well as compensatory turbinate pathology. When addressing septal deformities, it is important to assess all septal components. When performing a septal resection, it is important to remember that the perpendicular plate of the ethmoid is contiguous with the cribriform plate posterosuperiorly. Therefore, a sidewise fracture of the perpendicular plate should be performed with care to prevent iatrogenic fracture of the cribriform plate and its untoward consequences (for example, cerebrospinal fluid rhinorrhea, potential ascending infection/meningitis). Restoration of a normal straight septum will help reestablish laminar airflow.



The turbinates help to guide the transport of air during respiration and condition/humidify inspired and expired air. These structures are mucosa-lined extensions of the lateral nasal cavity, and undergo a normal autonomically mediated cycle of expansion and contraction. Of all the turbinates, however, it is the inferior turbinate that has the greatest impact on airway resistance, providing up to two thirds of the total airway resistance from its most anterior aspect. However, overresection of the anterior inferior turbinate can have a deleterious effect on its regulatory and physiologic functions, and can lead to crust formation, bleeding, and nasal cilia dysfunction.



The internal nasal valve can contribute up to 50% of the total airway resistance, and is the narrowest segment of the nasal airway. It is composed of the angle formed by the intersection of the nasal septum and the caudal margin of the upper lateral cartilage, and is usually 10 to 15 degrees. In some cases, the anterior portion of the inferior turbinate may be a significant contributor to the decrease in the cross-sectional area of this region. Patients with short nasal bones and long, poorly supported ULCs have a propensity to have collapse at this area. Traditionally, lateral traction on the cheek (positive Cottle's sign) diagnoses collapse of the internal nasal valve and signals the need for spreader grafts to increase the valve angle and stent the airway open.

The external nasal valve is the cartilaginous vestibule bounded by nares and lateral alar sidewalls. It is caudal to the internal valve. Obstruction at this area may be caused by foreign bodies, weak or collapsed lower lateral cartilages, loss of vestibular skin, or scar tissue. Several options are available to reestablish proper airflow through this area, including alar contour grafts, lateral crural strut grafts, lateral crural cephalic turnover flaps, lysis of adhesions, scar revision, mucosal grafts, skin grafts, or composite grafts.

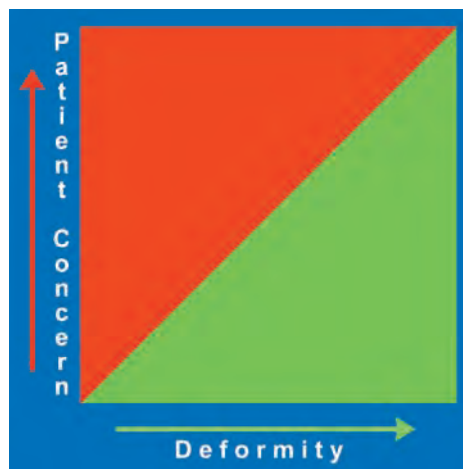
Preoperative Assessment

Initial Consultation

Before proceeding with a rhinoplasty, it is important to completely evaluate the patient's motivations and expectations for surgery to determine whether the patient is a suitable surgical candidate. Gunter and Gorney have both commented on "danger signs" that may be exhibited by certain patients. Patients that meet these criteria should be approached with caution because surgical intervention may not be in the

best interests of either the patient or the surgeon. Gunter identified the following 13 danger signs that may signify underlying psychological issues:

1. Minimal disfigurement
2. Delusional distortion of body image
3. Identity problem or sexual ambivalence
4. Confused or vague motives for wanting surgery
5. Unrealistic expectations of change in life situation as a result of surgery
6. History of poorly established social and emotional relationships
7. Unresolved grief or currently in a crisis situation
8. Present misfortunes blamed on physical appearance
9. Older neurotic man who is overly concerned about aging
10. Sudden dislike for one's anatomy, especially in an older man
11. A hostile, blaming attitude toward authority figures
12. History of consulting physicians and being dissatisfied with them
13. Indication of paranoid thoughts



Similarly, Gorney uses two systems to identify potential problem patients. The first uses the acronym SIMON (single immature males, overly expectant, narcissistic) to describe certain traits to be wary of. The second method Gorney uses plots the patient's concern on one axis and the degree of deformity on the other. Patients with an appropriate amount of concern relative to their degree of deformity are excellent candidates for treatment. However, those with minimal deformity but disproportionate concern should be avoided, because frequently their expectations exceed the amount of aesthetic improvement that is possible. Furthermore, regardless of the degree of deformity, if the level of skill and expertise required to perform the rhinoplasty exceeds the surgeon's ability, the patient should be referred to a more proficient surgeon.

It should also be noted that men in general tend to have a poorer understanding of their deformity than women do. Furthermore, they tend to have a more difficult time elucidating the changes they want. Thus, for this subgroup of patients, during the initial consultation the physician must determine the patient's goals and whether they are realistic. A second follow-up consultation is recommended to reiterate the patient's desires, develop a realistic operative plan, and reaffirm the patient's understanding of the anticipated procedure.

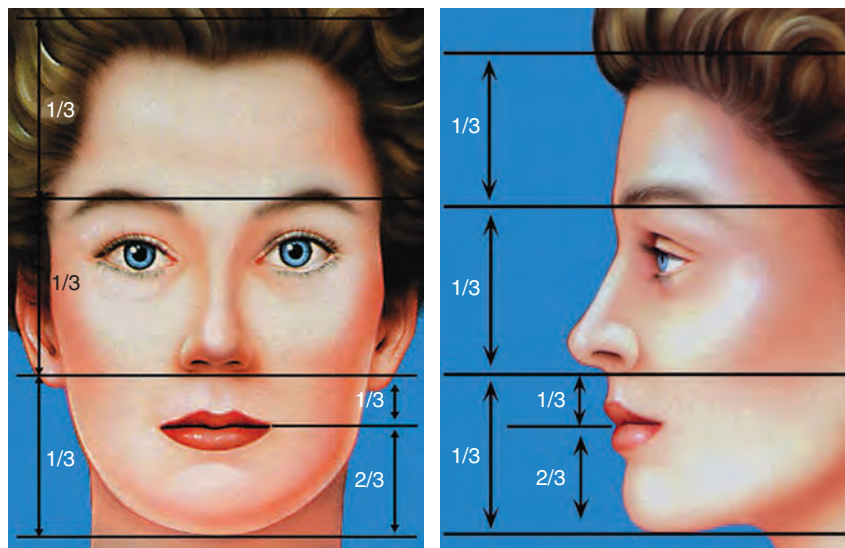
Although there are different methods for integrating the patient into the surgical process, we find that computer imaging provides an excellent way for patients to gain a realistic understanding of the anticipated outcome. Although the images are not meant to guarantee surgical results, they do provide a visual level of understanding that may otherwise be lacking. These images, combined with standardized anterior, lateral, oblique, and basal photographs, serve as an integral element of the preoperative surgical plan.

Facial Analysis

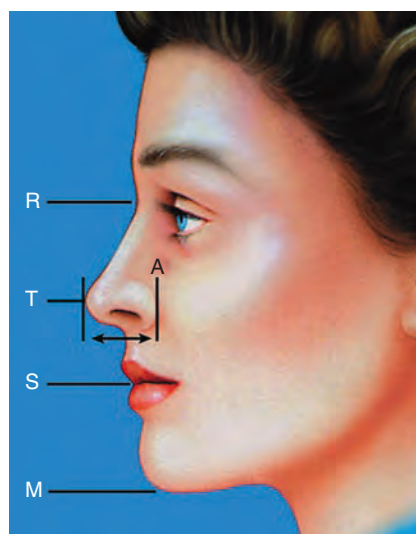
Another critical element to proper preoperative surgical planning is critical facial analysis. Each individual nose has different proportions, morphology, and relative relationship with the surrounding face. To preserve nasofacial harmony, it is crucial to perform a systematic and meticulous analysis of the nose and face to accurately diagnose the deformity and then to determine the optimal surgical plan to correct the problem. It is also important to point out natural facial asymmetries to the patient preoperatively so the patient gains a better understanding of what was actually present before any operative intervention is performed.

We begin by evaluating the patient's skin type, thickness, and texture. As previously mentioned, this is important because thicker, more sebaceous skin tends to camouflage changes made to the underlying osteocartilaginous framework, whereas thinner skin tends to show even minor changes.

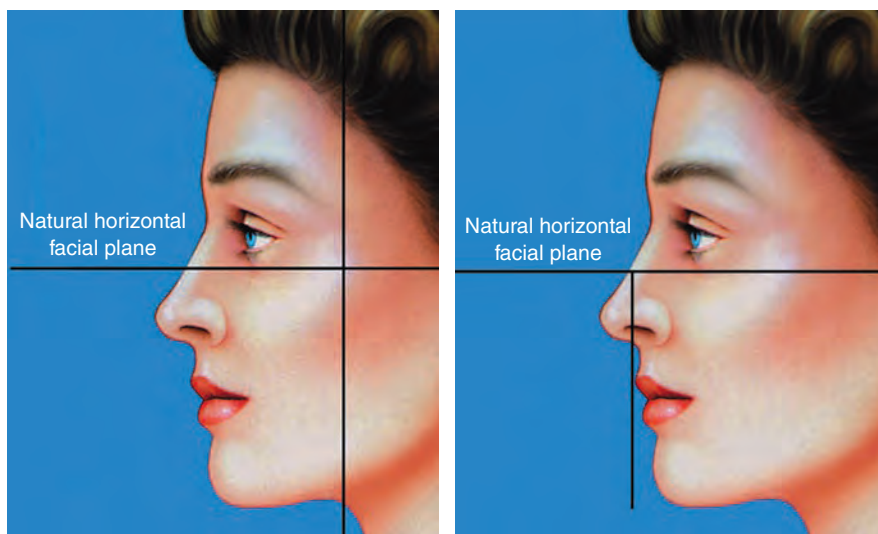
We then proceed with the remainder of the facial analysis. There are some proportions and relationships of facial structures that make up an "attractive" face. Although more proportions have been described, the following are some of the fundamental relationships that we routinely use in our preoperative evaluation of the rhinoplasty patient. We will describe these relationships briefly for white women and point out when the proportions differ between men and women.



We start by evaluating for disproportions and anomalies of the underlying facial skeleton, including the maxillomandibular relationship. To do this, we divide the face into thirds using horizontal lines adjacent to the hairline, brow (at the level of the supraorbital notch), nasal base, and menton. The upper third (between the hairline and the brow) is the least important as it is the most variable (depending on the hairstyle). The lower third of the face is then subdivided into thirds by visualizing a horizontal line between the oral commissures (stomion). The upper third of this subdivision lies between the nasal base and the oral commissures, and the lower two thirds between the commissures (stomion) and the menton. If there are significant deviations from this, the patient may have underlying craniofacial disproportion (i.e., vertical maxillary excess) that may need to be addressed in addition to rhinoplasty.



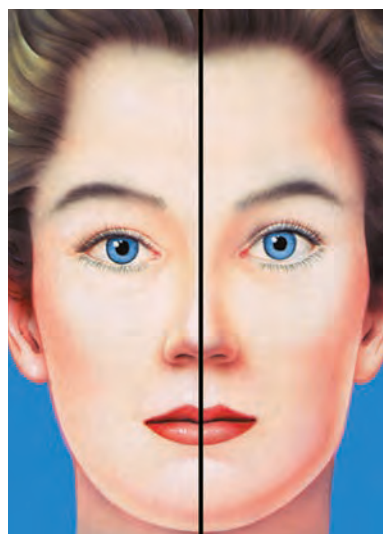
The nasal length (radix to tip, or RT) is verified against the stomion-to-menton distance (SM), which should be equal, as was described by Byrd and Hobar.



For future reference, a natural horizontal facial plane is determined by drawing a line perpendicular to a plumb line superimposed over the head in repose and the eyes in straightforward gaze. As the external auditory canal position may differ between patients, this line may or may not correspond to Frankfort's line.

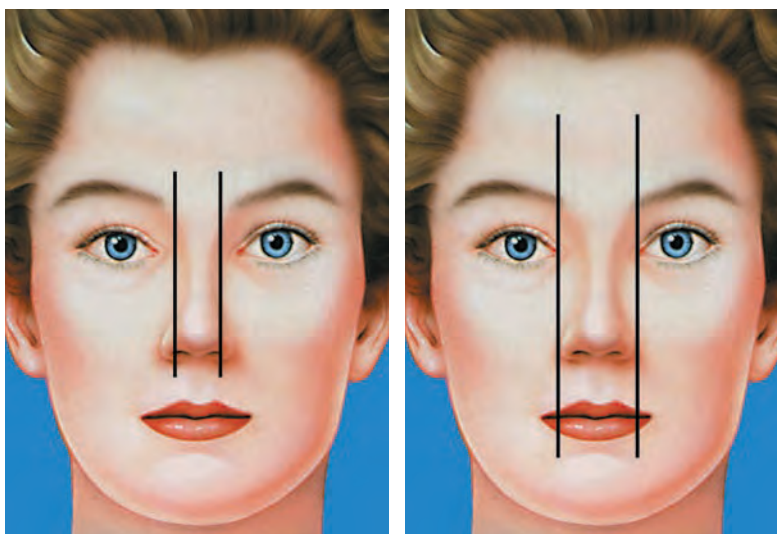
The lip-chin relationship is assessed next. Byrd determines ideal chin projection by dropping a vertical line from a point one half the ideal nasal length tangential to the vermilion of the upper lip. The lower lip should be no more than 2 mm behind this line. The ideal chin position varies with gender, with the chin lying slightly posterior to the lower lip in women but equal to the lower lip in men. If there is a discrepancy in these relationships, orthodontics, orthognathic surgery, or a chin implant may be necessary to improve facial harmony.

Nasal deviation is noted by drawing a line from the midglabellar area to the menton, bisecting the nasal ridge, upper lip, and Cupid's bow. This line will pass between the central incisors in patients with normal occlusion. Any deviation of the nose from this line will likely require septal surgery.





The nasal dorsum is then assessed on frontal (anteroposterior) view. The curvilinear dorsal aesthetic lines are traced from where they originate at the supraorbital ridges, and then follow along the corrugators to converge at the medial canthal ligaments, from which they flare slightly at the keystone area. From this point, they track to the tip-defining points, slightly diverging from each other along the dorsum during their course. Ideally, the width of the dorsal aesthetic lines should match the width of either the tip defining points or the interphiltral distance. These lines may be ideal, narrow, wide, asymmetrical, or ill-defined.



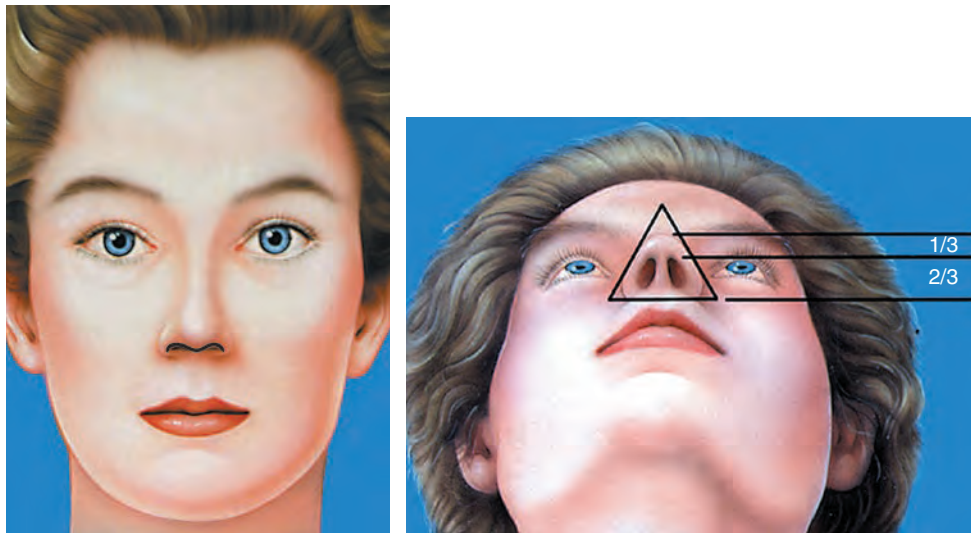
The width of both the bony base and the alar base are then assessed. The width of the bony base should be 80% of the normal alar base width (which typically is equal to the intercanthal distance), or the width of the palpebral fissure. If the bony base is greater than 80% of the alar base width (assuming the alar base width is normal), it is likely that osteotomies will be required to narrow the bony vault. Although men tend to have a wider bony base than women, it is important not to narrow the dorsum too much in males, since this could feminize the nose.



The alar base is analyzed, as is the geometry of the alar rims. If the alar base width is greater than the intercanthal distance, it must be determined if this is the result of a narrow intercanthal distance, a true increased interalar width, or alar flaring. If the intercanthal distance is smaller than the width of the palpebral fissure, it is better to maintain a slightly wider alar base. If there is true increased interalar width, a nostril sill resection may be indicated. If the increase in width is secondary to alar flaring (greater than 2 to 3 mm outside the alar base), an alar base resection should be considered. Again, the alar rims should also be assessed for symmetry, and should flare slightly outward in the inferolateral direction.



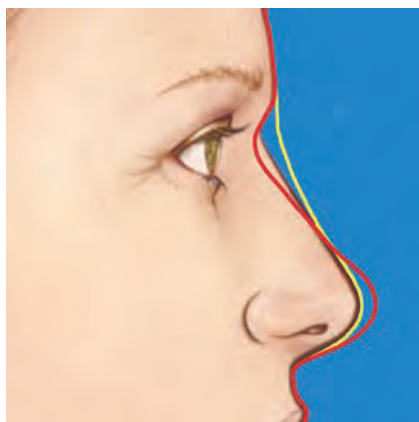
While still addressing the frontal view, the surgeon assesses the tip to determine the supratip break, the tip-defining points, and the columellar-lobular angle. These points serve as landmarks to draw two equilateral triangles with their bases opposed. If these triangles are asymmetrical, the underlying reason should be investigated, and the patient will likely require tip modification.



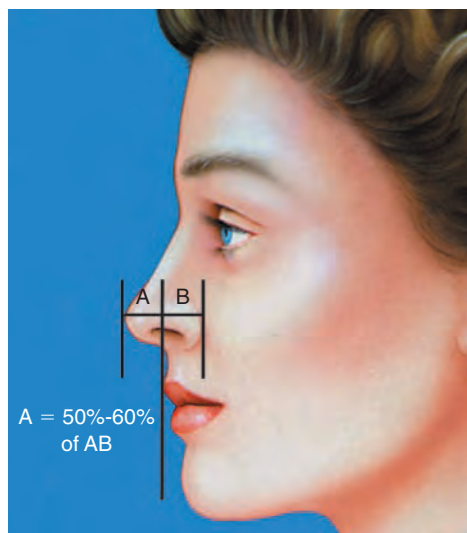
The final assessment on frontal view is of the outline of the alar rims and the columella, which should resemble a seagull in gentle flight, with the columella lying just inferior to the alar rims. If the curve is too drastic, the patient probably has an increased infratip lobular height, which will need correction. If, on the other hand, the curve is flattened, the patient probably has decreased columellar show, which may require columellar augmentation or alar rim modification.

The basal view of the nose is addressed next, with the outline of the nasal base describing an equilateral triangle with a lobule-to-nostril ratio of 1:2. The nostril itself should have a teardrop-like geometry, with the long axis from the base to the apex oriented in a slight medial direction.

The lateral view is then analyzed, beginning with the position and depth of the nasal root at the radix. The nasofrontal angle connects the brow and the dorsum through a soft concave curve at the radix. The apex of this angle should lie between the upper lid eyelashes and the supratarsal fold, with the eyes in natural horizontal gaze. Although this angle can vary from 128 to 140 degrees, it is ideally 134 degrees in women and 130 degrees in men. Other important reference measurements from this view include the nasion-medial canthal distance, which should be approximately 15 mm, and the nasion-corneal plane distance, which is approximately 11 mm.

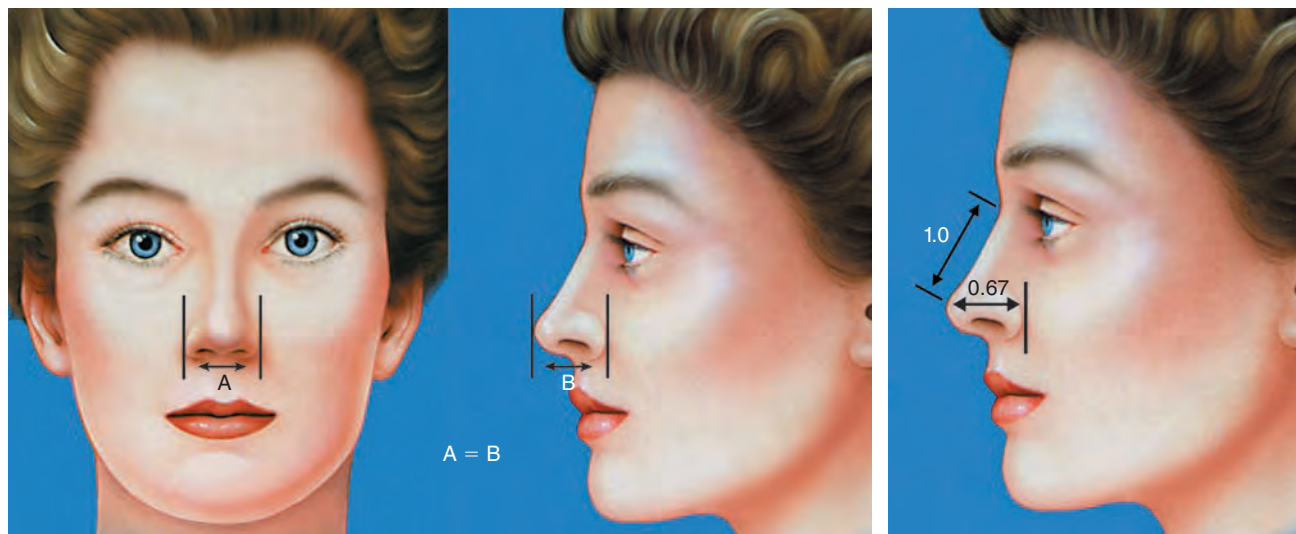


While still concentrating on the lateral view, it is important to remember that the perceived nasal length and tip projection can be altered by the position of the aforementioned nasofrontal angle. For instance, if the nasofrontal angle is positioned more anteriorly and superiorly than normal, the nose will appear elongated, the nasofacial angle will be decreased, and the tip projection will appear diminished (*yellow line*). Conversely, if the nasofrontal angle is too posteriorly and/or inferiorly positioned, the nose will appear shorter, and the tip more projecting (*red line*). Ideally, the nasofacial angle (as defined by the junction of the nasal dorsum with the vertical facial plane) should measure 32 to 37 degrees.

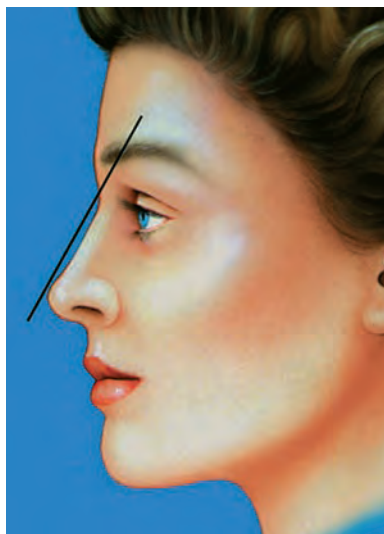


Tip projection is addressed next, still from the lateral view. Although several methods have been described to assess this, we prefer the following two ways. In a patient with normal upper lip projection, we begin by drawing a line from the alar-cheek junction to the tip of the nose. The tip projection is considered normal if 50% to 60% of the tip lies anterior to a vertical line adjacent to the most projecting part of the upper lip. The tip is considered to be overprojected if greater than 60% of the

tip lies anterior to this reference line and may therefore require deprojection. Conversely, if less than 50% of the tip lies anterior to the line, the projection may need to be augmented (in any number of ways).

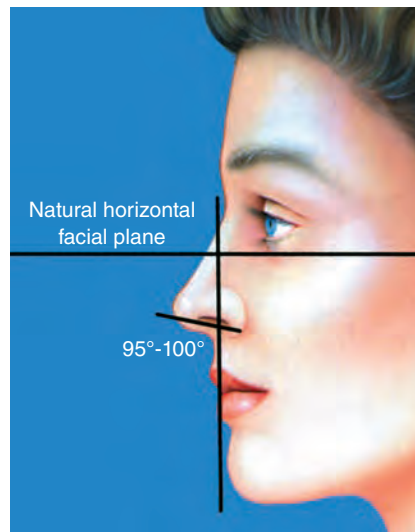


The second method we use to help assess tip projection is by comparing it to the alar base width (they should be equal), and by comparing the ratio of nasal length (RT) to the tip projection (alar base to tip). In the latter, the ideal tip projection is $0.67 \times \text{RT}$.

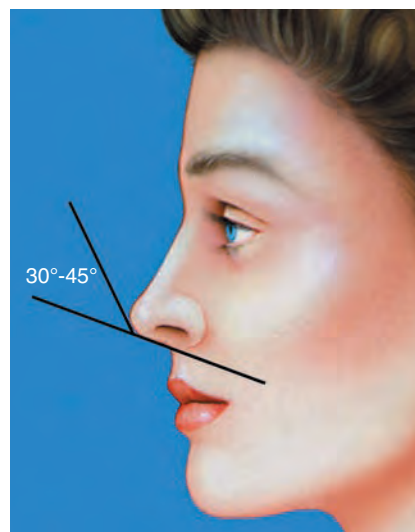


After the tip projection is assessed, the dorsum is analyzed. The aesthetic nasal dorsum should lie approximately 2 mm behind and parallel to a line from the radix to the tip-defining points in women, but in men it should approach this line to avoid feminizing the nose.

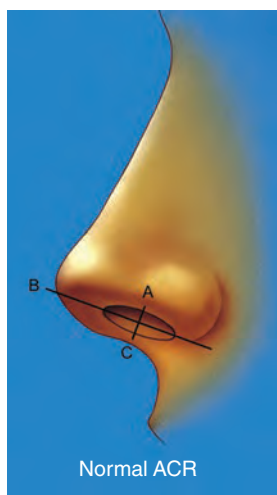
The degree of supratip break is appraised when the nasal tip projection and dorsum are evaluated. A slight supratip break is preferred in women, but not in men. This gives the nose more definition and distinguishes the dorsum from the tip.



The nasolabial angle is used to determine the degree of tip rotation. This angle is obtained by measuring the angle between a line coursing through the most anterior and posterior edges of the nostril and a plumb line dropped perpendicular to the natural horizontal facial plane. This angle should be between 95 and 100 degrees in women and between 90 and 95 degrees in men.



The nasolabial angle should not be confused with the columellar-labial angle, which is formed at the junction of the columella with the upper lip–infratip lobule. Increased fullness in this area is usually caused by a prominent caudal septum and gives the illusion of increased rotation, even though the nasolabial angle is normal. This angle is normally 30 to 45 degrees.



The alar-columellar relationship is then assessed in the lateral and frontal views. A line is drawn through the long axis of the nostril, and a perpendicular line is drawn from alar rim to columellar rim that bisects this axis. The distance from the alar rim (point A) to the long axis line (point B) should equal the distance between the long axis line to the columellar rim (point C) if the alar-columellar relationship is normal ($AB = BC \approx 2 \text{ mm}$). If these measurements are not normal, the deformity can be categorized into six classes. Classes I to III describe increased columellar show, classes IV to VI demonstrate decreased columellar show (described later in the section on operative techniques). These may be treated differently depending on the class of deformity.

Again, these proportions generally apply to white women. Generally, the male face tends to have a squarer, less rounded appearance, with stronger, more pronounced features. The key differences in men are as follows:

The male dorsum tends to be straighter and wider, with decreased concavity at the superciliary ridges.

The male nasal dorsal profile should hug a line drawn from the radix to the tip-defining points instead of falling 2 mm behind and parallel to this line, as in women.

There should be no supratip break.

Tip rotation in men is slightly less than in women (90 to 95 degrees versus 95 to 100 degrees in women), because men have less nostril show as a result of a longer nasal dorsum.

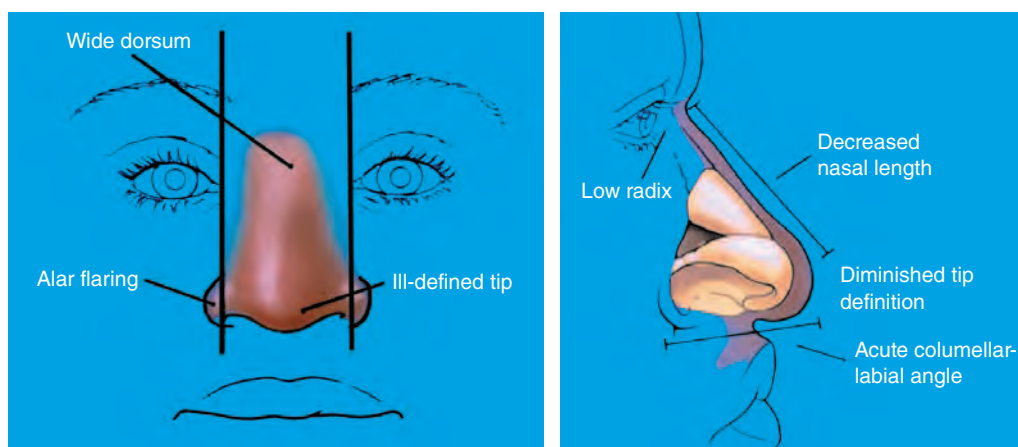
Men have a stronger chin, abutting the plumb line drawn tangential to the upper lip; in women the chin is 2 to 3 mm posterior to this line.

In general, men have a broader, more bulbous nasal tip.

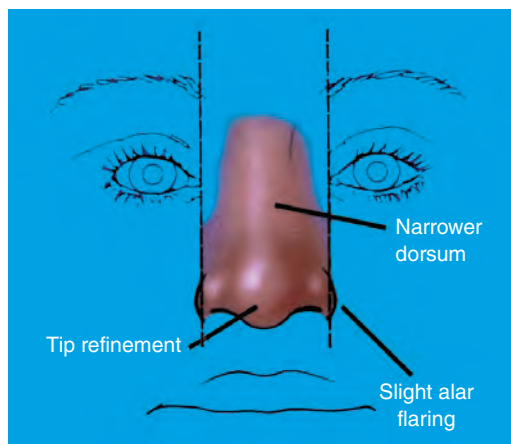
Male skin is usually thicker, masking the amount of perceivable change.

It is important to remember that these proportions are general guidelines and can vary tremendously between different individuals. In addition, it is important to consider the patient's ethnicity and culturally accepted aesthetic ideals as rhinoplasty is becoming increasingly more popular amongst different ethnic groups.

Rhinoplasty in Patients of African Descent



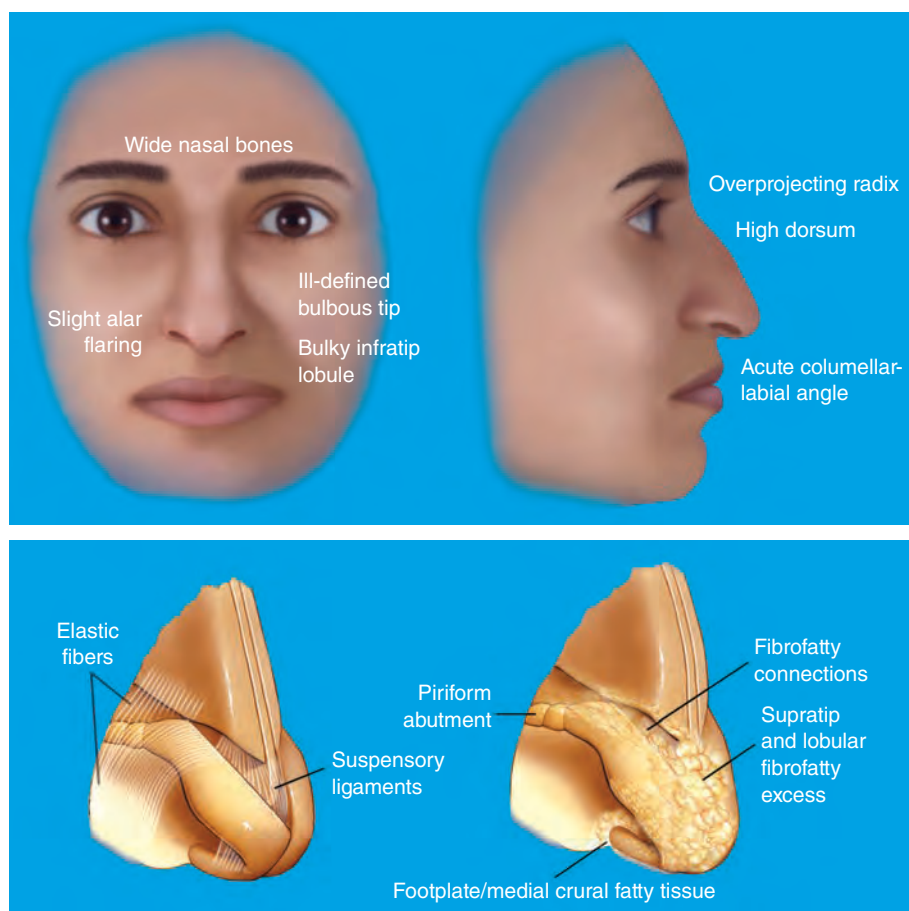
Compared with the nasal ideals for whites, the noses of patients of African heritage typically feature a wide, low nasal dorsum, decreased nasal length and tip projection, poor nasal tip definition, an acute columellar-labial angle, and alar flaring.



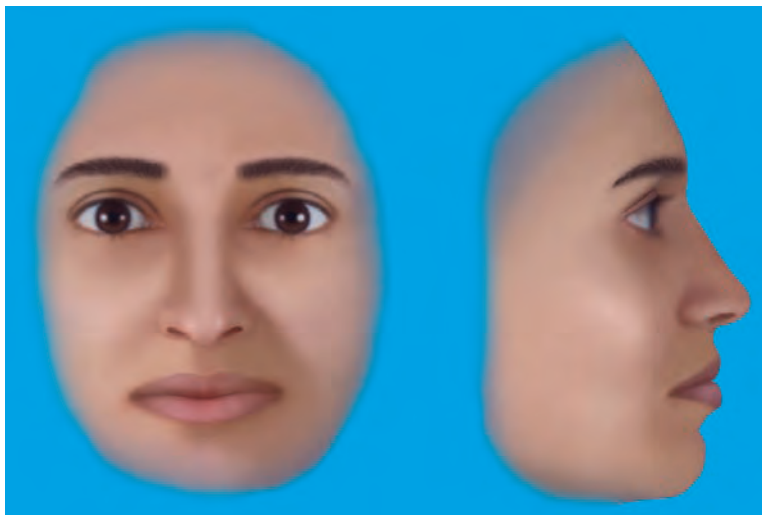
The goals of rhinoplasty in a patient of African descent include achieving a narrower, straight dorsum, improved tip projection and definition, decreasing alar flaring and alar base width. Improvement of the typically low nasal dorsum may require cartilage grafting. Tip definition is improved by suture techniques and cartilage grafting, as needed.

Rhinoplasty in Patients of Middle Eastern Descent

The complex nasal morphology of the Middle Eastern nose warrants discussion: it demonstrates a combination of features seen in individuals of African, Mediterranean, and Hispanic origin. The Middle Eastern nose features thick, sebaceous skin and is most prominent at the supratip. The radix may overproject, the bony and middle vaults tend to be wide, and a significant dorsal hump is common. The lower lateral cartilages can feature malposition of the lateral crura and weak middle and medial crura, resulting in various characteristic deformities of the tip, including poor tip definition, underprojection of the tip, or a droopy tip with an acute columellar-labial angle. The tip deformities may be exacerbated by hyperdynamic depressor septi nasi muscles. Nasal deviation and nostril asymmetry are also common.



Achieving ethnic nasofacial harmony in a Middle Eastern patient includes moderate dorsal hump reduction, narrowing of the wide nasal bones, debulking of soft tissue, particularly at the supratip, modest correction of underrotation and underprojection of the nasal tip, improvement of tip definition, repositioning of the alar bases, and correction of nostril asymmetries.



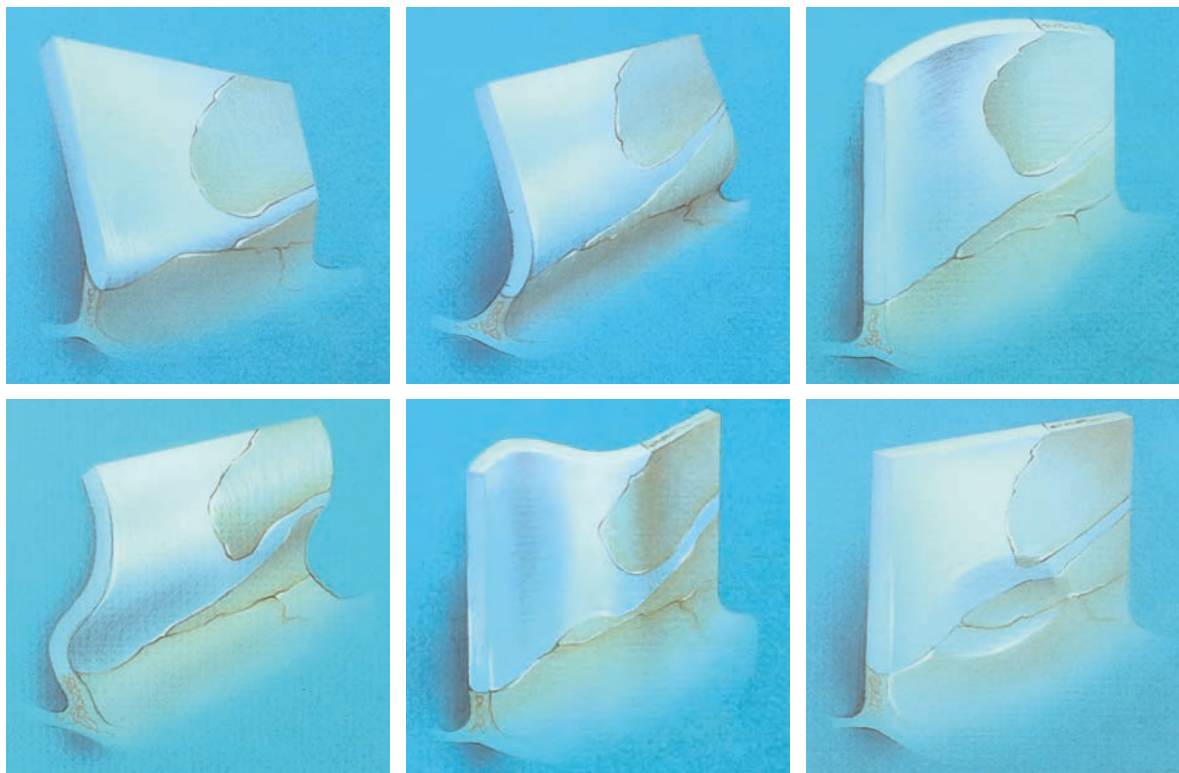
These guidelines are meant only as a systematic method of analysis with general proportions and relationships. Each nose should be individualized to the patient's facial structure and tempered by the patient's desires to create facial harmony and balance.

Intranasal Examination

The final part of the preoperative analysis of the rhinoplasty patient is the intranasal examination. This is performed with a nasal speculum, headlight, and vasoconstriction. The septum, turbinates, and external and internal nasal valves are evaluated for obvious deformities or pathology. Septal perforation or deviation should be identified. Septal deviation can involve deviation of the septal cartilage, perpendicular plate of the ethmoid bone, or vomer and can cause obstruction of one or both of the nasal airways, along with external deviation of the nose. Guyuron et al classified septal deviation as follows:

1. Septal tilt 40%
2. Anteroposterior C-shaped deviation 32%
3. Cephalocaudal C-shaped deviation 4%
4. Anteroposterior S-shaped deviation 9%
5. Cephalocaudal S-shaped deviation 1%
6. Localized deviation or septal spur 14%

Septal tilt is the most common type, where the quadrangular cartilage and perpendicular plate of the ethmoid are straight but the quadrangular cartilage is tilted to one side internally and to the opposite side externally. Hypertrophy of the inferior turbinate contralateral to the side of internal deviation is usually present.



If inferior turbinate hypertrophy is identified, the underlying cause should be investigated. Turbinate enlargement can be congenital or acquired. If acquired, it may be the result of autonomic, environmental, medical, or anatomic factors. A complete workup, especially a detailed history, is essential. The external nasal valve should be examined for patency on normal and forced inspiration. Collapse of the alar rim from weakness of the lower lateral crus should be evaluated. A Cottle test should be performed to assess the internal nasal valve. Septal deviation or midvault collapse can contribute to airway obstruction in this area. Finally, nasal polyps or masses may require further evaluation and treatment.

Preoperative Planning

After the initial history-taking and physical examination, the procedure is fully discussed with the patient. The risks and benefits of the procedure are detailed, and all questions are answered. The patient is provided with a written, detailed estimate of surgical charges with complete explanations by the practice's billing staff. We ask the patient to return for a second clinic visit to review the previous discussion and to assess the patient's psychological and emotional stability to ensure that he or she is a good surgical candidate. We also reiterate the deformities we plan to correct and answer any further questions. The consent form is reviewed again and signed. Our patients sign a form accepting financial responsibility. A preoperative instruction sheet and a list of medications to be avoided are also provided.

Preoperative Instructions

Two Weeks Before Surgery

1. Some medications can interfere with anesthesia and cause undesirable side effects that can affect your surgery. Please read over the enclosed medication information list and let us know if you take any of them. Aspirin should not be taken at least 2 weeks before or after surgery. Tylenol is a good medication to take for any aches or pains you may have before surgery.
2. Smoking will affect how you heal. It is very important to stop smoking 4 weeks before your surgery.
3. If you develop a cold, facial sore, or any other illness before surgery, please notify us.
4. If you are having surgery as an outpatient, please be certain that arrangements have been made for a responsible adult to drive you to the surgery center and pick you up after your surgery and to stay with you for the first 24 hours.

Evening Before Surgery

1. Shampoo your hair and wash your face. Do not use conditioner or hair spray after shampooing.
2. Make some Jell-O and/or soup for after surgery.
3. Get a good night's rest.
4. Do not eat or drink anything after midnight.

Morning of Surgery

1. Arrive at the surgery center/hospital by _____.
2. Do not eat or drink anything if your surgery is scheduled before noon. If your surgery is scheduled after noon, you may have coffee or tea and dry toast no later than 6 hours before your scheduled surgery time.
3. Do not wear wigs, hairpins, hairpieces, or jewelry. Dress in old, loose, comfortable clothes. Do not wear pullover tops or pantyhose. Wear slip-on shoes.
4. Have someone drive you to the surgery center and make certain a responsible adult will be available to take you home and stay with you for 24 hours. Put a pillow and blanket in the car for the trip home.

We convert our operative plan into a graphic representation (using Gunter Graphics) to assist us in the operating room. Any modifications to the plan are documented intraoperatively on a worksheet, transposed to the graphic depictions afterward, and placed in the patient's chart for future reference.

On the morning of surgery, any final questions are answered, and the patient is taken to the operating room and positioned supine on the operating table. Noninvasive hemodynamic monitoring devices are placed, and all pressure points are padded appropriately. One gram of cefazolin is administered intravenously for perioperative antibiotic prophylaxis. We prefer general anesthesia for our patients, although certainly local anesthesia with intravenous sedation may be used. After anesthetic is ad-

ministered, the nasal vibrissae are clipped and the nares are swabbed with povidone-iodine (Betadine) solution.

We mark a line for the anticipated incision (transcolumellar stairstep, if using an open approach) and then inject approximately 10 ml of 1% lidocaine with 1:100,000 epinephrine into the intranasal mucosa, along the septum, and into the soft tissue envelope. The inferior turbinates are injected if we anticipate performing an inferior turbinoplasty.

Location and Volume Distribution of 1% Lidocaine With 1:100,000 Epinephrine

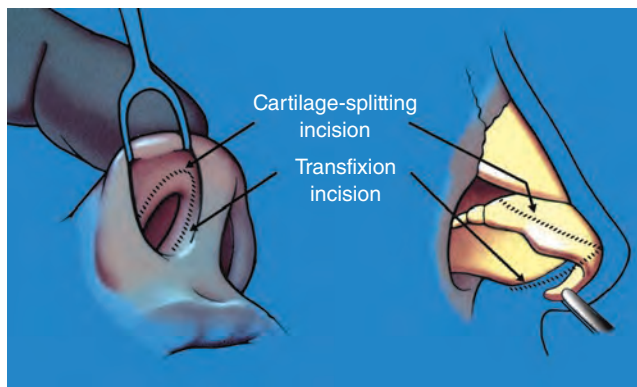
Location	Amount (ml)
Vestibules/aperture	2
Dorsum	1
Lateral walls	2
Tip/columella	2
Distal septum	2
Inferior turbinates	1
TOTAL	10

After the local anesthetic is injected, the nasal mucosa is shrunk with cottonoid pledgets soaked in oxymetazoline. A drop of methylene blue is added to the oxymetazoline to differentiate this from the local anesthetic and prevent inadvertent injection. We do not use 4% cocaine, because comparable hemostasis can be obtained using lidocaine with oxymetazoline, avoiding the use of a controlled substance with potential cardiac effects that may be seen with cocaine, although certainly both have proved effective. A throat pack is placed in the oropharynx to prevent possible ingestion of blood during surgery, which could lead to postoperative nausea and vomiting. At this point the patient is prepared and draped for surgery.

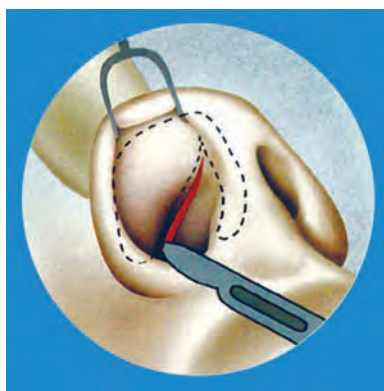
Operative Technique

Incision: Endonasal Approach

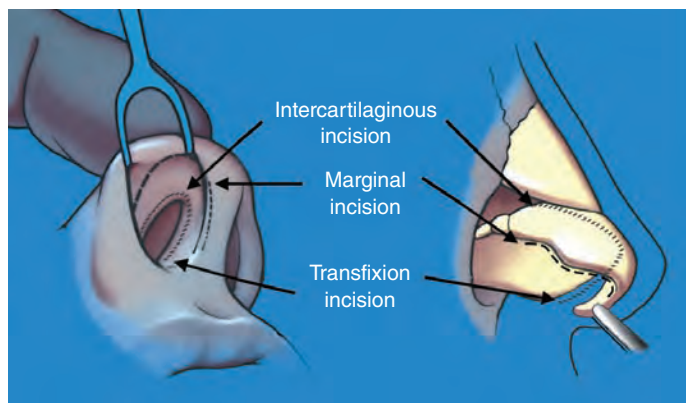
When deciding on what incision to use in the endonasal approach, once again the surgeon must employ accurate preoperative nasofacial analysis. Because the objective is to minimize incisions, any incision that can be used to access multiple areas should be used so that separate incisions become unnecessary. For example, if an alar contour graft will be needed as well as rasping of a dorsal hump, the access incision can be made on the same side as the alar contour graft.



There are two basic techniques for access in endonasal rhinoplasty: nondelivery and delivery. The nondelivery approach can use either a transcartilaginous (cartilage-splitting) incision or a retrograde or eversion incision. The transcartilaginous incision is made several millimeters cephalad to the caudal margin of the lateral/middle crura, thus preserving a rim strip to support the ala. Double hook retraction combined with digital alar eversion provides the necessary exposure to facilitate this.



The vestibular skin is carefully dissected off the overlying cartilage to expose the cartilage for resection. In the retrograde approach, the vestibular incision is made at the most cephalic margin of the lower lateral cartilage rather than through it. Again, a double hook retractor and digital manipulation are used to facilitate exposure. The theoretical advantage to this incision is that it maintains the caudal alar margins and prevents potential scar contracture deformities in this area.



The delivery approach is used in cases in which moderate tip modifications are necessary, especially if the angle of divergence (as a measure of tip bifidity) is large. Again, using a double hook retractor in the ala and digital counterpressure to expose the cartilaginous margins, a No. 15 blade scalpel is used to create an intercartilaginous incision starting laterally just above the cephalic margin of the lateral crus. It is extended medially approximately 2 mm caudal and parallel to the limen vestibule. An infracartilaginous incision is then created along the caudal margin of the lower lateral cartilage (from lateral crus to medial crus), ending at the columellar-lobular junction. Sharp scissors are then used to dissect the soft tissue off the cartilage just above the perichondrium, including over the dorsal cartilaginous septum. The same incision is made on the contralateral side, and the two incisions are connected in the midline over the anterior septal angle, ending in a hemitransfixion incision. If necessary, this may be extended to a full (complete) transfixion incision. The lower lateral cartilage is then dissected free from the surrounding tissue and “delivered” outside the incision. If there is difficulty delivering the cartilages, the incisions may be extended and the soft tissue undermined to a greater extent. Once the cartilages (and domes) are delivered, modifications may be made.



55-1 Open approach
to primary
rhinoplasty

Incision: Open Approach



In the open approach, we use a stairstep transcolumellar incision across the narrowest portion of the columella with a No. 15 blade scalpel. The stairstep is important, because it helps to provide landmarks for accurate closure, prevents linear scar contracture, and camouflages the scar.



Bilateral infracartilaginous extensions are then performed. These begin first from lateral to medial along the caudal border of the lower lateral cartilage, then from medial to lateral, from the level of the transcolumellar incision to the apex of the middle crus, where it joins the lateral incision. A double-pronged skin hook placed along the alar rim is used to perform this maneuver. External digital pressure is used to evert the ala and augment visualization of the lateral crus.

Important points during this step are as follows:

- Take your time—most mistakes are made trying to obtain exposure.

- Keep the incisions superficial to prevent unnecessary injury to the underlying cartilages.

- Identify the caudal border of the lower lateral cartilage before cutting.

Skin Envelope Dissection



Dissection of the skin envelope should be done meticulously. As mentioned previously, it is important to perform the dissection in the supraprichondrial/submusculoaponeurotic plane, because this avoids injury to the arterial, venous, and lymphatic supply to the nose. There should be no residual soft tissue remaining on the lower lateral cartilages if the dissection is performed properly. This dissection is then continued in a superior direction, exposing the cartilaginous dorsum and ULCs. At the level of the bony pyramid, the scissors are traded for a Joseph periosteal elevator, which continues the dissection in a subperiosteal plane to the radix. It is im-

portant to limit the extent of the subperiosteal dissection to just the area of the bony dorsal hump that needs to be addressed; otherwise, all the periosteal attachments to the nasal bones may be disrupted, leading to prolonged wound healing and potential nasal bone malposition, especially after osteotomy.

Key points are as follows:

Take your time—it is easier to go slowly through the correct dissection than to spend more time fixing mistakes from inadvertent mishaps resulting from haste.

Stay just above the perichondrium in the submusculoaponeurotic plane.

Limit lateral subperiosteal dissection over the bony pyramid.

Make certain the ULCs are not detached from the nasal bones by accidental dissection under the nasal bones (rather than on top).

Nasal Dorsum

We prefer to perform component dorsal hump reduction of the osteocartilaginous hump instead of composite reduction because component reduction offers incremental control and greater precision. This process involves four basic steps, after the skin envelope dissection just described:

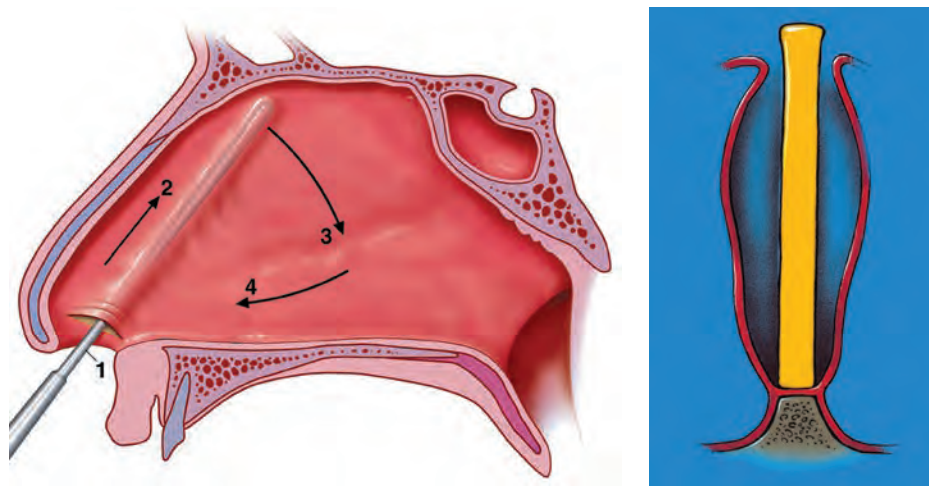
Separation of the ULCs from the septum

Incremental reduction of the septum proper

Incremental dorsal bony reduction (using a rasp)

Three-point palpation test

Separation of the Upper Lateral Cartilages From the Septum



To minimize mucosal trauma that could result in internal nasal valve stenosis or vestibular webbing, it is critical to create bilateral dorsal submucoperichondrial tunnels before embarking on reduction of the dorsal hump. This is done by elevating

the mucoperichondrium of the dorsal septum from caudal to cephalad with a Cottle elevator until the nasal bones are reached. The transverse processes of the ULCs are then sharply separated from the septum using a No. 15 blade scalpel without damaging the mucosa. If necessary, spreader grafts or dorsal grafts can then be placed in this enclosed space, separated from the nasal cavity (later in the case).

Incremental Component Cartilaginous Dorsal Septal Reduction

At this point, the cartilaginous dorsal septum is separated into three components: the septum centrally and the transverse portions of the ULC laterally. The cartilaginous septum is addressed by serially shaving down the dorsal hump deformity with a sharp scalpel under direct vision. This maneuver is done carefully, avoiding damage to the adjacent ULCs. If the septum and ULCs were taken down en bloc, not in component fashion, the patient will end up with a rounded dorsum. Furthermore, if the ULCs were resected to a greater extent relative to the septum, an inverted-V deformity will result. Although reduction of the ULCs is not routinely performed, it may be necessary in certain circumstances. If so, it must be done after the septal cartilaginous hump and bony dorsal hump are addressed. Again, overresection of the ULCs must be avoided to prevent internal nasal valve collapse and long-term dorsal irregularity. Maintaining the transverse portions of the ULC also preserves the dorsal aesthetic lines.

Component Bony Dorsum Reduction



The method of reducing the bony dorsum depends on the amount of deformity that requires resection. Large humps (generally greater than 5 mm) are reduced either by a power burr with a dorsal skin protector or a guarded 8 mm osteotome. For humps smaller than 5 mm, a sharp rasp is used (we prefer a down-biting diamond rasp). When rasping, it is important to maintain a slightly oblique bias to minimize potential mechanical avulsion of the ULCs from the nasal bones. The rasping is done in a controlled, methodical fashion, proceeding along the left and right dorsal aesthetic lines, and then centrally. The nondominant thumb and index finger are used simultaneously for maximum control.

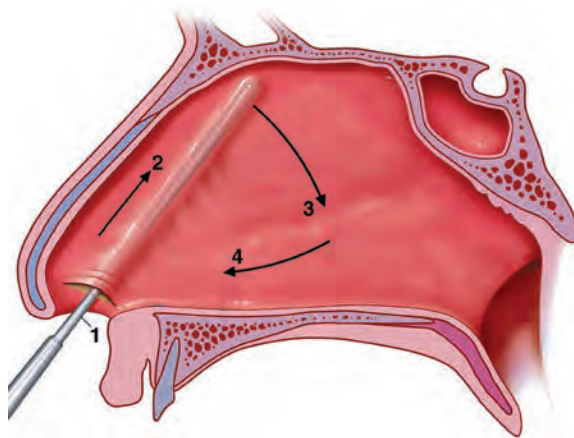
Three-Point Dorsal Palpation Test



The three-point dorsal palpation test is performed repeatedly throughout the component dorsal hump reduction process, after redraping the skin envelope. This test is performed with a saline-moistened dominant index fingertip, which is used to gently palpate the left and right dorsal aesthetic lines, as well as centrally, to detect any dorsal irregularities or contour depressions.

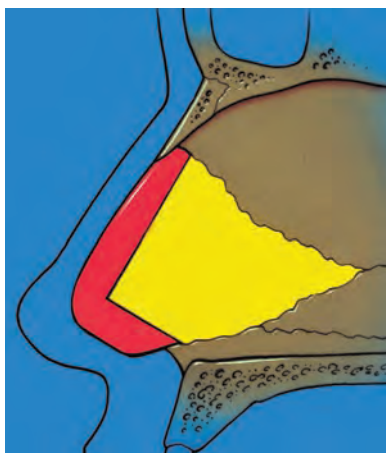
Septal Reconstruction/Cartilage Graft Harvest

If the septum is deformed, or if cartilage is needed for graft construction, the septum is harvested. The septum is ideal for cartilage graft harvest in rhinoplasty because of its close proximity to the operating field and its minimal donor site morbidity. In the endonasal approach, a Killian or hemitransfixion incision is generally used because a full transfixion incision can lead to decreased tip projection, especially if dissected down over the anterior nasal spine.



In the open approach, the cartilage harvest is begun by separating the middle crura, incising the interdomal suspensory ligament, and exposing the anterior septal angle. A No. 15 blade scalpel is used to incise the septal perichondrium, exposing the distinct bluish-gray underlying cartilage (1). A Cottle elevator is used to create a submucoperichondrial plane posteriorly to the perpendicular plate of the ethmoid (2) down to the nasal floor (3) and across the face of the septum (4).

If the dissection is difficult at first, it may be because the improper plane has been accessed, and a deeper plane should be sought. The dissection should be more difficult at the junction of the cartilaginous and bony septum, and therefore one should proceed with caution in this area because perforation of the overlying mucoperichondrium is more likely. It may be advantageous to dissect two separate tunnels, one subperichondrial and one subperiosteal, and then divide the junction sharply to help avoid potential perforation in this area. The same dissection is then performed on the contralateral side. After this is complete, a Vienna speculum is used to directly visualize both sides of the septum to identify underlying deformity and to help achieve exposure for the septal harvest.



When harvesting septal cartilage, it is necessary to preserve an L-strut with 10 mm of dorsal septum and 10 mm of caudal septum retained to support the lower nasal vault. After the cartilage is resected, it is preserved in saline solution. Any residual deviations in the ethmoid or vomer are rongeured or resected, and any mucosal perforations are repaired.

Correction of the Deviated Nose

Septal deviation, described previously in this chapter, can manifest as external deviation of the nose. We classify the deviated nose into three basic types: caudal septal deviations, concave dorsal deformities, and concave/convex dorsal deformities.

Classification of the Deviated Nose

Type I: Caudal septal deviation

- a. Straight septal tilt
- b. Concave deformity (C-shaped)
- c. S-shaped deformity

Type II: Concave dorsal deformity

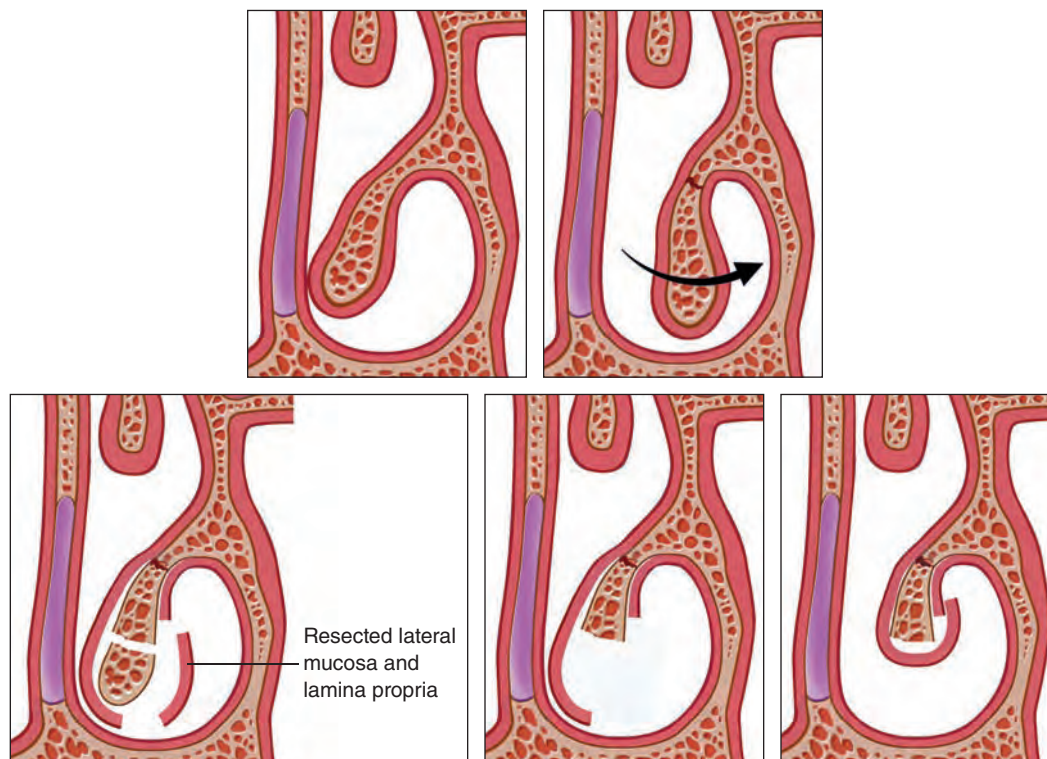
- a. C-shaped dorsal deformity
- b. Reverse C-shaped dorsal deformity

Type III: Concave/convex dorsal deformity (S-shaped)

Correction of the deviated nose is based on the following principles:

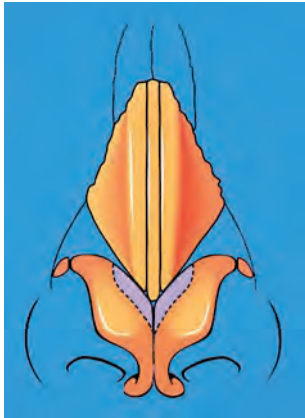
1. The open approach to expose all deviated structures
2. Release of all mucoperichondrial attachments to the septum, especially the deviated part
3. Straightening of the entire septum while maintaining a 10 mm caudal and dorsal L-strut
4. Restoration of long-term support with buttressing caudal septal batten or dorsal spreader grafts
5. Outfracture or submucous resection of hypertrophied anteroinferior turbinates, if necessary, for correction of the deviated septum
6. Precisely planned and executed external percutaneous osteotomies

Inferior Turbinoplasty



In patients with symptomatic nasal airway obstruction caused by inferior turbinate hypertrophy that is refractory to medical management, an inferior turbinoplasty is performed. This can be done by turbinate outfracture, submucous morselization of the turbinate bone, or submucous resection of the anterior one third to one half of the inferior turbinate. The submucous resection is done by developing medial mucoperiosteal flaps, exposing the conchal bone using a Cottle elevator, and sharply resecting the proper amount. The flaps are replaced after this resection without the need for suture repair. It is important to note that the extent of the conchal bone resection is limited to the anterior portion. This is done mainly to avoid complications of bleeding if the posterior portion is resected.

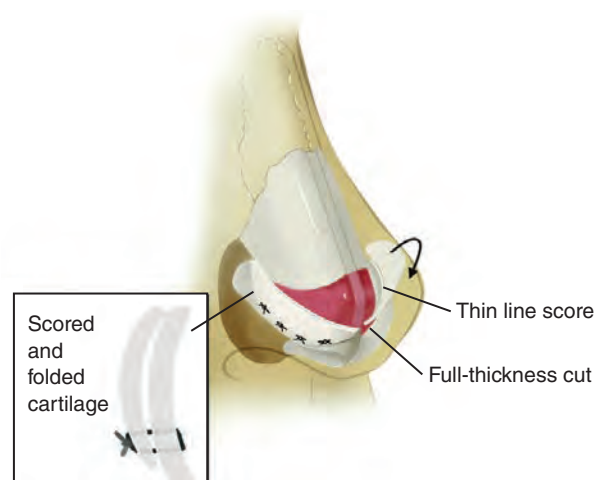
Cephalic Trim



In cases in which the tip is boxy or bulbous and requires better refinement and definition, when the tip-defining points need medialization, or when rotation of the tip is desired, a cephalic trim is performed. This is done by using a caliper to measure along the caudal margin of the lower lateral cartilage to preserve a 6 mm rim strip. After this is demarcated, the cephalic portion of the middle and lateral crura is resected. The cartilage is preserved for possible use later in the case.

Lower Lateral Crural Turnover Flap

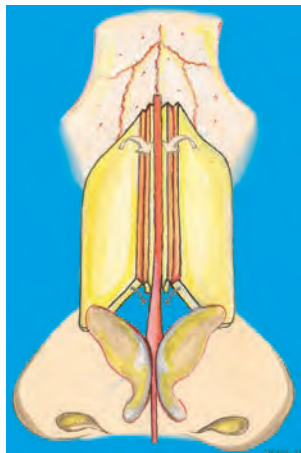
A lower lateral crural turnover flap is another useful technique to address paradoxical fullness while providing additional support to the lower lateral cartilages. It is beneficial for deformities, weakness, and collapse of the lower lateral crura and can also be used to improve lower lateral crural strength during tip reshaping. However, there must be sufficient lower lateral crura to leave a 6 mm rim strip. It can be used in combination with other external valve and alar arch supporting techniques.



A horizontal line that bisects the cephalic aspect of the lower lateral crus from the 6 mm rim strip is marked with methylene blue. The cephalic aspect is dissected from the underlying vestibular skin inferiorly to this horizontal line and then the line is scored with a No. 15 blade and 2 mm full-thickness cuts at the medial and lateral ends of the horizontal line are performed. The flap is turned over and its caudal edge is secured with multiple horizontal mattress sutures.

Autospreader Flaps

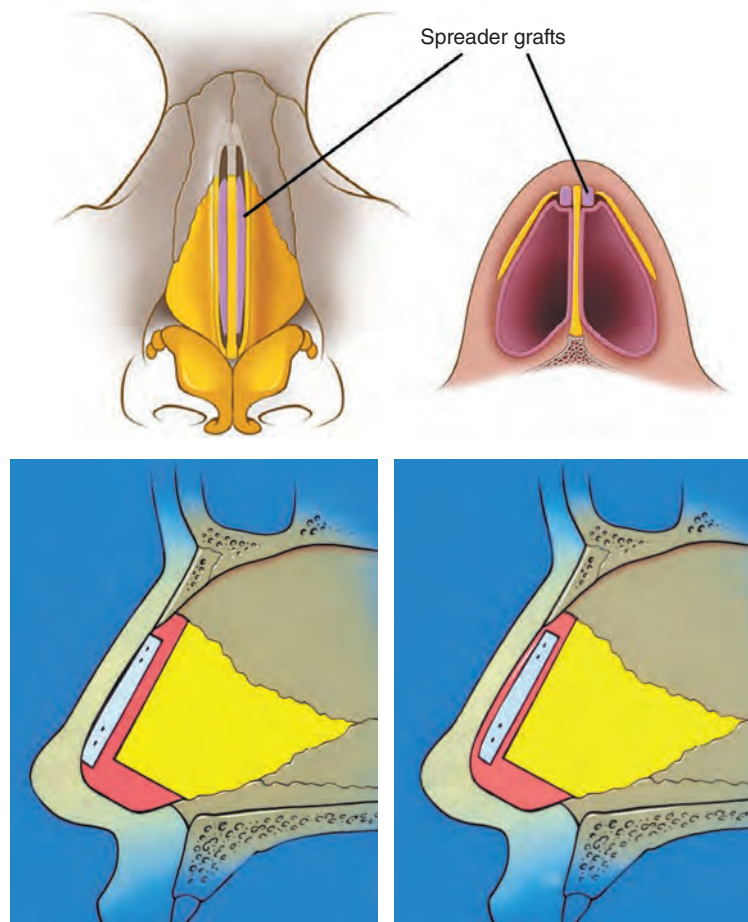
Reduction of the nasal dorsum may compromise the internal nasal valves. Even a slight decrease in the angle between the upper lateral cartilage and the septum can lead to a significant increase in nasal airway resistance. Patients who have a high, narrow dorsum, a weak middle vault, short nasal bones, or a positive Cottle test preoperatively are at risk for developing postoperative internal nasal valve dysfunction and consequently, nasal airway obstruction.



In these cases, the use of autospreader flaps fashioned from the dorsal aspects of the upper lateral cartilages can maintain patency of the internal nasal valves while preserving the dorsal aesthetic lines. After component dorsal hump reduction has been performed, the overprojecting dorsal aspect of the upper lateral cartilages is incised, leaving the underlying mucoperichondrium intact. This dorsal portion of the upper lateral cartilage is then rotated internally approximately 90 degrees to lie between the septum and the medial edge of the upper lateral cartilages supported as a flap by its attachment to the mucoperichondrium. The new dorsal edges of the upper lateral cartilages are then sutured with 5-0 PDS at the midline to the rotated autospreader flaps and secured along the septum.

Limitations using this technique include patients with a deviated dorsal septum or asymmetrical dorsal aesthetic lines, a weak bony vault or lower lateral cartilages, a deviated nasal tip, or lack of tip support. Spreader grafts are indicated in these cases.

Spreader Grafts



Spreader grafts can be used to help stent open the internal valve, stabilize the septum, and preserve the dorsal aesthetic lines. These grafts usually are obtained from septal cartilage and are designed to measure approximately 25 to 30 mm by 3 mm. Their cephalic ends can be trimmed obliquely to fit snugly underneath the bony dorsum and their caudal ends can be placed either at the septal angle (if lengthening of the nose is not desired) or extending past it (if lengthening is desired). Furthermore, the grafts can be placed in a visible position (secured in a higher position along the septum) or in an invisible position (positioned lower). We secure the grafts with 5-0 PDS in horizontal mattress fashion.

Tip Modification

Altering Tip Projection

It is important to recognize the factors that contribute to tip projection in situ before embarking on a discussion on how to precisely alter tip projection. There are six key anatomic elements to tip projection:

1. The supporting ligament between the anterior septal angle and the overlying dermis
2. The length and strength of the lower lateral cartilages
3. The suspensory ligament bridging the anterior septal angle
4. The fibrous connections between the upper and lower lateral cartilages (and septum)
5. The abutment of the cartilages with the piriform aperture
6. The anterior septal angle

Alteration of any of these anatomic structures can result in incremental changes in tip projection.

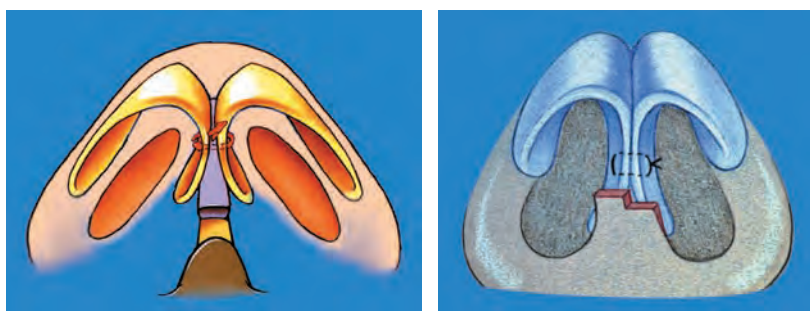
A graduated approach to tip projection is predicated on precise, incremental, non-destructive changes made to the tip complex, beginning with placement of a columellar strut graft, proceeding with suture modification, and finishing with the use of tip grafts.

The algorithm begins with placement of a columellar strut graft. This strut is usually fashioned from septal cartilage, and measures approximately 25 by 4 mm. It can be placed in a “fixed” (secured to the anterior maxilla) or a “floating” (not secured to the maxilla) fashion. This strut not only controls the columellar profile, but also bolsters tip projection and unifies the tip complex. The strut is placed by dissecting a pocket between the medial crura. A double-pronged hook is then used to gently retract the middle crura anteriorly to set the desired projection and symmetry. The strut is positioned in the pocket, and a 25-gauge needle is used to stabilize this configuration. Most are left floating on a soft tissue pad between the base of the pocket and the nasal spine. Medial crural sutures (described previously) are placed in horizontal mattress fashion to secure the complex. Further medial crural sutures can be placed more caudally on the medial crura to control flaring, if necessary.

The next step in altering tip projection involves suture techniques, which can increase tip projection by 1 to 2 mm. Suture techniques are ideal for controlling cartilage in a precise, nondestructive fashion. Although the choice of a particular suture material is surgeon dependent, the underlying premise is to choose a material that one can easily work with that will hold the cartilage in its altered position long enough to allow the natural fibrotic reaction to solidify the result. Although many suture techniques can be performed in both open and closed rhinoplasty (with cartilage delivery), we find

them easier to place using the open method, because it affords greater visualization and ease of placement. We commonly use four suture techniques to alter projection and shape the nasal tip:

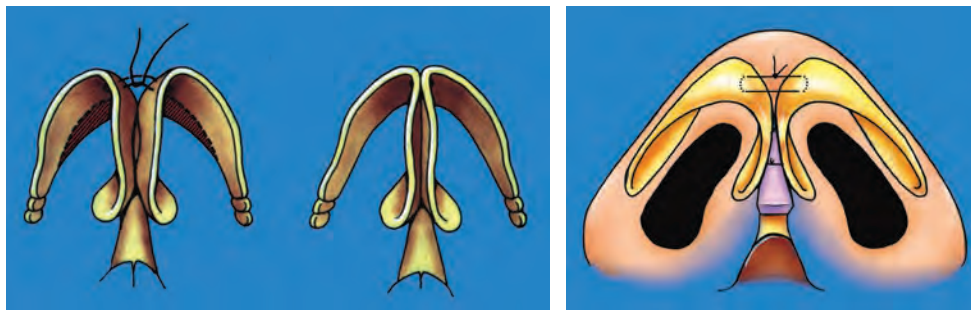
1. Medial crural
2. Medial crural septal
3. Interdomal
4. Transdomal



Medial crural sutures serve to unify the medial crura of the lower lateral cartilages and are frequently used in conjunction with a columellar strut (to help stabilize the strut). They can also be used to straighten out flaring of the medial/middle crura (either on the caudalmost aspect or near the domal area), thereby effecting an increase in projection, albeit to a limited degree. We generally use 5-0 PDS suture in horizontal mattress fashion for this technique; however, the suture choice can vary by individual preference.



Medial crural septal sutures anchor the medial crura to the caudal septum, and can alter projection as well as rotation. They are often used in conjunction with columellar struts. We frequently use 5-0 clear nylon suture in spanning fashion for this technique.



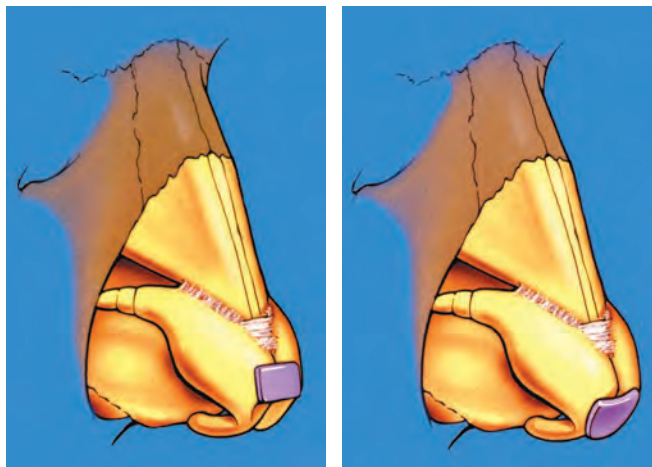
Interdomal sutures are placed through the medial walls of the domes in mattress fashion and are tied to narrow the interdomal distance. This results in both an increase in tip refinement and an increase in projection.



Transdomal sutures are placed across the dome of the middle crura in mattress fashion so that the vestibular skin is not perforated. Local anesthetic can be used to hydrodissect a plane between the cartilaginous dome and the adherent underlying mucoperichondrium to help prevent inadvertent incorporation into the suture bite. We generally use 5-0 PDS in horizontal mattress fashion and leave the knots on the medial aspect of the dome. These sutures can be made asymmetrical to correct anatomic asymmetries, if necessary. They can be fashioned with one end left long on each side, and then subsequently tied together in a spanning configuration (resembling an interdomal suture) to narrow the tip-defining points. It is important, however, to prevent overtightening of this suture, which can result in an unnaturally sharp tip-defining point.

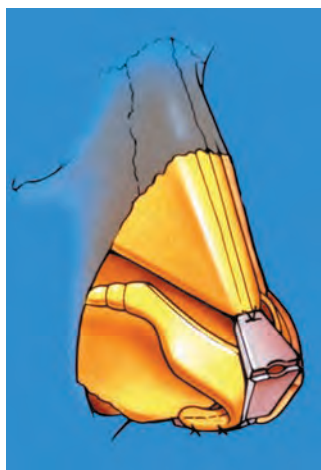
If more tip projection or definition is desired after the preceding maneuvers, tip grafts may be used. We find it easier to place these grafts using the open approach, because it allows excellent visualization, precise placement, and facilitates subsequent manipulation, if necessary. It should be noted that grafts, in general, have a tendency to be visible, so their use is reserved only for the patient in whom the prior, more predictable methods do not result in satisfactory tip projection. There are three general types of tip grafts:

1. Onlay tip grafts
2. Infratip lobular graft
3. Anatomic tip graft

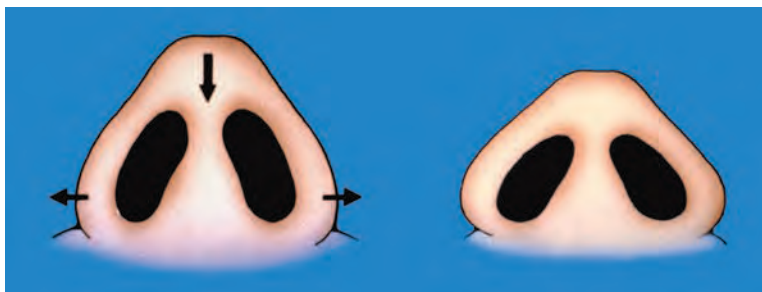


The onlay tip graft can be fashioned from any type of cartilage, although we find that the cartilage obtained from the cephalic trim harvest works exceptionally well. This graft is placed in a position overlying the dome of the middle/lateral crura and fixed in place using the techniques just described. We generally use 5-0 PDS suture for this, with the knots hidden underneath the dome.

The infratip lobular graft is positioned with its superior margin overlying the dome and tip-defining points and extending inferiorly a variable distance, usually 10 to 12 mm. It is usually shield-shaped, and has rounded graft edges to avoid a visible and palpable step-off. This graft increases infratip lobular definition and projection, and is secured in the same fashion as described previously.



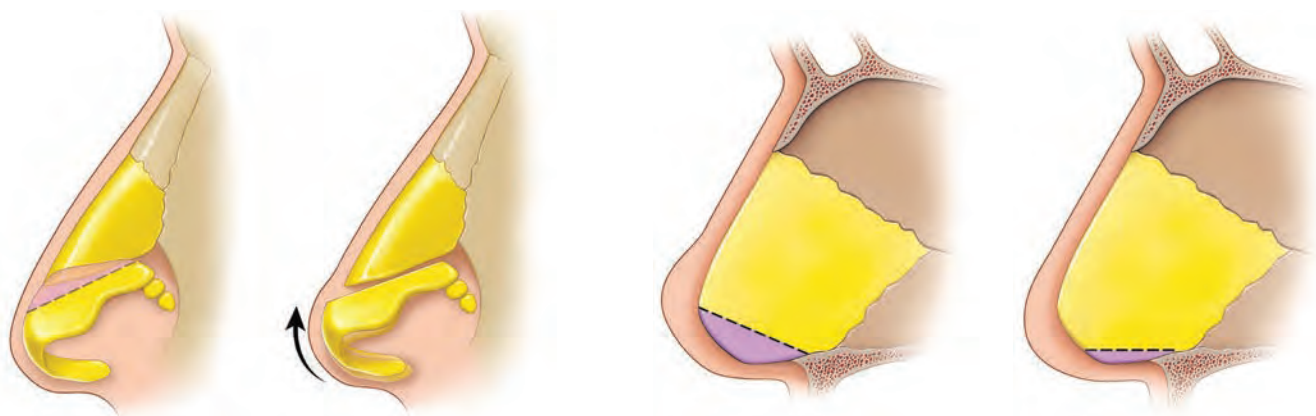
The anatomic tip graft is a more aggressive type of graft that we generally use in difficult primary rhinoplasties, thick-skinned patients, and secondary rhinoplasties with inadequate tip projection. Its superiormost aspect is anchored to the ULCs and its inferiormost aspect secured to the caudal margin of the medial crura. It is essentially a combination graft and can be visible, so it must be placed carefully.



When trying to *decrease* nasal tip projection, once again it is important to realize the anatomic factors that contribute to tip projection in the first place. If the support derived from the fibroelastic and ligamentous attachments is disrupted, tip projection becomes primarily dependent on the length and strength of the lower lateral cartilages. Therefore, in the open approach, if the skin envelope has been undermined and these fibroelastic tissues have been severed, the primary means of decreasing tip projection lies in altering these lower lateral cartilages. This may include techniques such as transection, setback, and resuturing of the medial or lateral crura. It is important to recognize that if the tip projection is decreased significantly, alar flaring or columellar bowing may result, which would necessitate concomitant correction.

Altering Tip Rotation

Using the nasofacial analysis techniques described, rotation is evaluated generally by the nasolabial angle. This angle, found by measuring the angle between a line coursing through the most anterior and posterior edges of the nostril and a plumb line dropped perpendicular to the natural horizontal facial plane, should be between 95 and 100 degrees in women and between 90 and 95 degrees in men.

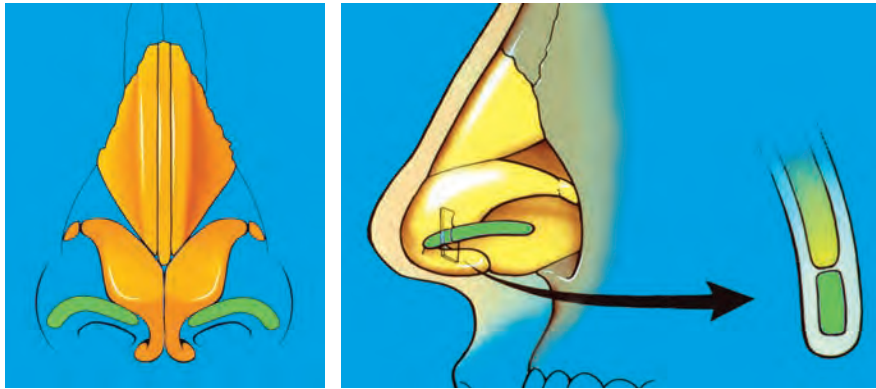


When changing tip rotation, the extrinsic forces holding the tip at its current angle must be released. This is generally done by severing the connection between the lower and upper lateral cartilages. This frequently takes the form of a cephalic trim, as described previously. Furthermore, the fibrous attachments of the medial crura and the caudal septum can be transected to release tension on the nasal tip and allow for more cephalad rotation. This is generally achieved by resecting a variable amount of the caudal septum. This maneuver can also affect tip projection.

Depending on the amount of tip rotation, it may be necessary to perform a limited resection of the nasal mucosa and membranous septum to maintain proper nasal balance and harmony. After the tip is rotated, its position is maintained with suture techniques (medial crural septal sutures) and/or a columellar strut or septal extension graft.

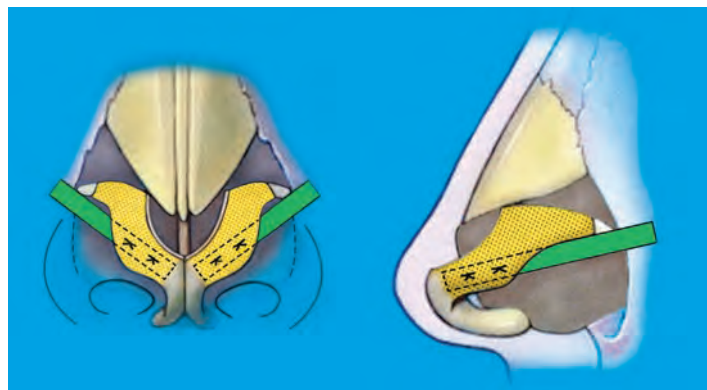
Alar Rims

Alar Contour Grafts



Alar contour grafts are used as a simple and effective method to correct and prevent alar notching or retraction, and facets of the soft tissue triangles. A subcutaneous pocket below the infracartilaginous incision and parallel to the alar rim is created with dissection scissors. The pocket should span the length of the deformity and extend 3 mm to each side of it. An alar contour graft is typically 4 by 10 mm, but it may be need to be larger, depending on the size of the deformity.

Lateral Crural Strut Grafts

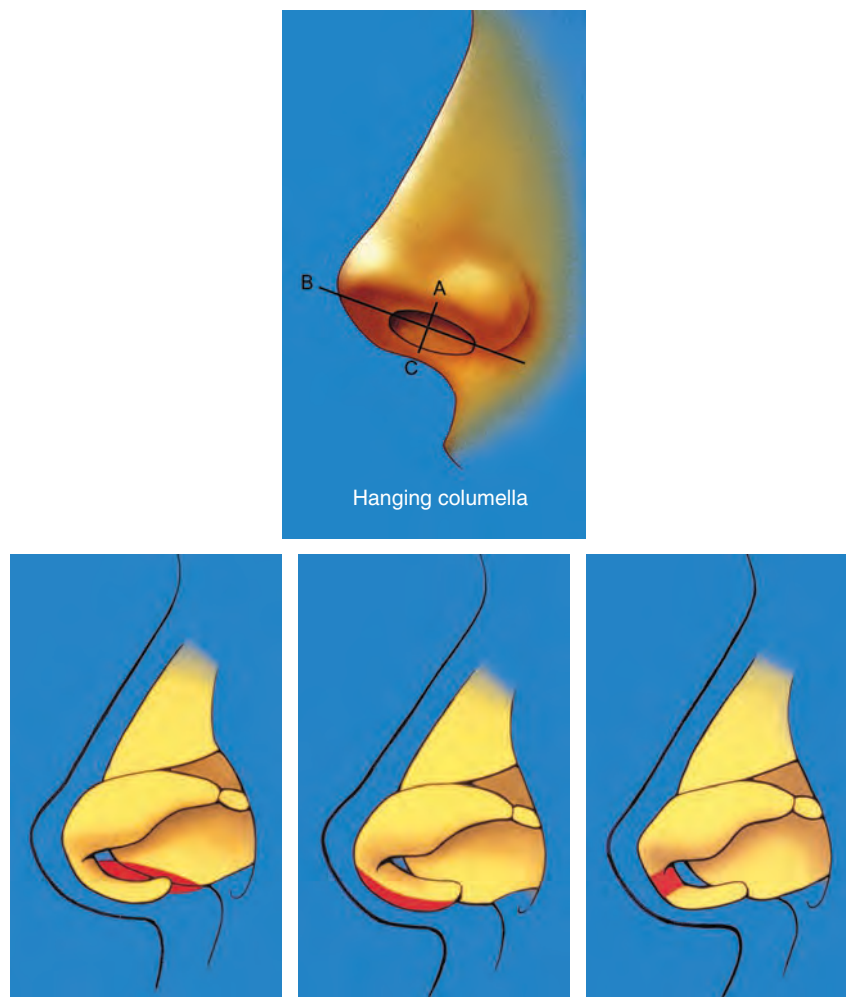


Lateral crural strut grafts are used to support weak lateral crura, prevent collapse of the external nasal valve, address malposition of the lateral crura, or increase tip projection. The vestibular skin is dissected from the deep surface of the posterior two thirds of the lateral crus. The lateral crus is separated from the accessory cartilages.

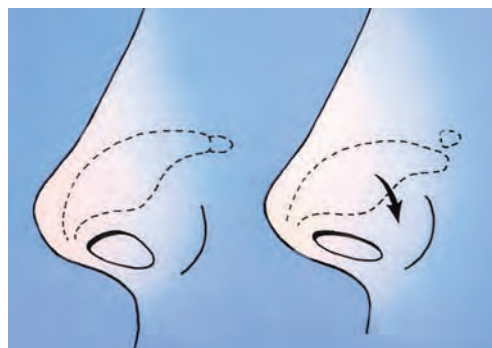
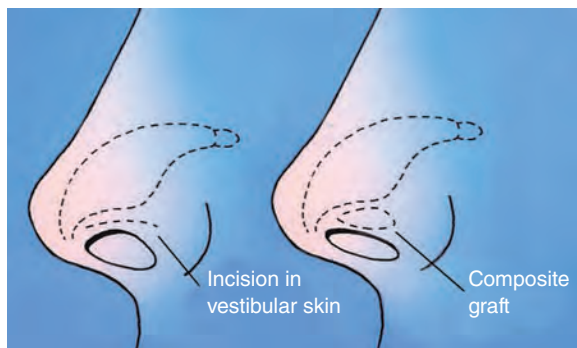
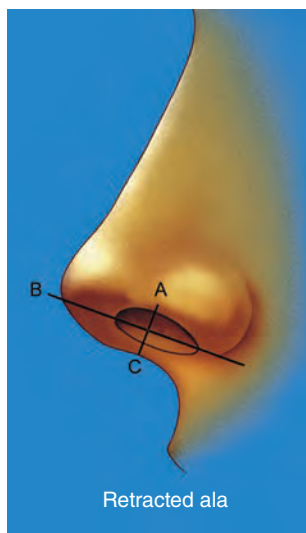
A subcutaneous pocket below and adjacent to the accessory cartilages is dissected posteriorly to the piriform aperture. To correct malposition of the lateral crura, the pocket is dissected below the infracartilaginous incision and parallel to the alar rim. A 4 by 25 mm lateral crural strut graft is placed in the pocket and rests on the piriform aperture posteriorly. The anterior aspect of the graft is placed deep to the lateral crus and secured with two or three 5-0 PDS simple interrupted sutures.

Correcting the Alar-Columellar Relationship

Class I Deformity

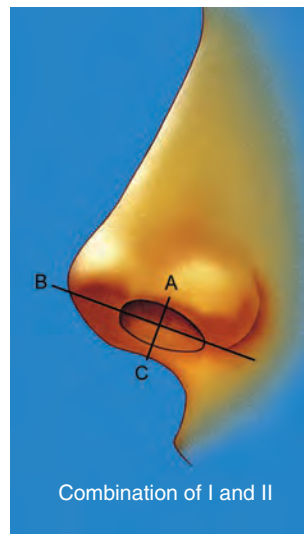


When the patient has a class I deformity, or when the long axis–columellar rim distance (BC) is greater than 2 mm and the alar rim–long axis distance (AB) is normal, this is an example of a true hanging columella. Correcting this involves resecting either the caudal septum, the caudal portion of the medial crus, the caudal portion of the middle crus, or a combination of these, whichever is responsible for the deformity.

Class II Deformity

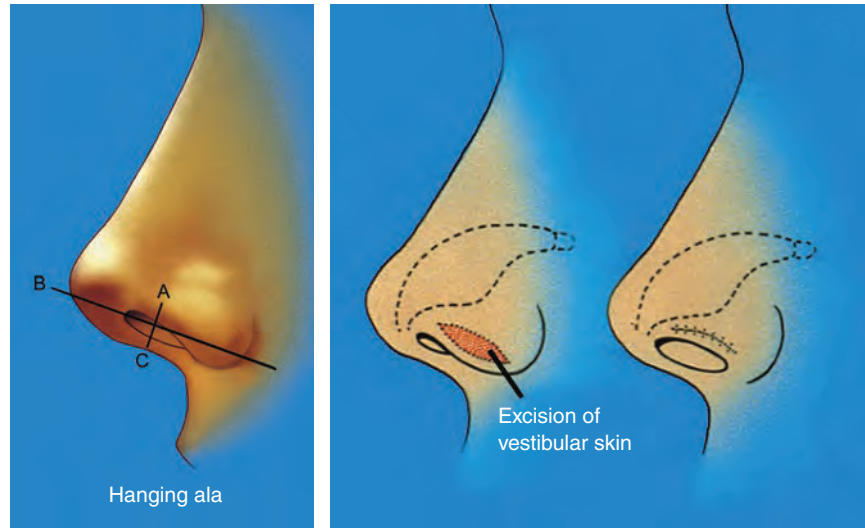
A class II deformity, or a retracted ala (AB greater than 2 mm, BC less than 2 mm), is treated in several ways. One method is to insert an elliptically shaped composite graft from an access incision made in the vestibular skin. The graft is made slightly larger than is needed to compensate for secondary contraction. If the retraction is mild and there is no tissue deficiency present, an alternative technique can be used where the lateral crura are detached from the accessory chain and repositioned inferiorly. A final method is to place an alar contour graft (nonanatomic position) in a pocket created along the vestibular rim to displace the ala inferiorly.

Class III Deformity



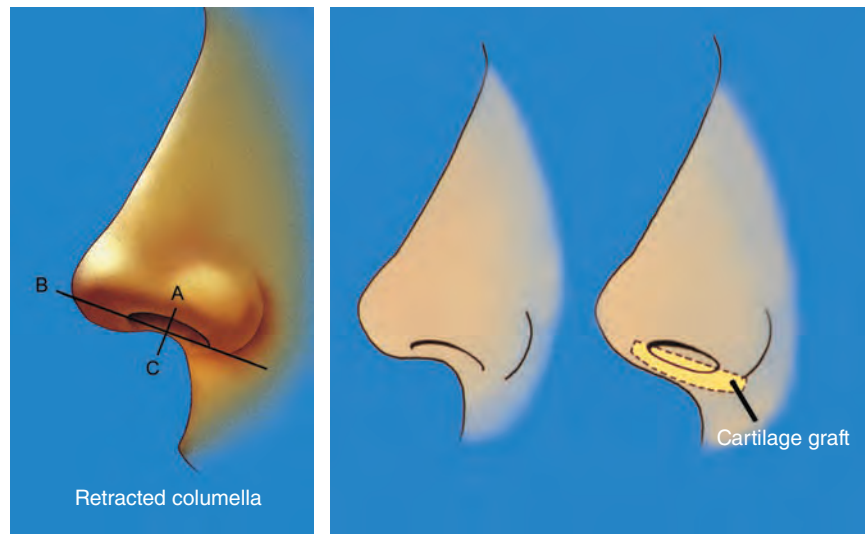
A class III deformity is a combination of a class I and class II deformity and is therefore corrected with a combination of the two procedures.

Class IV Deformity



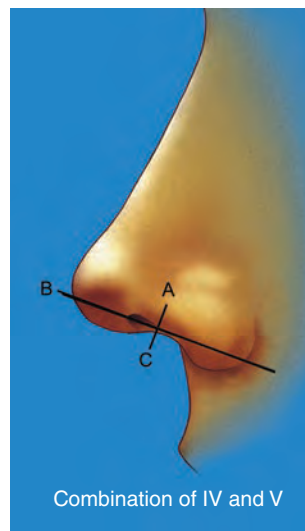
A class IV deformity is a hanging ala (AB less than 1 mm, BC less than 2 mm). This is usually treated with an elliptical excision of vestibular skin. Care is taken to avoid overresection of skin in this maneuver, because an abnormal, rolled-in appearance of the alar rim can result.

Class V Deformity



A class V deformity is a retracted columella (AB less than 2 mm, BC less than 1 mm). The treatment of choice for this deformity is placement of a columellar strut, which is positioned more caudally to extend the caudal dimension of the columella.

Class VI Deformity



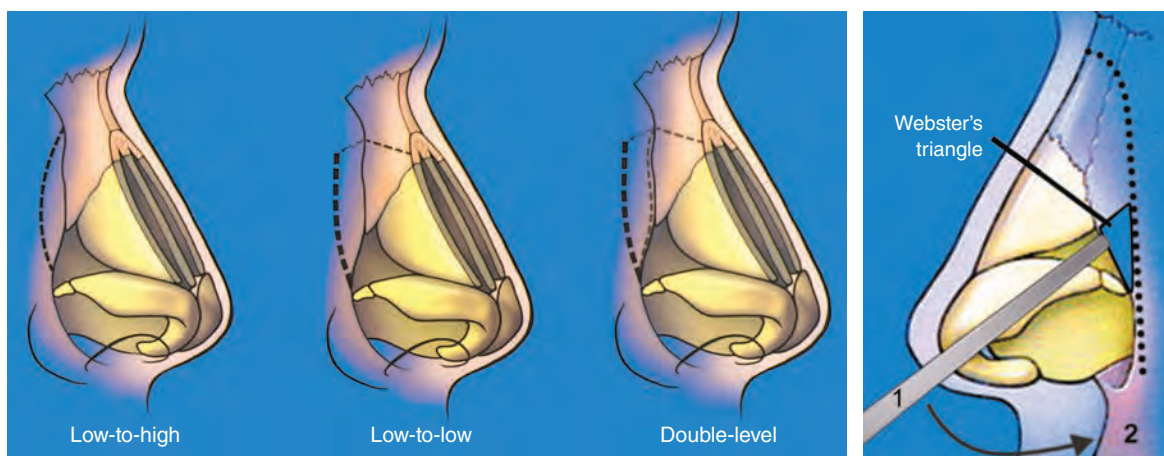
A class VI deformity is a combination of class IV and class V and is treated with a combination of the techniques just described.

Osteotomies

Osteotomies are a powerful technique in rhinoplasty. The indications to perform osteotomies, regardless of technique, are as follows:

- To narrow the lateral walls of the nose
- To close an open-roof deformity (after dorsal hump reduction)
- To create symmetry by straightening the nasal bony framework

Contraindications to osteotomies can include patients with short nasal bones; elderly patients with thin, fragile nasal bones; and patients with heavy eyeglasses. There are several osteotomy techniques, including medial, lateral, transverse, or a combination of these. Furthermore, they can be performed through either an external or internal approach.



A lateral osteotomy may be performed as *low-to-high*, *low-to-low*, or *double-level*. They may be combined with medial, transverse, or greenstick fractures of the upper bony segment, as well. No matter how the osteotomy is performed, however, it is necessary to preserve Webster's triangle, which is an area of the caudal aspect of the maxillary frontal process that is near the anterior aspect of the inferior turbinate. By preserving this area, patency of the internal valve is preserved during osteotomies, and functional nasal airway obstruction from collapse is prevented. Furthermore, regardless of the technique used in performing the lateral osteotomy, it is important to maintain a smooth fracture line by staying low along the bony vault, thereby preventing the potential for a step-off deformity. The cephalic margin of the osteotomy should not be higher than the intercanthal line (the level of the medial canthi); the thick nasal bones above this level increase the technical difficulty, and it is possible to cause iatrogenic injury to the lacrimal system (with resultant epiphora).

A low-to-high osteotomy is generally used to correct a small open roof deformity or to mobilize a medium-wide nasal base. It begins low at the piriform aperture and ends high medially on the dorsum. The nasal bones are then "greensticked" to medialize them, with predictable fracture patterns obtained based on nasal bone thick-

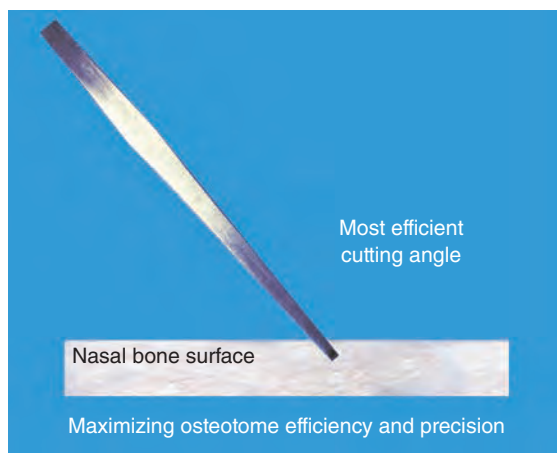
ness. Occasionally, a separate superior oblique osteotomy is necessary to mobilize thicker nasal bones enough to be greensticked. A low-to-low osteotomy is generally a more powerful technique, in that it results in more medial movement of the nasal bones, and therefore is classically used when there is a large open-roof deformity or if a wide bony base requires correction. It starts low along the piriform aperture and continues low along the base of the bony vault to end in a lateral position along the dorsum near the intercanthal line. As there is more bone between the cephalic aspect of this osteotomy and the midline, this type of osteotomy technique is frequently accompanied by a medial osteotomy to better mobilize the nasal bones to achieve the desired result.

We have refined our preferred technique of external perforated lateral osteotomies, which has proved to be well controlled, predictable, and reproducible. Furthermore, there are certain unique advantages to this technique based on the preservation of the periosteal attachments, namely:

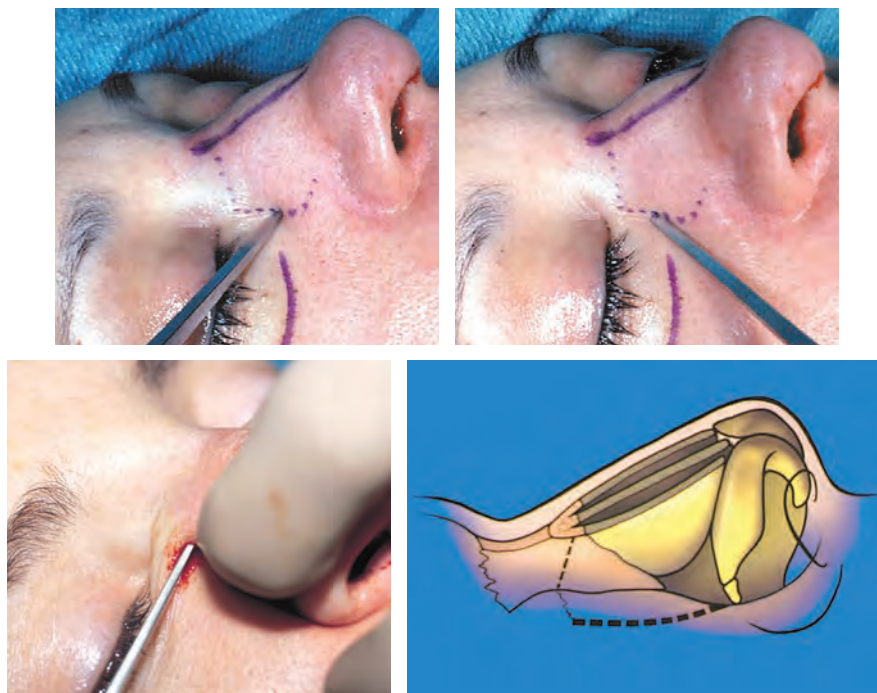
- Decreased amount of dead space
- Reduced subluxation and subsequent airway compromise
- Greater overall stability after positioning

Our technique is as follows:

1. Inject both intranasally and along the lateral nasal sidewalls with 2 ml of 1% lidocaine with 1:100,000 epinephrine, allowing 5 to 7 minutes for the hemostatic process to take effect.
2. Introduce a sharp 2 mm osteotome percutaneously on the midportion of the bony nasal pyramid at the level of the inferior orbital rim and nasofacial junction. It must be held at a plane parallel to the surface of the maxilla.
3. To avoid injury to the angular artery, sweep the osteotome down the lateral nasal sidewall in a subperiosteal plane.



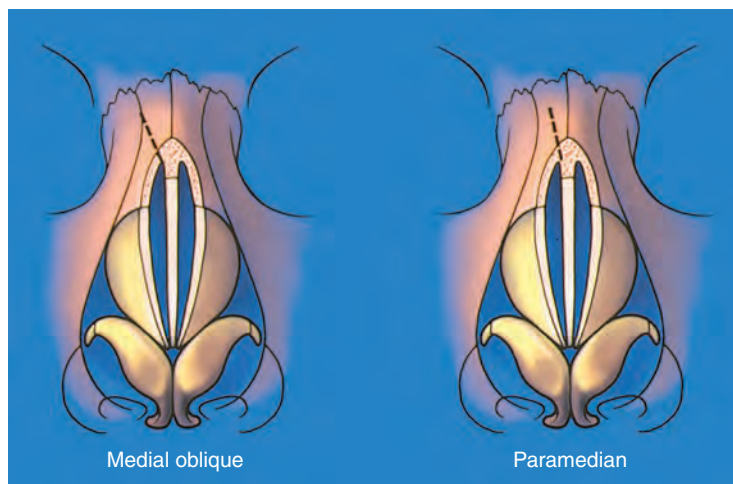
4. Position the osteotome at an angle such that one edge is in contact with the bone and strike with the mallet. The endpoints are a change in the feel and sound at that location.



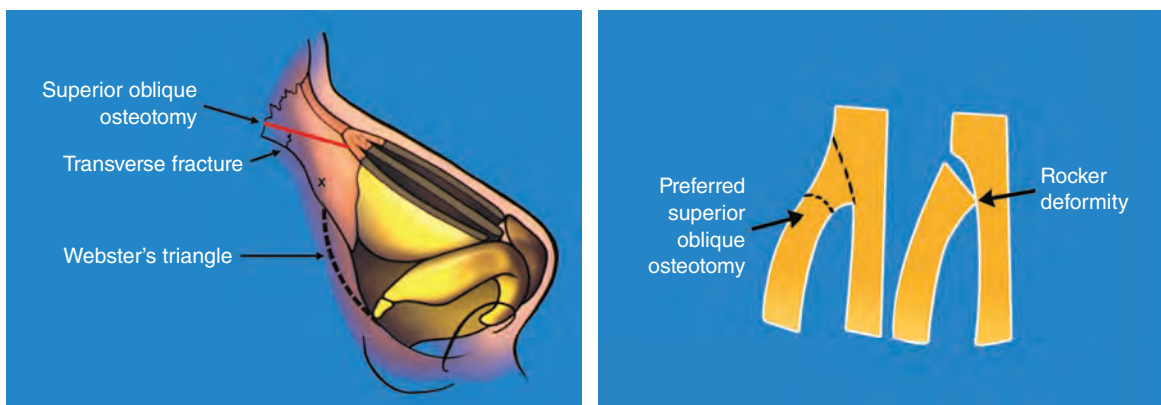
5. Extend the osteotomy in an inferior, superior, and superior-oblique manner at the level of the piriform. Leave a 2 mm gap between each individual osteotomy.
6. Perform the same procedure on the contralateral nasal wall.
7. After the osteotomies are completed, use gentle pressure between the thumb and forefinger to perform a greenstick fracture of the nasal bones to position them in the desired location.



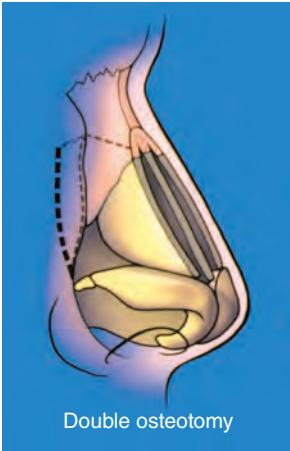
8. Cover with flesh-colored Steri-Strips and apply a dorsal compression splint (Denver splint), which is kept in place for 7 days to minimize postoperative edema.



Medial osteotomies are used to facilitate medial positioning of the nasal bones. They are generally indicated in patients with thick nasal bones or a wide bony base to achieve a more predictable result, because greenstick fractures in these subgroups can sometimes be difficult and can lead to unpredictable fracture patterns. Medial osteotomies can be used in conjunction with lateral osteotomies; however, it is not necessary to use both types in all cases. When using both techniques, the medial osteotomy is usually performed first, because this makes it technically easier to perform subsequent lateral osteotomies. Although the cant of the medial osteotomy can be varied (such as medial oblique, paramedian, or transverse), for the reasons just stated, the cephalic margin should not cross the intercanthal line.



It is paramount to avoid placing the medial osteotomy too far centrally as it connects with the lateral osteotomy because this can cause a *rocker deformity* in which the upper portion of the fractured nasal bone “kicks out,” resulting in a widened upper dorsum. This can be avoided by following an oblique angle. After the medial and lateral osteotomies are created, the nasal bones are greensticked, as described earlier, to the desired position.



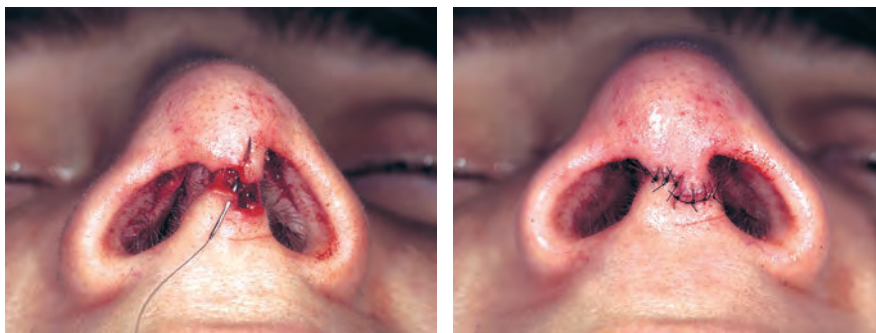
Occasionally, a double-level lateral osteotomy is needed to correct lateral wall convexities that are too great to be corrected with a standard single-level lateral osteotomy, or when significant lateral nasal wall asymmetries exist. This is done by first making the upper (more medial) lateral osteotomy along the nasomaxillary suture line. The lower (more lateral) of the two is then created in standard low-to-low fashion.

Regardless of the operative technique, there are potential complications associated with osteotomies.

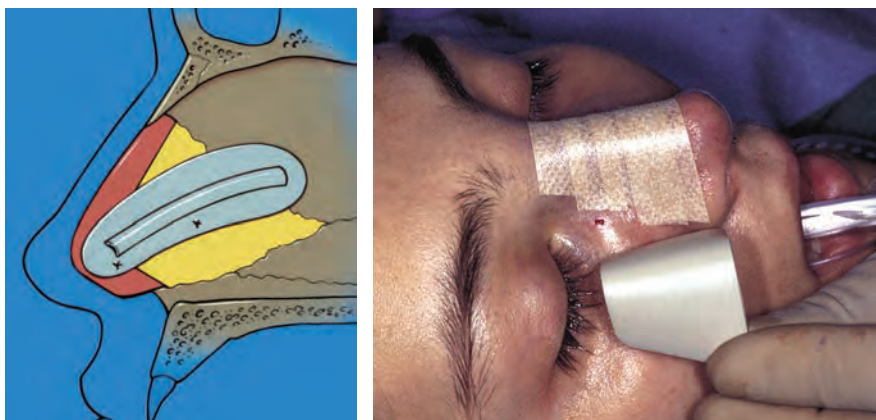
Potential Complications of Lateral Nasal Osteotomies		
Infections	Operative Trauma	Cosmetic Problems
Local	Hemorrhage (hematoma, ecchymosis)	Excessive narrowing or convexity
Abscess	Edema	Insufficient mobilization of lateral bony walls
Cellulitis	Nasal cyst formation	Unstable bony pyramid
Granuloma	Anosmia	Rocker deformity
Systemic	Arteriovenous fistula	Redundant soft tissue
Intracranial	Epiphora	Stairstep deformity
	Canalicular bleeding	Nasal bone asymmetry
	Neuromuscular injury	
	Intracranial injury	

Closure

After excellent hemostasis is achieved and the wound is irrigated to remove any excess debris, the skin envelope is redraped. If the patient has thick skin, and especially if the patient is a woman, we may choose to place a single 5-0 Vicryl suture from the dermis (underside of the skin envelope) to the underlying cartilaginous framework in an attempt to recreate a supratip break.



The transcolumnellar incision is then closed using 6-0 nylon suture in simple interrupted fashion, making sure the coaptation of the incision margins is precise. The stairstepping of the original incision helps us close this accurately. The infracartilaginous incisions are reapproximated using 5-0 chromic suture in simple interrupted fashion. We take special care to prevent overbiting with the suture, which can create contour irregularities and notching, especially in the soft triangle area.



If septal work has been performed, we place intranasal Silastic splints coated with antistaphylococcal antibiotic ointment. These are secured with a transseptal 3-0 nylon suture. The nasal dorsum is then carefully taped, and a malleable metal splint is applied over the dorsum. A drip pad is fashioned from a 2 by 2 gauze and secured under the nose with 1/2-inch paper tape. The throat pack is removed, and the oropharynx and stomach are carefully suctioned to help evacuate any blood that may result in postoperative nausea and vomiting.

Alar Base Surgery

In cases in which alar base surgery is necessary, it is generally performed after closure of the transcolumnellar and infracartilaginous incisions, but before intranasal and external splints are placed.

Analysis of the alar base was discussed earlier in the chapter. Based on proper and precise nasofacial analysis, alar base abnormalities may be diagnosed, which may

include wide or excessive nostril sills, a wide alar base, asymmetrical or malpositioned alar bases, or any combination of these.



Wide nostril sills, or alar flaring, is a relatively common problem. It is corrected by performing a small crescentic resection of the alar base, making sure to avoid extending the incision into the actual vestibule. The incision is placed approximately 1 to 2 mm above the true alar base to prevent alar notching. The soft tissue at the base is mobilized with judicious use of electrocautery and then transposed medially to the desired aesthetic endpoint, where it is sutured in place. We suture using the “halving principle” in this region, because the interior incision is shorter than the exterior incision.

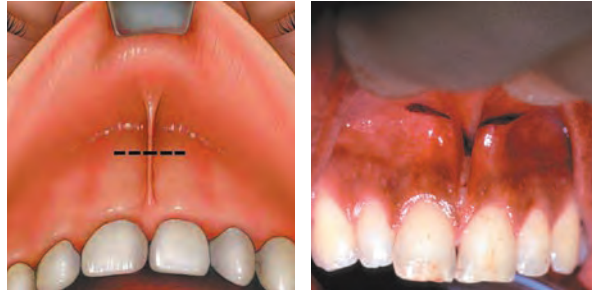


A wide alar base is corrected in a similar fashion; however, the crescentic excision assumes a more wedge-type geometry and may include a small portion of the nostril sill. If a transcolumellar incision was used at the start, it is crucial that the alar base excision stay within 3 mm of the lateral alar groove, because the blood supply to the nasal tip can be jeopardized if the lateral nasal artery is inadvertently injured.

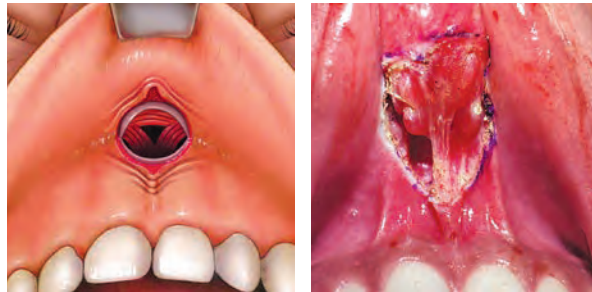
Although some have advocated suture techniques for narrowing the nasal base, we generally perform this with excisional techniques, as just described.

Depressor Septi Translocation

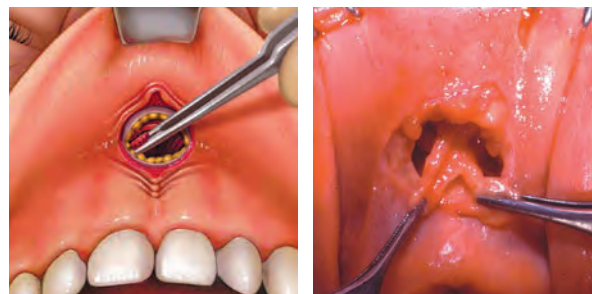
In patients who have a tension tip on animation (foreshortened upper lip with decreased tip projection), translocation of the depressor septi muscles is indicated. This is done in the following fashion.



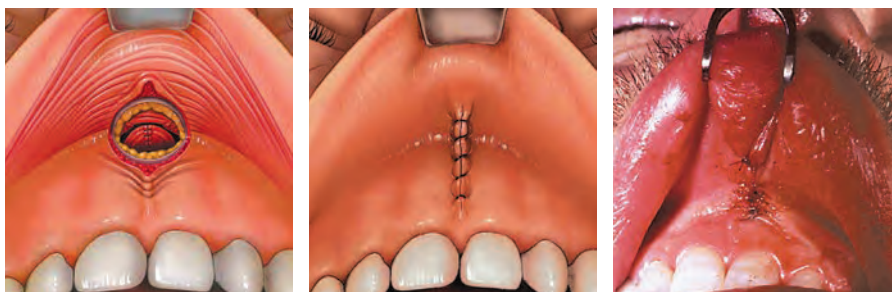
An 8 to 10 mm transverse incision is made using electrocautery centered on the frenulum.



The inferior attachments of the depressor septi muscles are identified and dissected using electrocautery.



The depressor septi muscles are released from either the orbicularis or the periosteum (anatomy dependent).



The muscles are transposed and their ends sutured together using 4-0 chromic gut suture. The transverse incision is closed vertically to lengthen the upper lip.

Postoperative Management

All preoperative and postoperative instructions are given to the patients in writing before as well as on the day of surgery. Postoperatively, we routinely prescribe the following:

- Medrol Dosepak for 7 days (to minimize postoperative edema)
- Hydrocodone/acetaminophen 5:500 for postoperative pain every 4 to 6 hours as needed
- Normal nasal saline solution for postoperative nasal congestion
- Antibacterial ointment to incisions three times daily

The patient is instructed to keep the head of the bed elevated at an angle of 45 degrees beginning immediately after surgery to help minimize postoperative swelling. Cool compresses (Swiss Therapy eye masks) are used periorbitally during the day for the first 48 hours. Antibacterial ointment is applied three times daily to the incisions after gentle cleaning with a half-strength hydrogen peroxide–saline solution. The patient is instructed to change the drip pad under the nose as necessary until the drainage stops, at which time the pad and tape can be discontinued. Any manipulation of the nose, including rubbing, blotting, or blowing, is discouraged for the first 3 weeks postoperatively. Sneezing should be done through the mouth during this time. It is imperative to keep the nasal splint dry, and the patient's hair should be washed as in a beauty salon, with the patient leaning the head backward over the sink.

We maintain our patients on a liquid diet on the day of surgery, which is subsequently advanced the following day to a soft regular diet. Any foods that require excessive lip movements, such as eating apples or corn on the cob, should be avoided for 2 weeks after surgery.

During the first 2 weeks, nasal congestion may be minimized by the use of normal saline nasal spray and over-the-counter nasal decongestant sprays such as Afrin (oxymetazoline). However, the use of Afrin should be limited, because cessation can cause rebound nasal congestion. If patients have difficulty with the passage of air through the intranasal splints, they are encouraged to breathe through the mouth. If the patient is very congested, in-office suctioning may be warranted.

We ask the patient to return on postoperative day 5 to 7, at which time the sutures and nasal splints are removed. The nose (especially the tip) may appear swollen and turned up, and the tip may feel numb, but the patient is reassured that this is to be expected and will resolve with time, with normal sensation returning within 3 to 6 months. The patient cannot let anything, including eyeglasses, rest on the nose for

at least 4 weeks. Glasses should be taped to the forehead. Contacts can be worn as soon as the swelling has diminished enough to allow easy insertion (usually less than 5 to 7 days postoperatively). Patients are instructed to avoid direct sunlight and to wear sunscreen of SPF 30 or higher to prevent possible hyperpigmentation of the scar.

We ask our patients to restrict strenuous activity that increases their heart rate (above 100 beats/min) or blood pressure for 3 weeks after surgery. After that, they can gradually resume normal activity. Obviously, any contact sports or activities that may cause direct trauma to the nose are prohibited for at least 4 weeks after surgery. Although some patients' noses look excellent within 6 to 8 weeks, some may remain swollen for up to 1 year, but after 3 to 4 weeks such swelling will generally not be obvious to anyone but the patient.

After the first postoperative visit (within the first week), we ask the patient to return to the clinic at 3 and 8 weeks after the operation. We continue to follow the patient 3, 6, and 12 months after surgery, and then annually thereafter.

Outcomes

Although it is difficult to determine an exact revision rate following primary rhinoplasty, a recent survey of plastic surgeons and otolaryngologists revealed that 58% of those surveyed cited their revision rate less than 5%. This survey also revealed that the open approach was preferred by 73% compared with 20% preferring the closed approach for revision rhinoplasty.

In the senior author's (R.J.R.) practice, approximately 1 in 25 primary rhinoplasty patients requires revision. The most frequent reasons for reoperation include further tip refinement or correction of tip asymmetries (lower third), parrot beak or pinched supratip deformity (middle third), and excessive dorsal reduction or dorsal irregularities (upper third).

Functionally, continued nasal airway obstruction after primary rhinoplasty has, in our experience, usually been from excessive narrowing of the internal valve (without placement of spreader grafts). We used to see this more frequently when we performed more aggressive resection of the transverse processes of the ULCs. Once we adopted the component dorsal hump reduction technique with preservation of the ULCs, the incidence of internal valve obstruction decreased and the need for spreader grafts greatly diminished.

Results

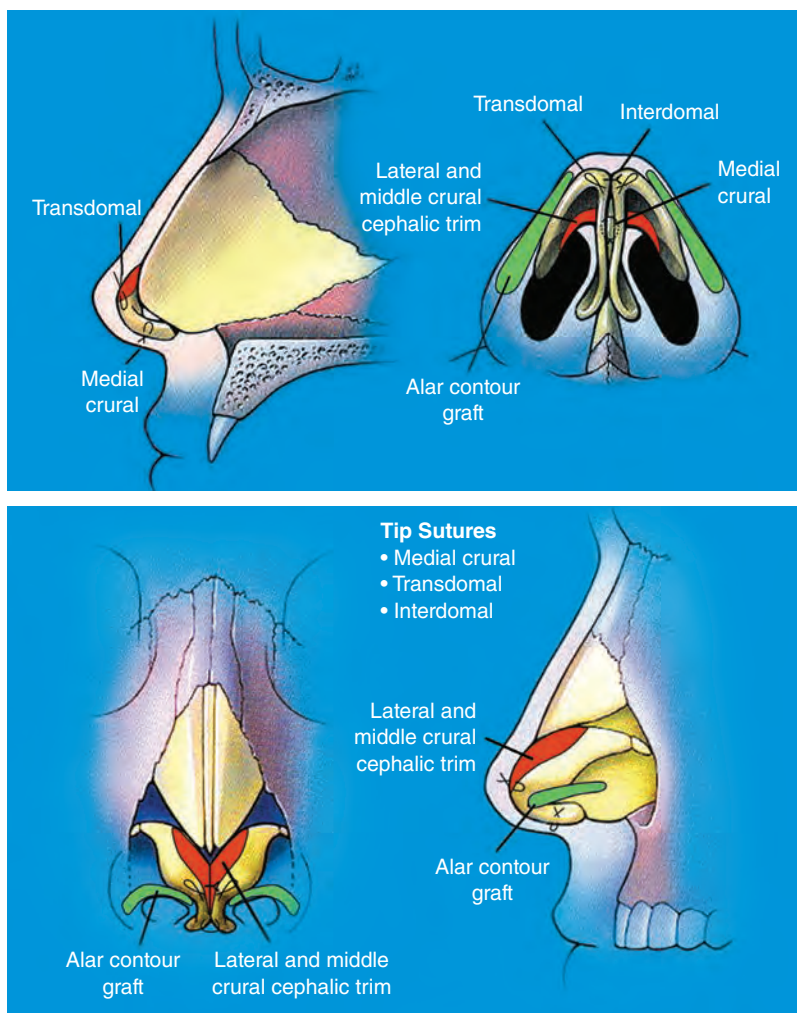
Patient Example 1



This healthy 24-year-old woman presented for cosmetic rhinoplasty without nasal airway obstruction. She was unhappy with the appearance of her boxy tip and desired correction. The frontal view demonstrates adequate dorsal aesthetic lines, but asymmetrical fullness of her supratip. Her left lower lateral cartilage segment is more obliquely rotated than the right lower lateral cartilage. She has excess lateral alar convexity with preoperative alar notching.

Operative Goals

1. Drastically refine tip and narrow tip-defining points
2. Correct lateral alar convexity and alar notching

Surgical Plan

1. Open approach with transcolumellar stairstep incision connected to bilateral infracartilaginous incisions
2. Cephalic trim of lateral and middle crura leaving a 6 mm rim strip
3. Medial crural, interdomal and transdomal suturing
4. Bilateral alar contour grafts to correct lateral alar convexity and prevent alar notching



Preoperative and 15-month postoperative views demonstrate improvement of dorsal aesthetic lines and correction of her boxy tip. She has dramatic tip refinement, with reduction of supratip fullness and narrowed tip-defining points. Placement of alar contour grafts has corrected the lateral alar convexity and prevented alar notching.

Patient Example 2

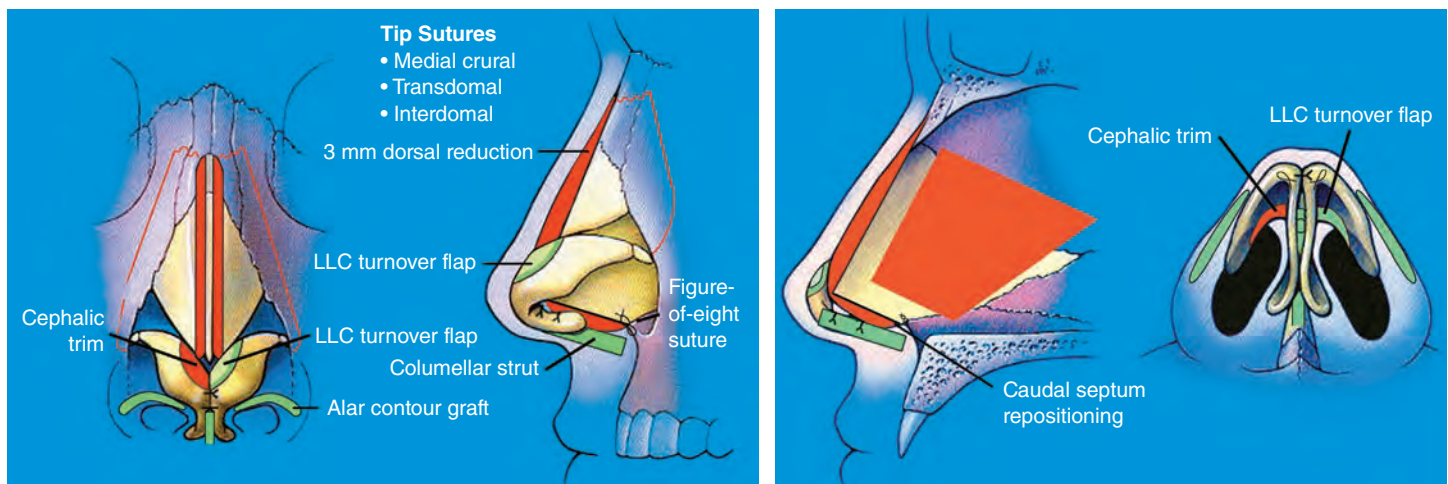


This healthy 24-year-old woman had aesthetic as well as functional concerns. Aesthetically, she did not like her dorsal nasal contour and boxy, asymmetrical nasal tip. Functionally, she complained of left nasal airway obstruction. The lateral view demonstrates a slight dorsal hump, supratip fullness, decreased tip projection, and a columellar-labial angle of 100 degrees. Her basal view confirms an asymmetrical tip with left-sided alar collapse. The left lower lateral cartilage is concave; the right is convex. Her intranasal examination revealed left-sided deflection of the caudal septum.

Operative Goals

1. Remove small dorsal hump
2. Decrease tip rotation
3. Correct tip asymmetry
4. Refine the tip and reestablish tip-defining points
5. Correct left external nasal valve collapse and concave left lower lateral cartilage
6. Prevent postoperative alar retraction

Surgical Plan

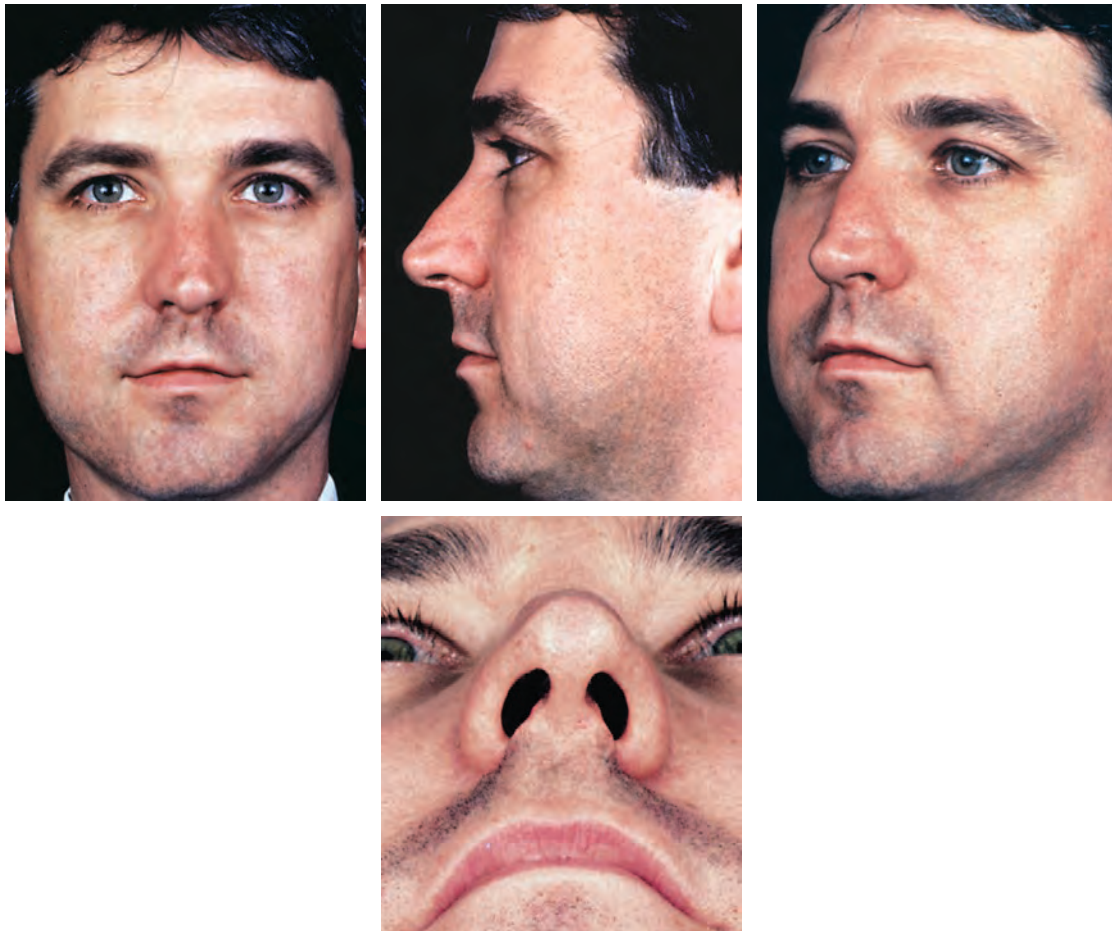


1. Open approach with transcolumellar stairstep incision connected to bilateral infracartilaginous incisions
2. Component reduction of dorsum (2 mm)
3. Caudal septal resection with medial crural set-back sutures to decrease tip rotation
4. Septal cartilage harvest leaving a 10 mm L-strut
5. Left lower lateral crural turnover flap to correct concave left lower lateral cartilage
6. Right cephalic trim leaving a 6 mm rim strip
7. Bilateral spreader grafts
8. Medial crural, interdomal, and transdomal suturing
9. Columellar strut
10. Lateral osteotomies (external perforated)
11. Bilateral alar contour grafts to prevent alar retraction



Comparison of the patient's preoperative and 12-month postoperative appearance demonstrates a straight dorsum and a unified tip complex with correction of her tip asymmetry. The lateral view confirms the straight dorsal profile with a supratip break, normal tip projection, and a nasolabial angle of 95 degrees. There is an improved alar-columellar relationship. The basal view confirms correction of her tip asymmetry and shows restoration of the columellar-infratip lobular relationship. The left-sided external valve collapse was corrected with the lower lateral crural turnover flap while alar contour grafts were placed to prevent postoperative alar retraction.

Patient Example 3

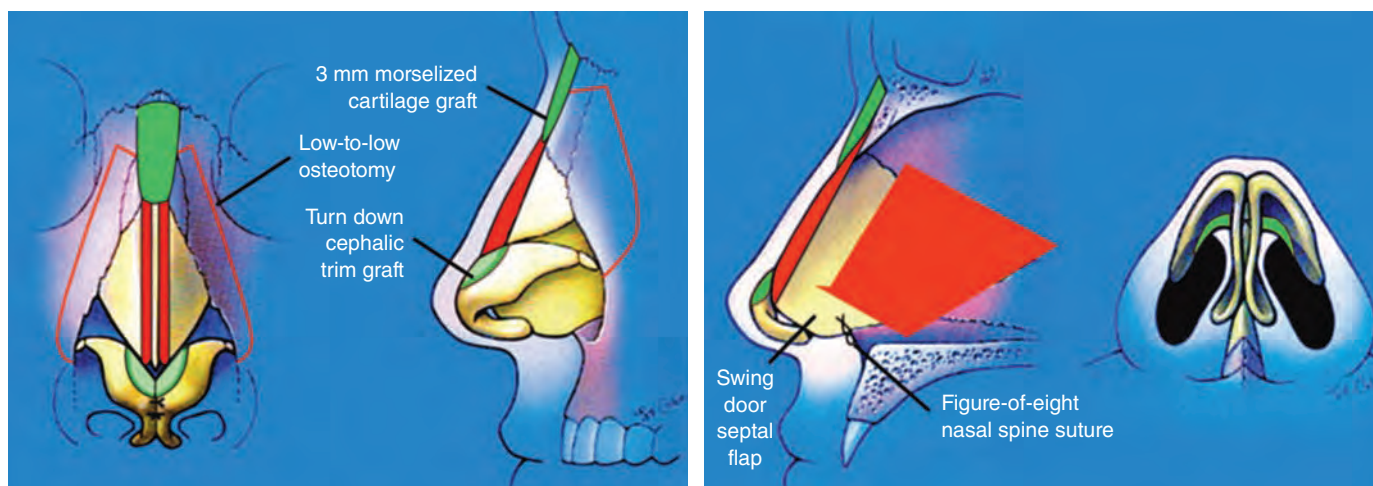


This healthy 35-year-old man presented with a history of traumatic nasal airway obstruction, greater on the left than on the right. He was also concerned about a pinched appearance to his nasal tip and deviation of his nose to the left. The frontal view demonstrates obvious leftward septal deviation with deviated dorsal aesthetic lines. He has a wide bony base, an asymmetrical tip with a concave, pinched appearance and narrowed tip-defining points. His lateral view demonstrates mild dorsal hump with a low radix but adequate tip projection. His basal view corroborates the pinched tip deformity and a wide alar base. Intranasal examination revealed a septal tilt, with left septal deviation.

Operative Goals

1. Correct nasal airway obstruction
2. Remove small dorsal hump
3. Remove/reposition septal deformity
4. Correct tip deformity (note thick skin)
5. Correct low radix
6. Narrow bony base

Surgical Plan

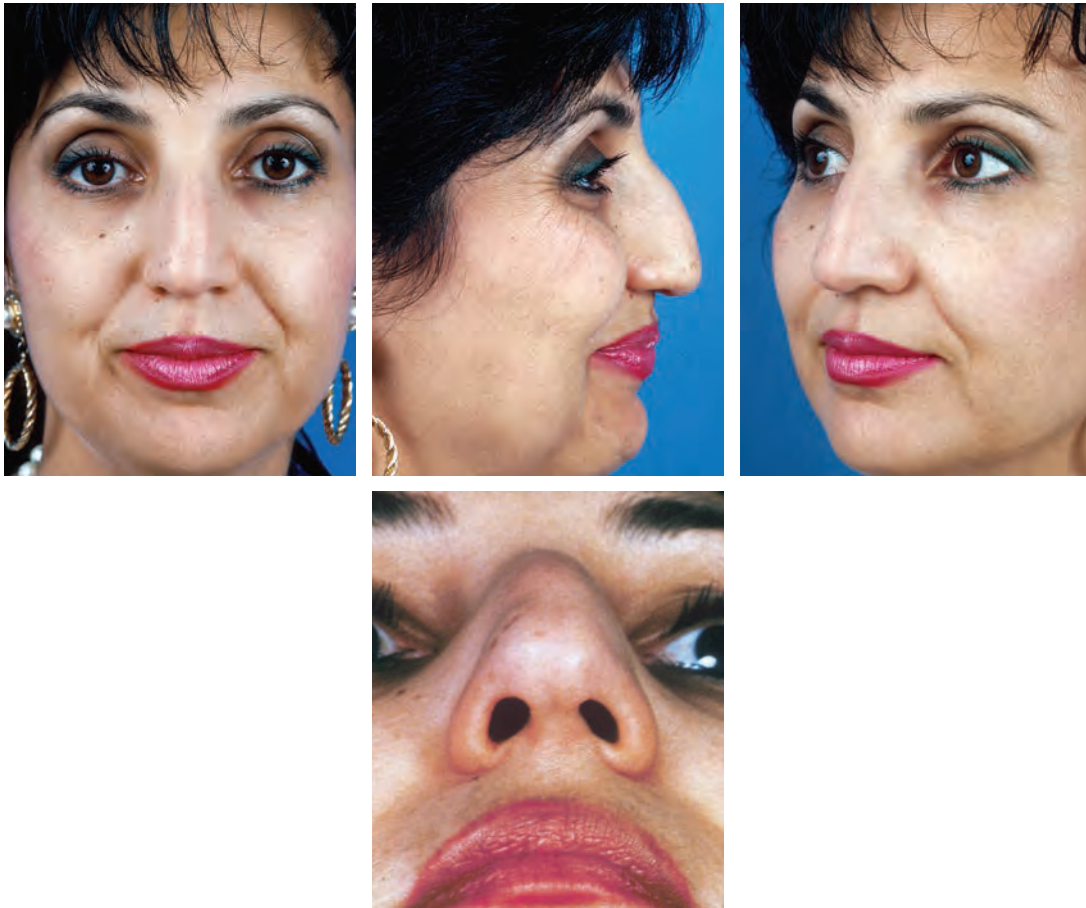


1. Open approach with transcolumellar stairstep incision connected to bilateral infracartilaginous incisions
2. Component reduction of dorsum (2 mm) with concomitant radix augmentation
3. Septal cartilage harvest leaving a 10 mm L-strut
4. Correct intrinsic deformity of caudal L-strut with septal scoring, swinging door septal flap and anchoring to anterior nasal spine
5. Lower lateral crural turnover flaps to correct pinched tip appearance
6. Medial crural and interdomal sutures
7. Submucous resection and outfracturing of inferior turbinates
8. Lateral osteotomies (external perforated)



Comparison views of the patient's preoperative and 14-year postoperative appearance demonstrates correction of the deviation with redefinition of symmetrical dorsal aesthetic lines, correction of the dorsal hump, narrowing of the bony base, and refinement of the tip (without feminization). His subjective complaints of nasal airway obstruction resolved.

Patient Example 4

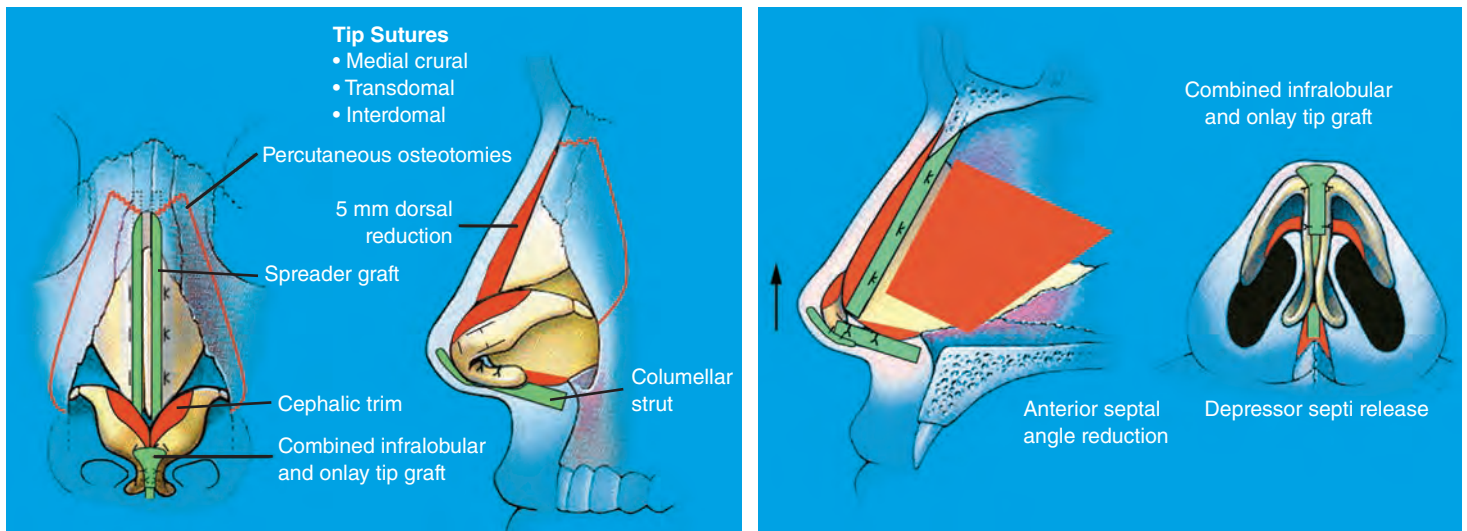


This healthy 41-year-old woman with Fitzpatrick type III thick nasal skin presented for cosmetic rhinoplasty without nasal airway obstruction. She was unhappy with the appearance of her dorsal hump and unrefined tip. This patient demonstrates the classic Middle Eastern nasal morphology. The frontal view demonstrates nasal deviation and a plunging tip with infralobular deficiency. Her lateral view demonstrates a large dorsal hump, a severely underprojected, underrotated, amorphous and plunging tip, as well as absence of a supratip break. She has an alar-columellar discrepancy with a retracted columella. Her basal view demonstrates nostril-tip imbalance with “short nostrils.” Intranasal examination was normal. Her dynamic examination revealed a hyperdynamic tip. Following primary rhinoplasty, she requested a more dramatic change in her tip, and this required a secondary soft tissue debulking operation.

Operative Goals

1. Remove large dorsal hump
2. Correct nasal deviation
3. Refine the tip and reestablish tip-defining points (note thick skin)
4. Drastically improve tip rotation and projection

Surgical Plan



1. Open approach with transcolumellar stairstep incision connected to bilateral infracartilaginous incisions
2. Component reduction of dorsum (5 mm)
3. Anterior septal angle reduction
4. Septal harvest (for cartilage grafting purposes) with 10 mm L-strut
5. Bilateral spreader grafts
6. Cephalic trim leaving a 6 mm rim strip
7. Columellar strut graft with medial crural septal sutures
8. Medial crural, interdomal and transdomal suturing
9. Combined infralobular and onlay tip graft
10. Lateral osteotomies (external perforated)



Comparison views of preoperative and 2-year postoperative appearance demonstrates a more balanced nose after reduction of the dorsum and refinement of the tip including improving tip rotation, projection and definition. The drastic improvement in overall nasal tip definition including enhancement of the supratip and infratip required a secondary operation with more soft-tissue debulking and visible onlay tip graft replacement secondary to early graft resorption. The necessity for secondary tip refinement or soft-tissue debulking is not uncommon in the Middle Eastern population and should be discussed during the initial informed consent.

Patient Example 5

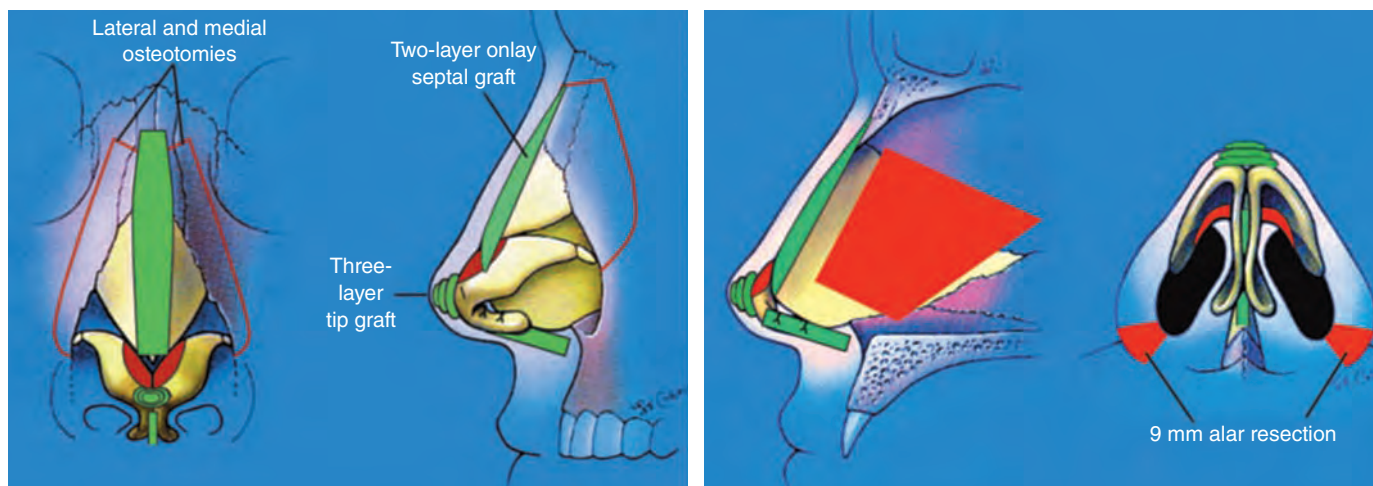


This healthy 40-year-old African American woman with Fitzpatrick type VI thick nasal skin presented for cosmetic rhinoplasty without nasal airway obstruction. Her concerns were a wide and flat-appearing dorsum with a small dorsal hump deformity; an ill-defined, flat but bulbous tip; and widened ala. She wanted a narrower, more defined nose. The frontal view demonstrates a wide bony base, poorly defined dorsal aesthetic lines, a prominent bulbous tip with bifidity, and a wide alar base. Her lateral view demonstrates a small dorsal hump, decreased projection, and a class IV hanging alar deformity. Her basal view corroborates the bulbous tip deformity with bifidity and an increased alar base width. Intranasal examination was normal, as was her dynamic examination.

Operative Goals

1. Dorsal augmentation and definition
2. Narrow middle vault
3. Drastically refine tip and narrow tip-defining points (note thick-skinned patient)
4. Increase projection
5. Decrease alar base width

Surgical Plan



1. Open approach with transcolumellar stairstep incision connected to bilateral infracartilaginous incisions
2. Septal harvest (for cartilage-grafting purposes) with 10 mm L-strut
3. Cephalic trim leaving a 6 mm rim strip
4. Two-layer dorsal onlay graft (septal cartilage) for augmentation
5. Medial crural, interdomal and transdomal suturing
6. Columellar strut
7. Three-layer onlay tip graft (cephalic trim cartilage) for definition and projection
8. Medial osteotomies (internal)
9. Lateral osteotomies (external perforated)
10. Alar base resection



Comparison views of preoperative and 24-month postoperative appearance demonstrates nasal dorsum augmentation with concomitant narrowing of the middle vault and redefinition of the dorsal aesthetic lines. She has dramatic tip refinement with creation of well-defined tip-defining points, as well as an increase in projection. Her alar-columellar deformity has been corrected, as has her widened alar base deformity. She did not subjectively complain of nasal airway obstruction postoperatively.

Concluding Thoughts

Success in primary rhinoplasty is predicated on accurate preoperative analysis and clinical diagnosis, identification of both the patient's expectations and the surgeon's goals, and a thorough review of the plan of care and expected postoperative recovery. Intraoperatively, adequate anatomic exposure of the nasal deformity, preservation and restoration of the normal anatomy, correction of the deformity using incremental control, maintenance and restoration of the nasal airway, and recognition of the dynamic interplay between the composite of maneuvers optimize outcomes and lead to a successful experience for both patient and rhinoplasty surgeon.

Clinical Caveats

The key to a successful outcome begins with proper patient selection.

A thorough understanding of normal and abnormal nasal anatomy is paramount.

Accurate, precise, and complete nasofacial analysis is mandatory to help plan the operation.

Full and complete disclosure of all risks and benefits, including financial responsibilities, must be performed to both the surgeon's and patient's satisfaction. There is no substitute for an informed patient.

The surgeon should never enter the operating room without a well-thought-out plan.

The type of incision used is far less important than the correction of the underlying problem. Choose appropriately according to the deformity and your own experience.

If performing an open approach through a transcolumellar incision, one must avoid excessively debulking the tip and avoid alar base incisions that are greater than 3 mm outside the alar groove to preserve blood supply to the tip.

The procedure should proceed in an organized, stepwise fashion from skin to skin, without rushing. Iatrogenic injuries are difficult to correct.

The dorsal reduction should always be performed before harvesting septal cartilage, so that the 10 mm L-strut is maintained.

Continued

Clinical Caveats—cont'd

The dorsum must be reduced in component fashion to prevent an inverted-V deformity.

The surgeon should attempt to preserve the transverse processes of the ULCs.

Tip modifications should be performing using a graduated approach.

Webster's triangle should be preserved when osteotomies are performed.

All incisions must be closed meticulously.

The postoperative splints/tapes should be positioned carefully to prevent iatrogenic deformity.

The postoperative course should be reviewed with the patient and family before and after the operation.

Annotated Bibliography

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Gunter JP, Rohrich RJ, Adams WP Jr. Dallas Rhinoplasty: Nasal Surgery by the Masters, 2nd ed. St Louis: Quality Medical Publishing, 2007.

A comprehensive two-volume text on all aspects of rhinoplasty. Multiple renowned contributors make this text an essential reference for the rhinoplasty surgeon, regardless of experience level.

Rohrich RJ, Gunter JP, Friedman RM. Nasal tip blood supply: an anatomic study validating the safety of the transcolumnellar incision in rhinoplasty. *Plast Reconstr Surg* 95:795-801, 1995.

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Sheen JH, Sheen AP. Aesthetic Rhinoplasty, 2nd ed. St Louis: Quality Medical Publishing, 1998.

Another classic comprehensive text. Authored by Jack Sheen, one of the preeminent master rhinoplasty surgeons.

Suggested Readings

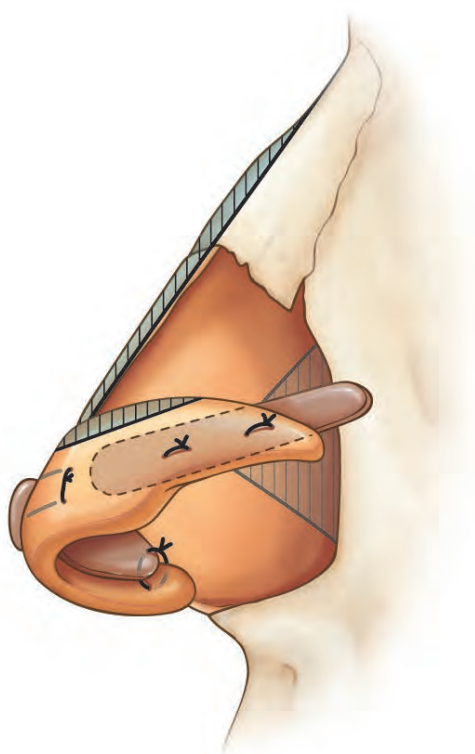
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CHAPTER 56



Tip Grafting for Nasal Contouring

WILLIAM D. LOSQUADRO, DEAN M. TORIUMI

Nasal tip contouring is perhaps the most difficult rhinoplasty skill to master. Seemingly isolated maneuvers can simultaneously affect multiple parameters on both the frontal and lateral views. The degree of difficulty is compounded by the relentless contraction of the skin–soft tissue envelope and the resultant potential for late complications. Early techniques in tip rhinoplasty were primarily reductive. The lower lateral cartilages were trimmed, scored, or divided to create smaller, albeit weakened, noses. Current techniques in tip rhinoplasty emphasize conservative lower lateral cartilage excision, suture reshaping, cartilage repositioning, and cartilage grafting.

One of the earliest reports of nasal tip cartilage grafting was by Peer in 1945. Through his histologic studies of grafts, he refuted the prevailing belief that septal cartilage was resorbed after transplantation, and he specifically described lengthening a retracted columella with septal cartilage. Hage in 1964 detailed the correction of dynamic alar collapse using auricular cartilage through, presciently, an open transcolumellar approach. Modern tip grafting techniques were first described by Sheen after he keenly observed that polly-beak deformities resulted from an overreduced nasal structure that was unable to accommodate a large skin–soft tissue envelope; his solution was to augment the tip with cartilage grafts placed through an endonasal approach. These techniques were later popularized through the external approach by Johnson and Toriumi.

Tip grafting is often performed in conjunction with conservative reduction of the lower lateral cartilages and suture contouring. Grafting significantly increases surgical complexity and the potential for postoperative complications and thus should not be used indiscriminately. A graded surgical algorithm may effect modest tip changes, such as narrowing and slight increases in projection, with conservative cartilage trimming and suture reshaping alone. Tip grafting can be used for greater changes, and grafting alone can lengthen or enhance the projection of a short nose, straighten a severely crooked tip, and reposition retracted alae. When used properly, cartilage grafting is a powerful tool for nasal tip contouring.

Indications and Contraindications

Indications for tip grafting in primary rhinoplasty include the increase of tip projection, prevention of postoperative loss of tip projection, nasal lengthening, straightening of tip deviations, and correction of cephalically positioned lower lateral cartilages. Mild increases in tip projection may be successfully achieved with suture

contouring (such as dome-binding sutures, lateral crural steal, and so on); increases greater than 1 or 2 mm frequently require tip grafts. The degree of augmentation and refinement, the anatomy of the existing nasal framework, and the skin thickness will further dictate the type of tip grafting employed.

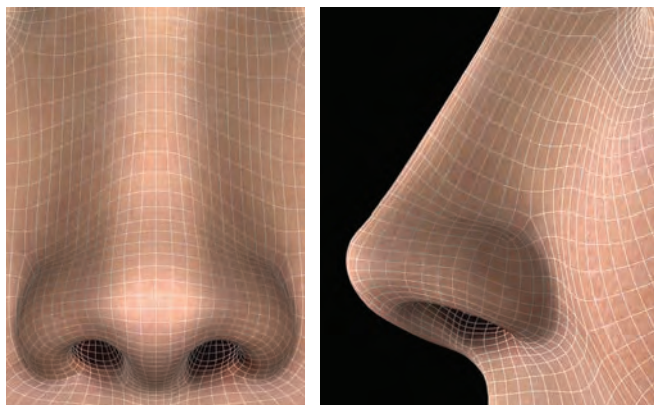
Patients with weak lower lateral cartilages, short medial crura, and a deficient caudal septum are at risk for postoperative loss of tip projection. Extended columellar struts, caudal septal extension grafts, and caudal septal replacement grafts can each be used to stabilize the tip. These same grafts can also be used to lengthen short noses and correct persistent caudal septal deviations. Costal cartilage may be needed when lengthening a short nose to withstand the force applied by the stretched, contracting skin–soft tissue envelope.

Cephalically positioned lower lateral cartilages are another indication for grafting techniques. Aesthetically, cephalically positioned cartilages contribute to tip bulbosity, the parentheses tip deformity, and alar retraction. Functionally, they facilitate lateral wall collapse and decreased nasal valve patency. After dissection from both the nasal skin and vestibular mucosa, only very strong, flat lateral crura permit suture repositioning alone. Most cartilages lack adequate strength to support the lateral wall and will require placement of lateral crural strut grafts to prevent postoperative alar collapse and retraction.

No absolute contraindications to tip grafting exist, although grafting is sometimes unnecessary. Primary rhinoplasty patients with adequate projection, proper rotation, and minimal tip bulbosity may successfully be treated with conservative trimming of the cephalic lateral crura and suture contouring. Overly long noses may be better addressed by setting the medial crura back on the caudal septum in a tongue-in-groove fashion. Desired aesthetic changes must be balanced against the increased risk of complications posed by grafting.

Pertinent Anatomy

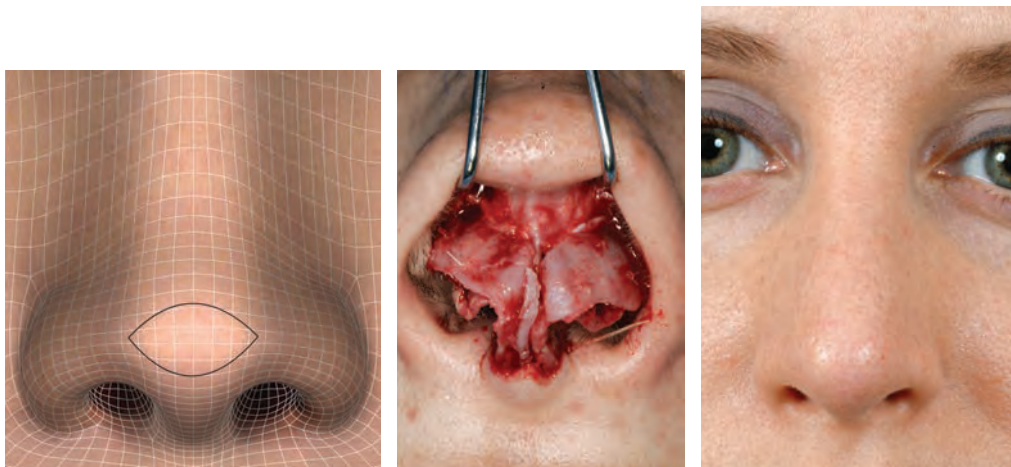
The nasal tip proper is one of the nine aesthetic subunits of the nose. Within the context of nasal tip contouring, the term *tip* more accurately reflects the lower third of the nose, specifically the tip, ala, soft tissue triangle, and columellar subunits. The transition points between these subunits contribute substantially to tip highlights and shadows.



The external appearance of the nasal tip is dictated primarily by the anatomy of the lower lateral cartilages and the caudal septum. Projection and rotation are the primary metrics analyzed when viewing the tip profile. Other important parameters are the alar-columellar relationship, the columellar-lobular angle or double break, and the supratip break. Ideal tip projection has been quantified by assorted mathematical equations and anatomic relationships. Yet adequate projection is often best determined by simple observation of each patient's anatomy—particularly dorsal height, nasal length, and chin projection. Ideal rotation in males is approximately 90 to 100 degrees and 100 to 120 degrees in females. The perceived rotation is affected by the position and contour of the nasolabial angle. A gentle curve is desirable; a sharp transition makes the angle appear more acute and unnatural.

The alar-columellar relationship can significantly affect the perceived harmony of the tip profile. Alar retraction creates a snarled appearance that mars an appropriately projected and rotated tip. Approximately 2 to 4 mm of columellar show is generally considered aesthetic. Greater show may result from alar retraction or a hanging columella; less show may be caused by hanging alae or retracted columella. The alar rim contour should approximate a gentle curve. Whereas alar retraction is characterized by a more uniform arc of elevation, alar notching describes an acute, focal retraction that interrupts the ideal contour.

The double break and supratip break are other important components of an aesthetic tip. The double break is formed by the natural divergence of the intermediate crura. The cephalic break point corresponds to the tip-defining points on the frontal view and represents the transition from the domes to the lateral crura. The caudal break point represents the initial divergence of the medial crura into the domes and can be difficult to appreciate on frontal view. The area between these two points forms the infratip lobule. The transition from the tip-defining point to the dorsum forms the supratip break. The dome height over the anterior septal angle and the skin thickness draping over it creates the break. A 1 or 2 mm supratip break is especially desirable in females, whereas males may tolerate less or no supratip break.



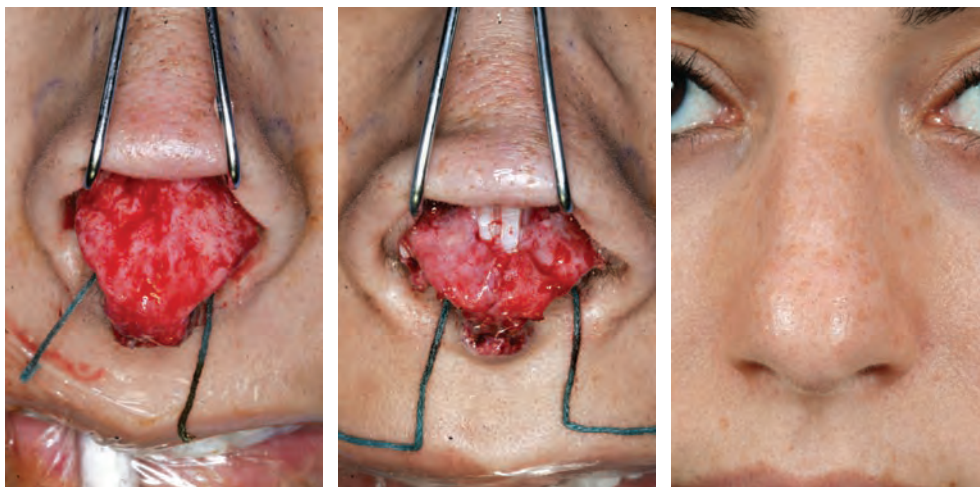
The tip profile is primarily a two-dimensional relief against a uniform background; subtle shadows and highlights compose the frontal view. When using a single midline light source, the tip highlight predominates. Ideally, it is a horizontally oriented ellipse formed by the divergence of the intermediate crura and the paired domes. The paired tip-defining points are more prominent when two light sources are used. The average width between tip-defining points is reportedly 8 mm, although this distance should be individualized based on overall facial width, base width, and cultural norms.



Cephalic to the tip highlight there should be a subtle shadow that represents the supratip break. Greater supratip breaks cast darker shadows. The tip highlight should gradually transition to the alae without a deep shadow. A concave transition between the tip and alae isolates the tip with shadows and creates the so-called parentheses deformity; this may be caused by bulbous or cephalically positioned lower lateral cartilages. An unnatural, single midline tip highlight may be seen in patients whose domes have been pinched together. On the basal view, a pinched tip will exhibit marked alar concavity.



Overall tip shape and size are crucial to tip aesthetics. A bulbous tip interrupts a smooth brow-tip aesthetic line. Bulbosity may result from both enlarged and cephalically positioned lateral crura. The ideal lateral crura position can range from 35 to 45 degrees off the midline; more simply, they should point towards the lateral canthus as opposed to the medial canthus.



Even after performing a cephalic trim, cephalically positioned lateral crura can leave residual tip fullness that tends to obliterate the subtle sidewall inflection at the confluence of the sidewall, tip, and ala.

The relationship of the infratip lobule to the ala is another important component of the frontal view, and the ideal contour is a gently curving V, or “gull in flight.” Prominence of the infratip lobule, tip rotation, and alar position all contribute to this contour. It is exaggerated by a prominent, “hanging” infratip lobule and reduced by a hidden, flattened infratip lobule. An underrotated tip also creates an unsightly shadow at the nasolabial angle.

Preoperative Assessment

The surgeon begins the preoperative assessment by eliciting the patient's functional and aesthetic concerns. Understanding the patient's surgical goals is crucial to a successful surgeon-patient relationship. Some patients request correction of obvious deformities, such as a dorsal hump or bulbous tip, whereas others provide annotated photographs detailing a multitude of changes. Some want to address a single deformity, such as male patient who wants a less bulbous tip but is unconcerned with a slight dorsal convexity. Ethnic patients may ask for subtle changes that maintain their ethnicity, or they may desire a more refined nose.

Identifying patients with unachievable aims or goals beyond the surgeon's aesthetic range is paramount. Patients with goals that are unattainable rarely have body dysmorphic disorder; they more commonly request changes that are not anatomically feasible. For instance, a finite reduction is achievable in a patient with thick skin, a large dorsal hump, and overprojected nasal tip without developing a polly-beak deformity; however, a small, petite nose is unrealistic. Other patients may desire changes that are displeasing to the surgeon's aesthetic sensibilities, such as a scooped dorsum or arched alae. These goals may be surgically attainable, and the patient may indeed be happy postoperatively. However, a dissatisfied patient is both unhappy and aesthetically worse. All of these patients are poor candidates, and the surgeon should politely decline to operate on them.

The patient's past surgical history should be obtained. The timing and number of prior septoplasties, rhinoplasties, and cartilage-harvesting procedures are recorded. Proper preoperative counseling requires that the surgeon be aware of available grafting material and whether alloplastic implants or injectable fillers have been used previously. Operative reports may detail implants unknown to the patient, although the accuracy may be unreliable. Many surgical decisions will thus require direct intraoperative inspection.

The patient's past medical history should also be elicited, particularly rhinologic complaints such as nasal obstruction, congestion, epistaxis, and rhinorrhea. Patients with allergic rhinitis should be counseled that medical intervention will be necessary to alleviate their symptoms rather than surgery. A history of bleeding diatheses, asthma, chronic obstructive pulmonary disease, diabetes, and immune disorders is also important, because these will have an impact on intraoperative management and postoperative healing. The patient's medication usage should be recorded, particularly nasal decongestant sprays.

For most primary and secondary rhinoplasties, smoking is not a contraindication, although the increased risk of infection, tissue necrosis, and prolonged healing should be discussed. Complex revisions of skin-soft tissue envelopes damaged by infection,

fillers, or alloplastic implants are at a much higher risk for complications and should be delayed until the patient stops smoking completely. Ideally, all patients should quit smoking 6 to 8 weeks before surgery.

The physical examination begins with visual inspection of the frontal, lateral, and basal views. The external manifestations of various anatomic irregularities were discussed in the previous section. Palpation helps to assess the strength of the lower lateral cartilages and caudal septum. In revision patients, palpation will aid in differentiating soft tissue from structural abnormalities and assessing the elasticity of damaged skin.

Anterior rhinoscopy with a nasal speculum can identify caudal septal deviations, internal nasal valve collapse, and inferior turbinate hypertrophy. It is prudent to perform nasal endoscopy in any patient who complains of nasal obstruction. A rigid zero-degree scope can be introduced under direct visualization or with a camera and monitor. The presence of a septal perforation, synechiae, polyps, concha bullosa, or mucopurulent drainage necessitates additional rhinologic workup.



Photography is an integral component of the rhinoplasty consultation. Standard views include frontal, lateral, oblique, and basal views. Photographs are taken with two umbrella lights each positioned behind the camera at a 45-degree angle to the patient. A frontal photograph with a single midline umbrella light positioned behind the camera improves the contrast between light and shadow and provides better visualization of nasal contours. Additional views include closeups of all standard views, an inspiratory basal view to assess external valve collapse, and smile views. Patients with vertically oriented smiles (that is, the corner of the mouth goes up instead of moving laterally) who will be undergoing placement of an extended spreader graft may develop a transverse upper lip crease when they smile.



Imaging software is an excellent tool for demonstrating operative goals. Modified photographs can help patients communicate their goals more effectively and provide the surgeon with a visual surgical template. It is imperative, however, that realistic imaging of an obtainable outcome be shown. In the senior author's practice (D.M.T.), preoperative digital imaging is performed, and copies of these simulated results are provided for the patient to take home. He or she is encouraged to review the photographs and schedule another visit if modifications or clarification is necessary. However, producing virtual results with the patient present should only be performed after considerable experience, because it requires deft use of the software and knowledge of what is surgically achievable. Likewise, photo imaging should not be performed by ancillary staff, who may not have knowledge of realistically achievable results. If used properly, photographic imaging can be a powerful tool in the surgical practice.

Preoperative Planning

Patients are positioned supine on the operating room table with the head supported by foam. Operative frontal, lateral, and basal photographs are taken after intubation.



Convexities and concavities are marked before local anesthetic is injected so that deformities can continue to be identified despite the inevitable edema from the injection and operative manipulation. Local injection of the tip, nasal spine, dorsum, side-walls, septum, and vestibular mucosa incision lines is then performed with 1% lidocaine with 1:100,000 epinephrine. Vigorous injection of the septum facilitates hydrodissection of the mucoperichondrial flaps.

An inverted-V incision is outlined midway between the superior extent of the columella and the medial crural footplates. A straight-line columellar incision should be avoided to prevent scar contracture and columellar notching. In patients whose noses will be deprojected, the incision should be outlined slightly higher to accommodate its eventual inferior movement.

Operative Technique

Incision and Dissection

The various benefits and drawbacks of endonasal and open rhinoplasty are a frequent topic of debate. Many advanced tip-grafting techniques require suture fixation and are best accomplished by the open approach. Flap elevation and closure warrants close attention and meticulous technique.



The anterior columellar portion of the incision is performed with a No. 11 blade. For precise incision placement, the blade is moved in a sawing motion. The lateral limbs are incised very superficially to avoid transecting the medial crura. The vestibular portion of the columellar incision is more easily completed with a No. 15 blade. Grasping and turning the tip with the left hand exposes the columella. The incision is extended up toward the vestibular apex, but not blindly into it.

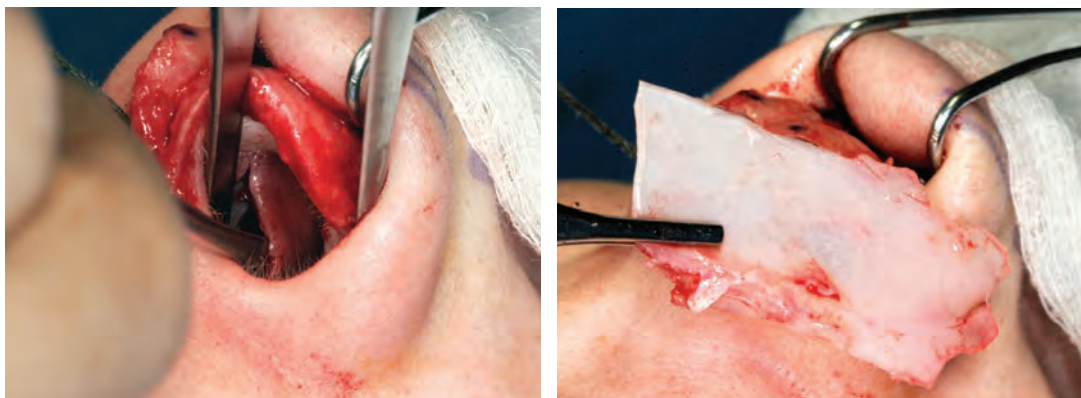
The marginal incisions are performed next. Using a wide double-pronged skin hook, the lateral crura are exposed. Gentle palpation with the scalpel can help identify the caudal edge of the lateral crura. The incision is then performed from lateral to medial but is stopped short of the vestibular mucosa beneath the dome. At this point the marginal incision has not yet been connected to the columellar incision.

Elevation of the skin–soft tissue envelope over the medial crura begins using Converse scissors, exercising care to avoid transecting the medial crura. As the dissection approaches the intermediate crura, it is important to dissect within the suprapreri-chondrial plane. This plane is often identified by its wispy connective tissue and lack of bleeding.

Once the skin flap has been elevated over the intermediate crura, the marginal incisions can be completed. A wide double prong skin hook is used to expose the vestibular apex and the incision is completed with the Converse scissors. Direct visualization permits precise incision placement. Dissection over the domes is facilitated by simultaneous caudal lower lateral cartilage retraction and cephalad skin flap retraction. Careful dissection over the lateral crura ensures that the caudal margin is not inadvertently transected.

Dissection continues in the suprapreri-chondrial plane onto the anterior septal angle and over the upper lateral cartilages; a Converse retractor facilitates visualization beneath the flap. Once the rhinion is encountered, the nasal bone periosteum is incised with the sharp edge of a Joseph periosteal elevator. The periosteum is raised off the nasal bones with the Joseph elevator.

Septal Cartilage Harvest



Septal cartilage is the first choice for grafting material because of its location, strength, and flexibility. There are multiple approaches for septal cartilage harvest; the choice depends on the work to be undertaken. A Killian incision may be used for rhinoplasties in which repositioning of the tip, columella, or nasal base is not necessary. If more extensive work is needed and the nose requires shortening, lengthening, rotation, or deprojection, dissection between the medial crura to expose the caudal septum may be beneficial. The interdomal space is divided, and dissection is carried onto the anterior and posterior septal angles; extended dissection requires division of the upper lateral cartilages from the dorsal septum. Entering the interdomal space and separating the upper lateral cartilages allow maximal septal exposure and precise control of nasal base and tip position.

Mucoperichondrial flap dissection in the subperichondrial plane ensures a relatively bloodless dissection. The proper plane is entered by scoring the septum with a No. 15 blade and then dissecting the flap with a Freer elevator. Dissection is carried back to the bony-cartilaginous junction bilaterally. If the bony septum is deviated, flap elevation continues posteriorly and the deviated portion is resected.

In harvesting septal cartilage, it is important to leave a 1 to 1.5 cm L-strut intact to provide nasal support. Additional cartilage may be left beneath the keystone area of the upper lateral cartilages to ensure dorsal support, particularly in patients with short nasal bones. Careful dissection of posterior septal cartilage between the perpendicular plate of the ethmoid bone and the vomer will ensure maximal length to the septal graft.

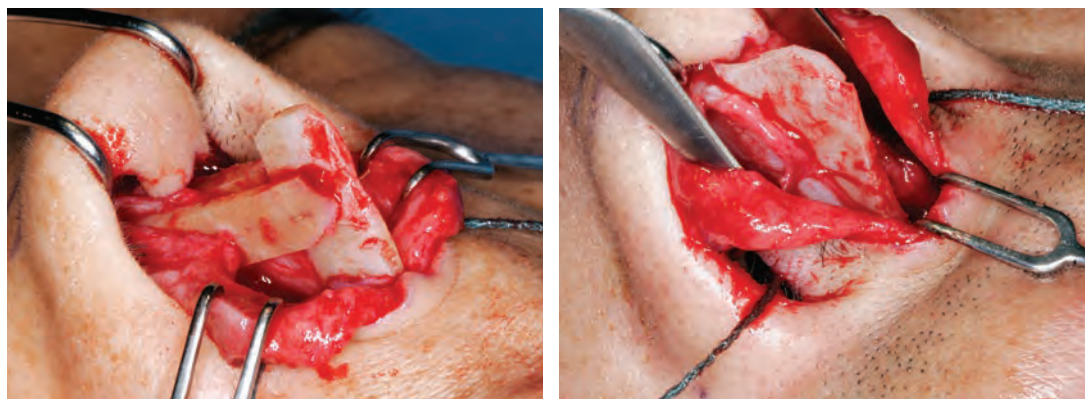
Costal Cartilage Harvest

Details of costal cartilage harvesting and carving are presented in Chapter 59. It is worth reiterating, however, that postoperative warping can be avoided by early and sequential intraoperative graft carving. Somewhat counterintuitively, bent pieces are often preferred to straight pieces, because the warping has commenced in the operating room and can be used to the surgeon's advantage.

Nasal Base Stabilization

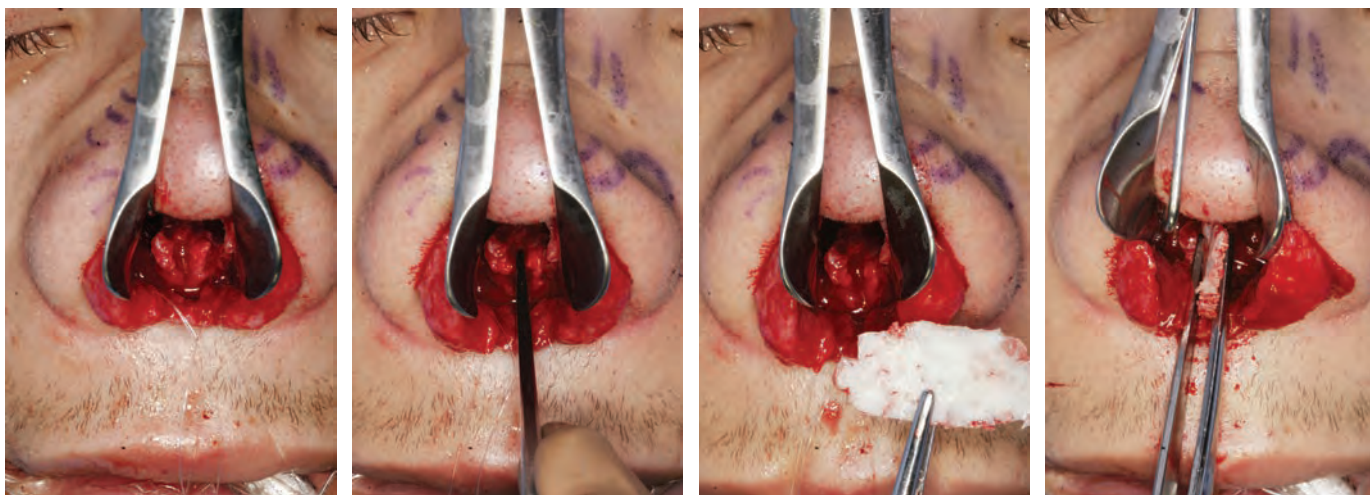
The nasal base is the foundation of the lower third of the nose and maintains tip position; anatomically, it is composed of the caudal septum and its soft tissue attachments to the lower lateral cartilages. Stabilization of the nasal base is a prerequisite for tip contouring. A weak nasal base requires overcorrection of projection and rotation in anticipation of postoperative loss of projection. Consistent results require precise intraoperative tip positioning on a stable base that is resistant to postoperative skin–soft tissue envelope contraction.

A graduated approach to nasal base stabilization is prudent. Patients at risk for postoperative loss of tip projection are those with weak lower lateral cartilages, a short caudal septum, and short medial crura. The nasal base of patients with long, strong medial crura can be stabilized with a columellar strut placed into a pocket dissected between the medial crura. In patients requiring rotation or shortening, the medial crura can be fixed to the midline caudal septum in a tongue-in-groove fashion.



Patients requiring nasal lengthening or significant projection need strong support to resist the skin–soft tissue envelope contractile forces. Lengthening is accomplished with a caudal septal extension or replacement graft. Caudal septal extension grafts can be placed end-to-end or overlapped, depending on the position of the caudal septum. End-to-end grafts are stabilized with two sets of bilateral splinting grafts sutured with 5-0 PDS sutures. A slightly deviated caudal septum can be lengthened

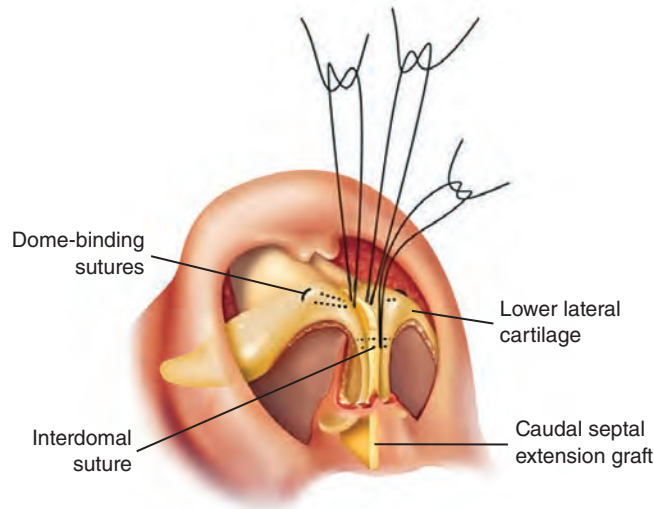
with an overlapping graft if the caudal margin of the graft is midline. The graft is secured with horizontal mattress 5-0 PDS sutures. The overlapping cephalic edge of the graft is beveled so the airway is not obstructed. End-to-end grafts are preferred because they are less likely to cause deviation or airway obstruction.



Patients with a severe caudal septal deviation, deficient septum, or nasal cant may benefit from a caudal septal replacement graft. In these cases, the caudal septum is removed while a strong dorsal strut is left intact. Spreader grafts are inserted up to the osteocartilaginous junction and extend beyond the end of the dorsal strut to stabilize the caudal septal replacement graft. Dissection is carried down through the interdomal space onto the nasal spine. After removal of the caudal septum, a straight 5 mm osteotome is used to make a notch in the nasal spine and set the midline of the nasal base. Creation of a wedge-shaped notch acts as a graft fixation point and allows precise and stable graft placement. The nasal spine may not be centered, such as in deviated noses, and the notch may need to be set off of the nasal spine midline. Before graft placement, two 4-0 PDS sutures are placed through the periosteum on each side of the notch and left untied. If no tissue is available for suture placement, a hole can be drilled through the nasal spine with a 16-gauge needle. Once the graft is placed within the notch, the suture is passed back through the graft and tied.

Cartilage from the septum or rib is preferred for caudal septal replacement and extension grafts. Equivalent strength with auricular cartilage requires thicker grafts, which can excessively widen the columella and block the airway. Costal cartilage is strong enough to resist postoperative contractile forces in complex revisions where scarred skin–soft tissue envelopes need lengthening and projection.

Tip Projection



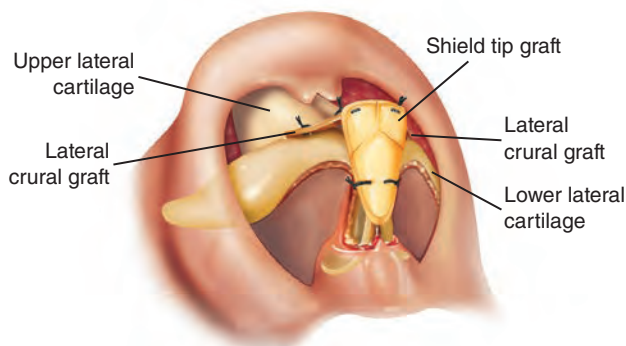
Multiple techniques are available to increase tip projection. Minor increases in projection can be obtained with suture contouring alone. Dome-binding sutures can be placed within the native domes or used to recruit lateral crura. The lower lateral cartilages may also be advanced on a stable nasal base and fixed with transeptal 4-0 plain gut sutures. This technique will blunt the nasolabial angle, which may or may not be a beneficial change. When these techniques prove insufficient, tip grafting is required.



Mild increases (1 or 2 mm) in tip projection can be attained with tip onlay grafts. These grafts are trimmed into a rectangular or elliptical shape to simulate the ideal tip highlight and are sutured directly over the domes in a horizontal orientation. Any type of cartilage may be used, although the cephalic trim of the lateral crura is ideal for mild increases, because its soft edge blends easily with the native cartilages. For greater increases in projection, thicker or multiple pieces of septal cartilage or soft tissue may be necessary.



Larger increases in projection can be obtained with shield tip grafts. The graft shape simulates the divergent intermediate crura and paired tip-defining points. Beveled edges facilitate graft camouflage. The shield tip graft is sutured to the intermediate crura and projects above the domes. The additional projection carries an increased risk of graft visibility, particularly in patients with thin skin. However, the graft's leading edge stretches and thus refines the thick-skinned tip. Slight graft flexion, often caused by compression from the skin–soft tissue envelope, helps preserve the double break. Support grafts (cap or buttress grafts) can be placed behind the shield graft to resist excessive cephalic pressure.



Smoothing the transition from the shield graft to the lateral crura is crucial to preserving a smooth tip–alar lobule junction and preventing shadows that isolate the tip. Lateral crural grafts extend from the existing lower lateral cartilages to the posterosuperior aspect of the shield graft and are secured with 6-0 PDS suture. They are used primarily when the shield graft projects more than 3 mm above the existing dome structures.



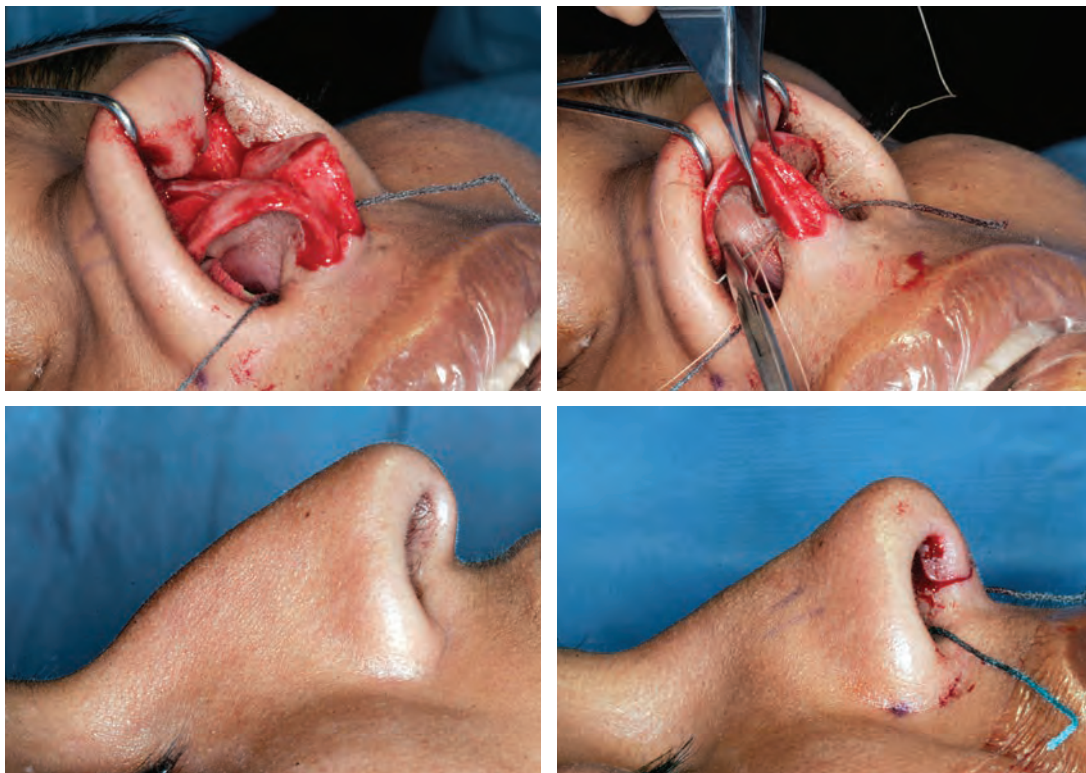
Skin thickness dictates the amount of camouflage necessary to prevent graft visibility.

Thick skin may require none, whereas thin skin requires several layers. Perichondrium is an excellent tissue for this purpose, especially thick, fibrous, costal perichondrium. Gently crushed septal cartilage, auricular cartilage, or scar tissue is also useful. These materials can be sutured over or around the leading edge of the shield graft to prevent graft visibility.

Greater tip projection increases the distance between the domes and anterior septal angle, thus increasing the supratip break. The visible supratip break reflects the skin thickness draped over this height. In a projected tip on a stable base, 4 to 6 mm between the dome and anterior septal angle is appropriate for thin skin, whereas 8 to 12 mm may be needed for thick skin. Too large a supratip break may appear as a scooped dorsum or mild saddle deformity. Supratip grafts can be sutured to the cartilaginous dorsum to ease the transition and improve the overall nasal profile.

Tip Rotation

Smaller degrees of tip rotation can be achieved simply by placing a columellar strut and dome-binding sutures. This maneuver will increase tip projection and often produce moderate tip rotation; the amount of rotation depends on the prominence of the caudal septum and its contribution to the ptotic tip. Trimming the caudal septum can result in tip rotation but is unreliable. Tip rotation can also be achieved by shortening the lateral crura or by performing a lateral crural division and overlay (the lateral crural steal technique described by Kridel and colleagues). Alternatively, tip rotation can be controlled by setting the medial crura into position about the native or extended caudal septum.



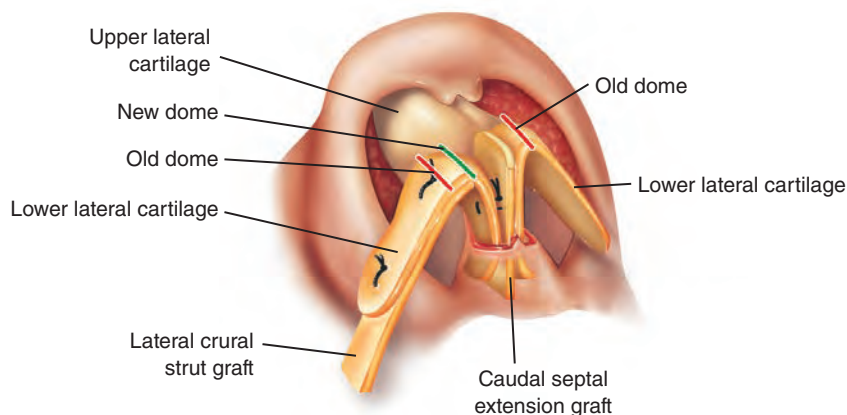
When excessive nasal length is caused by a redundant caudal septum, tip rotation can be achieved by dissecting between the medial crura and suturing them to the existing caudal septum. This maneuver will result in shortening of the nose and rotation of the nasal tip. The caudal septum is not trimmed but rather used as a fixation point to create tip rotation. The degree of rotation can be increased by moving the domes more cephalad than the lower segment of the medial crura. Once rotation is achieved using this method, there may be redundancy of the lateral crura that may require dissection of the lateral crura and repositioning. Maneuvers used to rotate and project the tip may also flatten the infratip lobule. Lack of a double break on tip profile will give the nose an unnatural, beaklike appearance. Infratip grafts can be sutured to the medial crura to recreate the ideal contour.

Tip Refinement

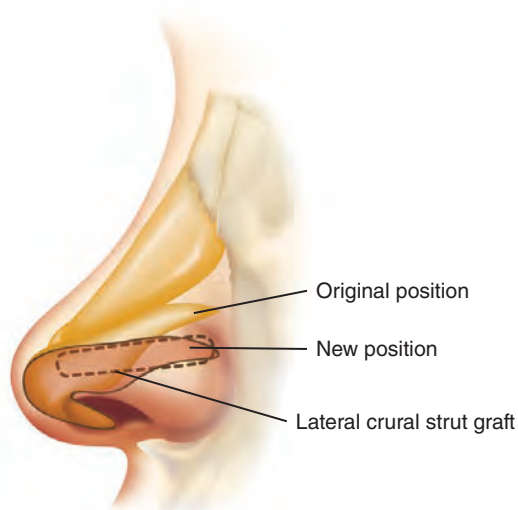
Tip refinement refers to the overall size, shape, and definition of the tip. The shape and width of the domes and the size and position of the lateral crura determine whether the tip is aesthetically pleasing. Large lateral crura should be trimmed cephalically; leaving behind 8 to 10 mm of width is advisable, although the precise amount resected depends on the shape and intrinsic strength of the cartilages. Dome-binding sutures refine and narrow the tip. Residual tip bulbosity after trimming and suture contouring is often caused by cephalically oriented lateral crura or residual deformity of the lateral crura. Dome-binding sutures may also deform the lateral crura by leaving an unnatural bulge lateral to the dome sutures or near the alar groove.



Lateral crural strut grafts can be used effectively to reposition the lower lateral cartilages, refine the tip, and enlarge the nasal airway. Lateral crural strut grafts are sutured to the undersurface of the lateral crura to position the cartilages in a flatter, stiffer orientation; they can then be effectively narrowed without bulging laterally. The lateral crura are freed from the underlying vestibular mucosa; local anesthetic is injected to facilitate the dissection. Septal cartilage is strong and flexible but not always available. The strength of costal cartilage permits reduced graft thickness at the expense of increased tip rigidity. Auricular cartilage is often too thick for this application. Grafts are generally 1 to 1.5 mm thick, 5 mm wide, and 25 to 30 mm long, although the exact length depends on the degree of airway collapse and alar retraction.



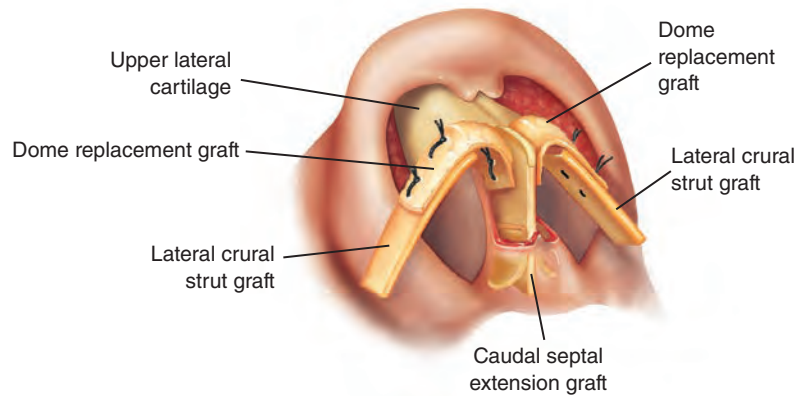
The position of the domes can be altered with lateral crural strut grafts. This technique is applied primarily in an overprojected nose to decrease tip projection and counterrotate the tip. Precise positioning of the medial graft edge creates a new tip-defining point along the intermediate crura or medial to the original dome. Positioning the lateral crural strut graft medially moves the old dome lateral to the new one and deprojects and counterrotates the tip. The new dome's position is fixed by placing transdomal 5-0 PDS sutures through the medial margin of the graft and native lower lateral cartilages; the suture is tied between the new domes to hide the suture knot. A limited increase in tip projection can be obtained by moving the medial margin of the lateral crural strut graft lateral to the existing dome. Tip projection is more commonly increased by advancing the nasal base on a stable strut or extension graft or with a shield tip graft.



Cephalically oriented lateral crura can be repositioned once lateral crural strut grafts are in place. A pocket is dissected caudally in the alar skin–soft tissue envelope with Converse scissors. The pocket is typically placed just caudal to the alar groove. Placement of the strut graft within this pocket will decrease the cephalic tip bulbosity and

improve retracted alae. Precise placement of the pockets is critical to producing symmetrical alar margins and nostrils. If the nostril shapes or alar margins are asymmetrical preoperatively, the two pocket locations must be altered to compensate for these differences.

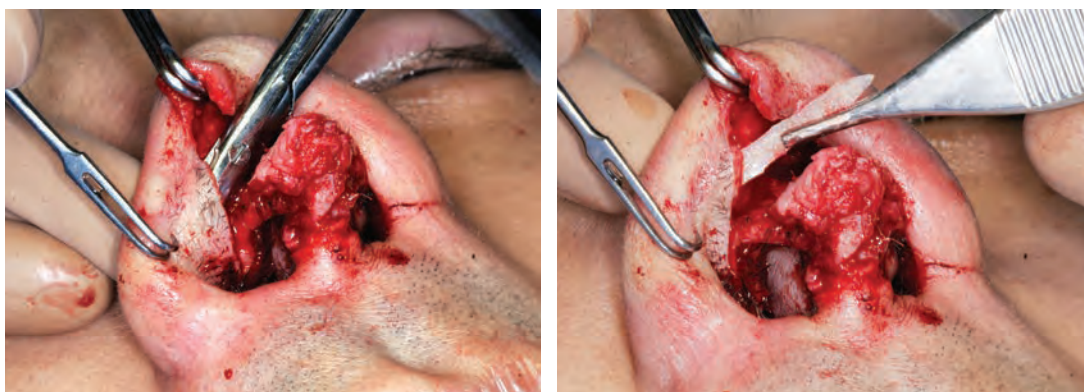
In complex revision cases, the native domes and lateral crura may be severely deformed by scar tissue, multiple grafts, and overresection. If no useable intermediate or lateral crura exist, new ones can be shaped from dome replacement grafts.



Dome replacement grafts are first sutured to the existing medial crura; in some cases, they can be sutured directly to the caudal septal extension or caudal septal replacement graft. Soft, flexible tissue is ideal for the dome grafts. Thin septal cartilage, scar tissue, and rib perichondrium are good options, although a remnant lateral crural graft with attached scar tissue is ideal because of its flexibility and strength. Lateral crural strut grafts can be sutured to the lateral aspect of the dome replacement grafts to provide lateral wall support. They should measure 25 to 32 mm in length depending on the size of the nose and the amount of lateral wall support needed. Ideal lateral crural strut grafts are slightly curved, and the concave side is oriented toward the nasal airway to ensure airway patency. Once the lateral crural strut grafts are in place, domes can be created by placing 5-0 PDS dome sutures bilaterally.

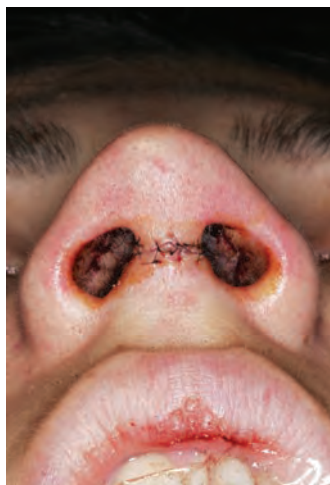
Nostril Reshaping

In addition to base reduction techniques, nostrils can be reshaped with grafting. Lateral crural repositioning is perhaps the most powerful method of pulling down retracted alae and recreating nostril shape on frontal view. Lateral crural overresection in traditional reductive rhinoplasties often led to alar collapse that isolated the tip in circumferential shadows. Alar retraction exaggerates the “gull in flight” contour on frontal view and contributes to the abnormal alar-columellar relationship on profile. As previously described, lateral crural strut grafts can be used to reposition the alae more caudally. It is essential to make the pockets for the repositioning caudally and down to the piriform aperture to ensure adequate alar movement. When moving the ala caudally, the pocket created for the lateral crura should be even more caudal and closer to the alar margin. Often this maneuver will result in increased alar flare, which must be addressed with alar base reductions.

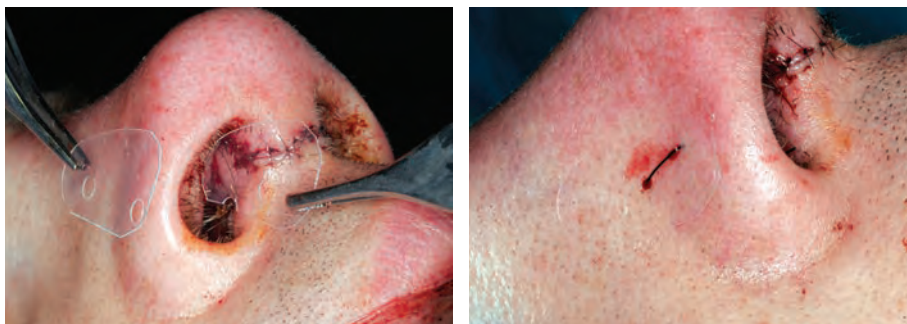


Further improvement in nostril shape can be obtained with alar rim grafts. These can help recreate and support the tip-alar transition and correct alar concavities. Alar rim grafts are typically 2 to 3 mm wide and 12 to 15 mm long. A pocket is carefully dissected caudal to the marginal incision, and the graft is slid into the pocket. It is held in place with a single 6-0 Monocryl suture. The medial graft edge should be gently crushed with Adson-Brown forceps to prevent visibility. Alar rim grafts help correct the alar concavities seen on the basal view and create a smooth transition from tip lobule to alar lobule.

Closure



Closure begins by reapproximating the skin flap with a single deep 6-0 Monocryl suture. The marginal incisions are then carefully approximated with 5-0 chromic gut; poor reapproximation can lead to the development of vestibular webs and nasal valve stenosis. The columellar skin is closed with 7-0 nylon vertical mattress sutures placed perpendicular to the incision line apices. Precise closure at the columellar edge is crucial to prevent visible contour irregularities. The spaces in between are then filled with vertical mattress or simple interrupted sutures, depending on the amount of eversion needed. The vestibular portion of the columellar incision is closed with single interrupted 6-0 fast-absorbing gut sutures. Meticulous technique helps to camouflage the scar.



Lateral wall splints fashioned from 0.25 mm bivalve septal splints facilitate integration of lateral crural struts. The bivalve septal splint is cut in half and the edges trimmed. One piece is placed intranasally and the other across the sidewall and ala. The splints are sutured in place with a single 3-0 nylon suture placed through-and-

through the sidewall, and the knot is tied intranasally. To account for the lateral wall edema and prevent skin ulceration or necrosis, the knot should be loose enough to allow passage of a needle-holder tip. Folded, nonadherent gauze packs are placed bilaterally, depending on the quantity of intraoperative bleeding. Vestibular splints also fashioned from 0.25 mm bivalve septal splints may be placed to stent constricted airways and to help preserve the lateral position of lateral wall grafts.

A narrow strip of nonadherent gauze is placed over the dorsum from the radix to the supratip. The nose is then taped with ¼-inch reinforced paper tape, and a thermoplastic cast is applied to the dorsum. Bacitracin is applied to all suture lines. A gauze drip pad is placed across the nose. Nonadherent gauze and a transparent dressing are used to cover the chest incision at the harvest site.

Postoperative Care

A broad-spectrum antibiotic is prescribed postoperatively for up to 2 weeks. Patients are encouraged to take acetaminophen for pain, although hydrocodone/acetaminophen pills are prescribed for more severe pain. Nonadherent gauze packing and vestibular splints are removed on postoperative day 1. The chest dressing is removed on postoperative day 2. The columellar and chest sutures, nasal cast, and lateral wall splints are removed on postoperative day 7. Alar base reduction sutures are removed on postoperative day 14. Patients return to the office for two additional visits the first month, monthly for the next two visits, and then bimonthly for two visits.

Correction of minor asymmetries with compression maneuvers can begin 3 weeks after surgery. Patients are directed to apply pressure to specific areas for 1 minute 10 times daily. Silicone sheeting is provided for chest wounds 3 weeks after surgery. Patients are instructed to tape the sheeting over the scar nightly and clean it with alcohol in the morning; sheets are changed monthly.

Walking may begin on postoperative day 1, but patients are asked to refrain from strenuous physical activity for 6 weeks. Swimming is restricted for 4 weeks; afterward patients may swim in chlorinated pools only for the next 2 months. Patients may wear glasses while their cast is still in place. Thereafter, patients are asked to bring glasses to the office so that their resting position on the nasal bridge can be assessed.

Problems and Complications

The most common complication after surgery is residual asymmetries, especially in difficult revisions or congenital or traumatic cases. The likelihood that asymmetries may develop is strongly correlated with the patient's skin thickness. Thick skin remains edematous for much longer after surgery and will tend to hide many irregularities; even minor irregularities will show through thin skin.

Nostril asymmetry can be one of the most difficult problems to correct in revision patients. Preference is given to aligning nostrils on frontal view. An appropriate alar-columellar relationship on lateral view is the next goal in nostril reshaping. Symmetry on the basal view is the most difficult to achieve, but fortunately the least visible.

Additional complications include bleeding, infection, and scarring. Epistaxis is uncommon after surgery and can often be treated with oxymetazoline spray. Recalcitrant bleeding may require application of hemostatic agents, packing, or operative intervention. The risk of infection is very low but increases substantially in patients who have had multiple procedures. Any suspicion of nasal cellulitis should be treated quickly and aggressively. A low threshold for incision and drainage in the operating room is prudent, since chronic abscesses can smolder and destroy nasal cartilage grafts or, in the worst cases, irreparably damage the skin envelope.

Careful attention to closure of the transcolumellar incision can maximize scar camouflage. Poor scars can be treated with dermabrasion or revision. Improper closure of marginal and intracartilaginous incisions can lead to vestibular scarring. Even the smallest scars or webs can compromise the internal nasal valve and drastically decrease nasal airflow. Repair often requires placement of an auricular composite graft.

Base reduction and chest incisions can be especially troublesome, particularly in thick-skinned ethnic patients, such as Asians and mestizos. Silicone sheeting, steroid injections, and dermabrasion can all be used to improve the appearance of hypertrophic scars.

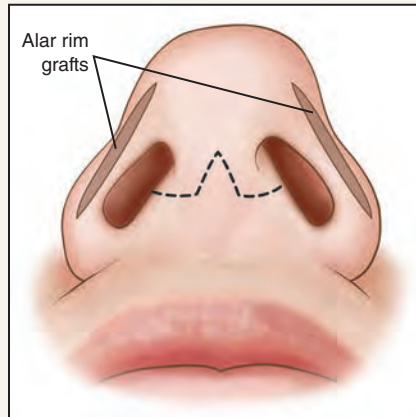
Results



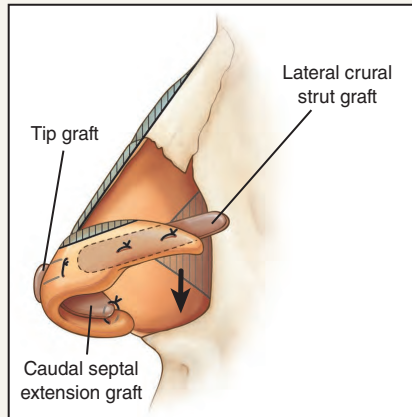
This 17-year-old patient requested nasal refinement. She reported nasal dyspnea during exercise. On frontal view, she had a narrow dorsum, lateral wall pinching, and a bulbous tip with a typical parentheses deformity. On lateral view, she had a dorsal hump, underprojected tip, and an obtuse nasolabial angle. Additionally, she had an underprojected chin. On basal view, she had flared medial crura, a wide columella, and a trapezoidal configuration secondary to her wide tip and lateral wall collapse. Intranasal examination revealed a septal spur along the floor of the left nasal cavity. She also exhibited external valve collapse on inspiration.

Surgical Plan

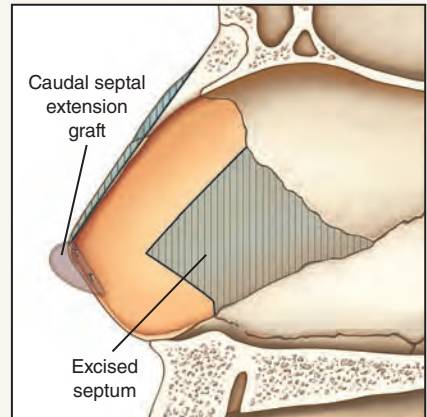
Correction of the patient's nasal airway obstruction required repositioning the cephalically positioned lateral crura. A small caudal septal extension graft was placed to support the nasal base. Spreader grafts were placed to correct the middle vault pinching. The lateral crura were dissected from the vestibular skin and supported with lateral crural strut grafts. The lateral crura were then positioned caudally to correct the cephalically oriented cartilages. A small, soft cartilage graft was placed over the domes to provide some additional tip projection and narrowing. Alar rim grafts were used to create a smooth transition from the tip lobule to the alar lobule. The rhinoplasty worksheet demonstrates the maneuvers performed during her surgery.



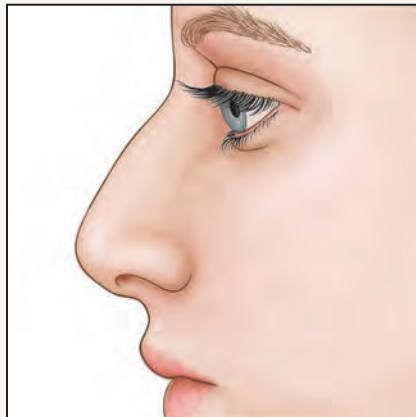
Nasal



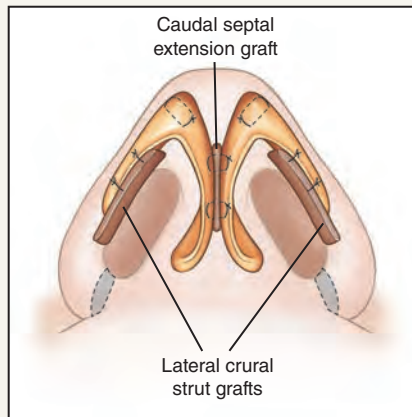
Lower lateral cartilage



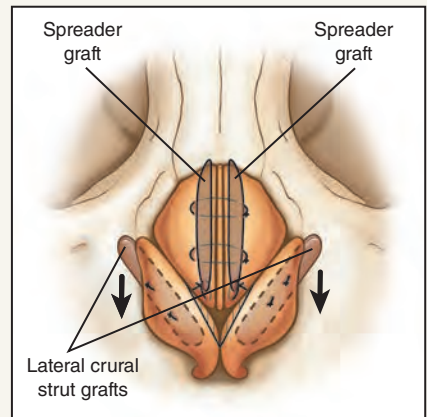
Septum



Lateral



Lower lateral cartilage

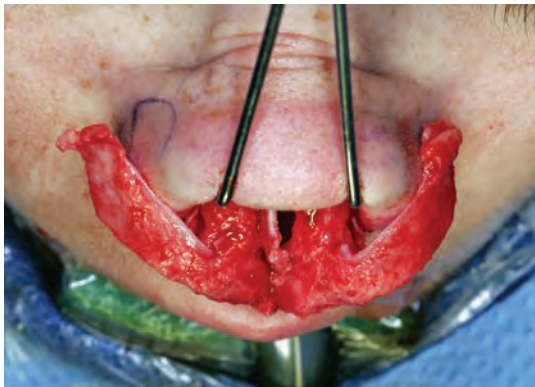


Upper and lower lateral cartilages

Surgical Steps



Inverted-V midcolumellar incision connected to bilateral marginal incisions
Open septoplasty and septal cartilage harvest
Bilateral spreader grafts
Caudal septal extension graft overlapping left septum
Bilateral cephalic trim of lateral crura



Bilateral lateral crural strut grafts, dome sutures, and lateral crura caudal repositioning
Bilateral alar rim grafts
Bilateral alar batten grafts



Crushed cartilage placed over domes





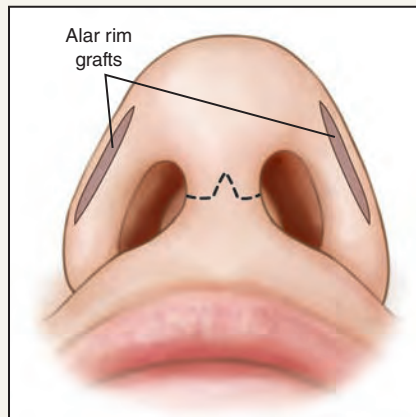
One year postoperatively, she has smooth brow-tip aesthetic lines, improved dorsal width, and a narrower tip. She no longer has a parentheses shape to her nasal tip, and the shadowing of her tip is more favorable. On lateral view, she has a smooth dorsum, increased projection, and an improved nasolabial angle. The basal view reveals a triangular configuration, lateral wall support, and increased nostril size.



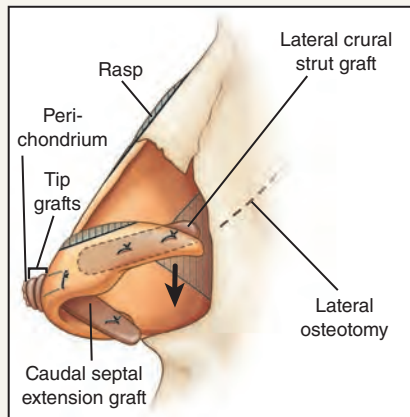
This 19-year-old patient requested rhinoplasty. On frontal view, she had a wide tip and a hanging infratip lobule. On lateral view, she had a slight dorsal hump, an underprojected tip, and an underprojected chin. Her nose appeared dependent because of the downward cant to the nostrils. On basal view, she had flared medial crural footplates and a trapezoidal shape consistent with her wide tip lobule.

Surgical Plan

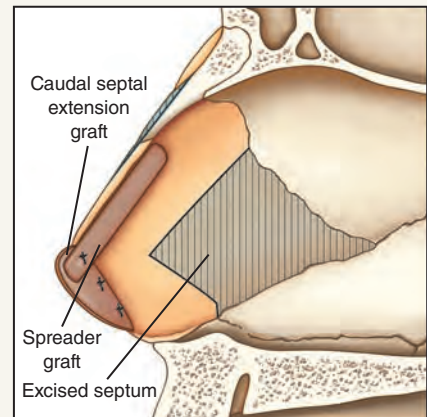
The primary goal was to increase the patient's nasal tip projection. Stabilization of the nasal base using a caudal septal extension graft was an important step in the surgery. The extension graft overlapped the septum slightly and was stabilized with splinting grafts. A dorsal hump reduction was performed and lateral crural strut grafts were placed. The lateral crura were then moved caudally to correct their cephalic position. Onlay tip grafts were placed horizontally over the domes to provide additional tip projection. Bilateral medial and lateral osteotomies were performed. Alar rim grafts contributed to proper tip contour. The rhinoplasty worksheet illustrates the steps performed during her surgery.



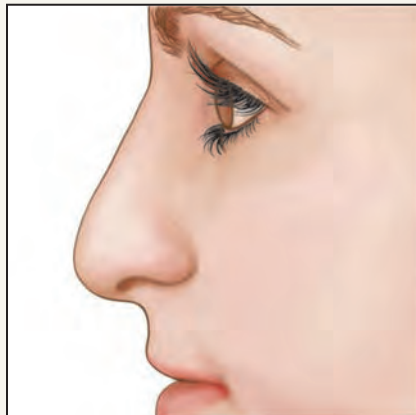
Nasal



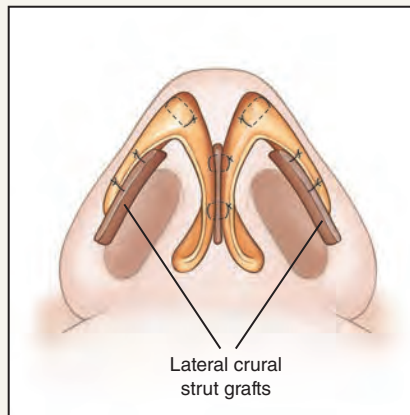
Lower lateral cartilage



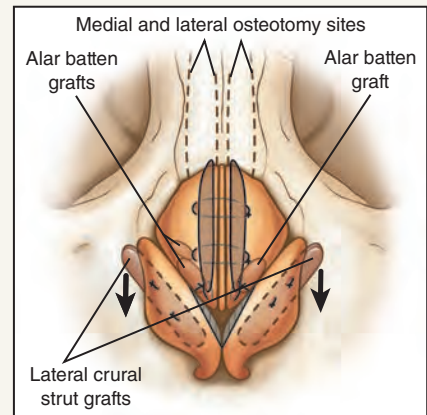
Septum



Lateral



Lower lateral cartilage



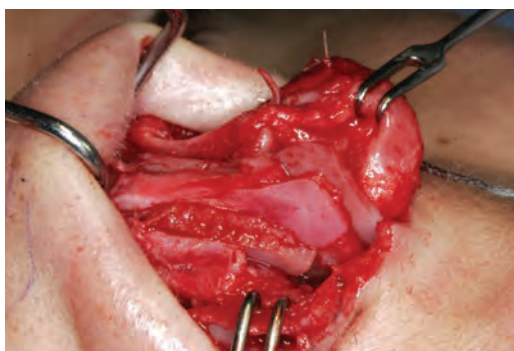
Upper and lower lateral cartilages

Surgical Steps

Submental incision with submental liposuction and placement of a small Silastic extended chin implant



Inverted-V midcolumellar incision connected to bilateral marginal incisions
Dorsal hump rasping
Bilateral medial and lateral osteotomies to narrow the upper third
Open septoplasty and septal cartilage harvest
Bilateral spreader grafts



Caudal septal extension graft overlapping the left side of the septum and stabilized with right splinting graft
Bilateral cephalic trim of lateral crura



Bilateral lateral crural strut grafts, dome sutures, and lateral crura caudal repositioning
Crushed cartilage on domes
Bilateral alar batten grafts





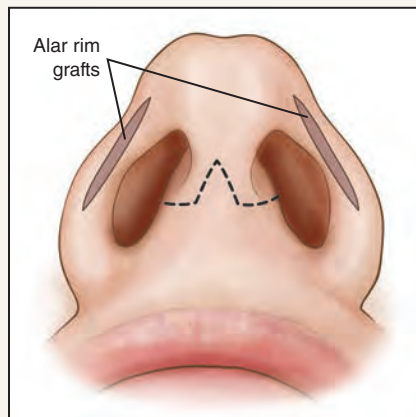
Two years postoperatively, she has a more refined tip and an improved alar-columellar relationship. On lateral view, she has a straight dorsum, increased tip projection, and more favorable angulation of her nostrils. The refined tip and increased projection is reflected in the triangular shape of her nasal base.



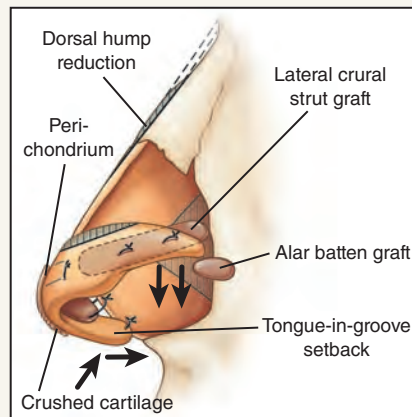
This 46-year-old female patient requested rhinoplasty. On frontal view, she had a narrow dorsum, bulbous tip, and hanging infratip lobule. On lateral view, she had a prominent dorsal hump, overprojected tip, hanging columella, and short upper lip. The basal view revealed a wide, bifid tip and short medial crura.

Surgical Plan

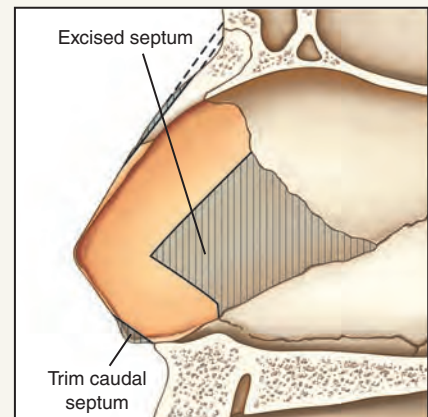
This patient underwent an external rhinoplasty approach and reduction in the overall size of her nose. Fortunately, she had relatively thin skin that was able to contract over time. (If she had had thick skin, there would have been a limitation to the amount of skin shrinkage that could occur, and this would have limited the degree of deprojection and downsizing that her nose would have tolerated.) She had a very large, harvestable segment of septal cartilage. After conservatively trimming the caudal septum, the medial crura were set back and sutured to the septum in a more inferior position to decrease tip projection. This maneuver relaxed the upper lip and created a more favorable nasolabial angle. Dorsal hump reduction was performed and spreader grafts were placed. The lateral crura were dissected from the underlying vestibular skin. Lateral crural strut grafts were sutured to the undersurface of the lateral crura, medial to where the original domes were located, to move the new domes medially and further deproject the tip. Dome sutures were placed to narrow the tip. The lateral crura were then repositioned caudally to correct their cephalic positioning. Additional cartilage was needed, so auricular cartilage was harvested and used for alar batten grafts and alar rim grafts. Alar base reductions were performed to decrease the excess nostril size caused by deprojecting the tip. The rhinoplasty worksheet illustrates the maneuvers performed during her surgery.



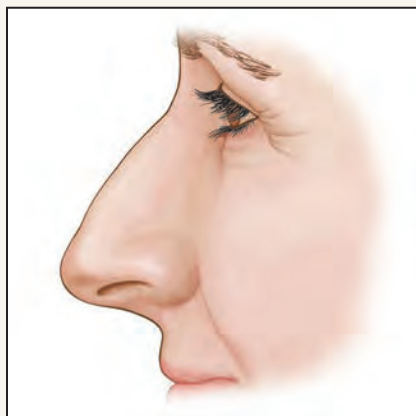
Nasal



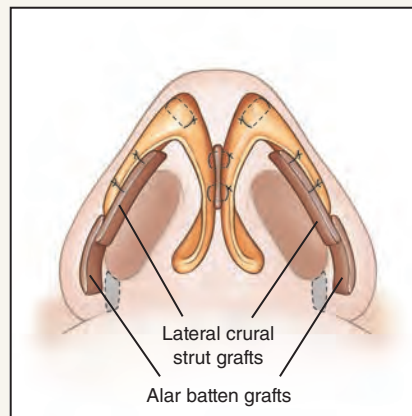
Lower lateral cartilage



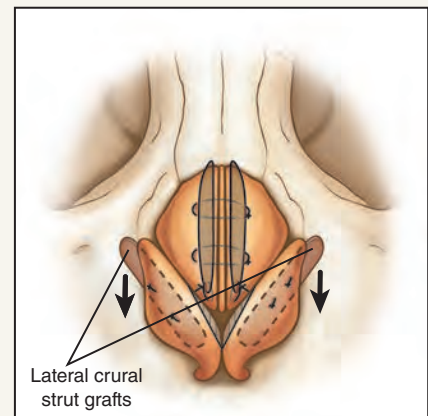
Septum



Lateral



Lower lateral cartilage

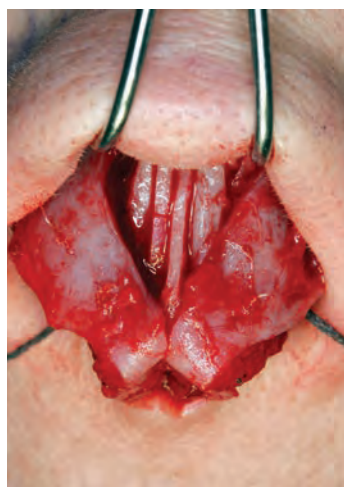


Upper and lower lateral cartilages

Surgical Steps

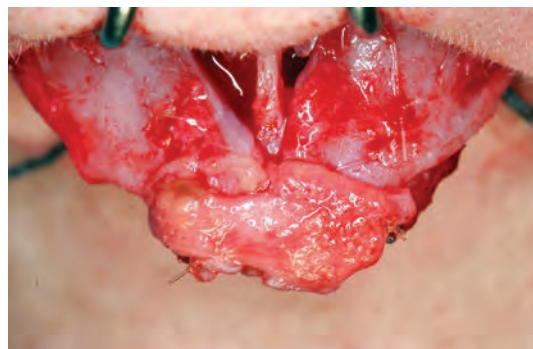


Inverted-V midcolumellar incision connected to bilateral marginal incisions
 Examination of lower lateral cartilages reveals cephalic positioning of the lateral crura
 Dorsal hump reduction
 Open septoplasty and septal cartilage harvest
 Bilateral spreader grafts with two on the right side
 Tongue-in-groove setback of medial crura onto caudal septum with deprojection
 Bilateral cephalic trim of lateral crura



Bilateral lateral crural strut grafts, dome sutures, and lateral crura caudal repositioning; domes moved medially to decrease tip projection
 Right auricular cartilage harvest through postauricular incision
 Bilateral auricular cartilage alar batten grafts
 Bilateral alar rim grafts

Auricular perichondrium and crushed cartilage over domes.





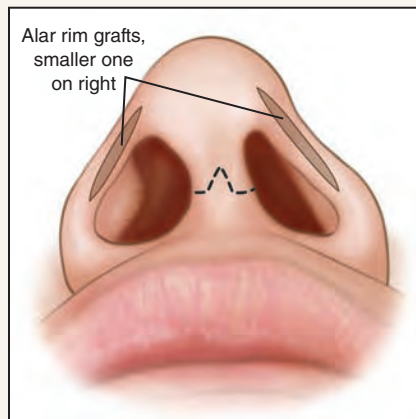
Downsizing the patient's nose left redundant skin, which caused tremendous swelling and a very wide nose in the early postoperative period. It took many months for the redundant skin to shrink. After 18 months, she has smooth brow-tip aesthetic lines and a narrower, more refined tip. On lateral view, she has a straight dorsum, decreased projection, a shorter nose, and a softer nasolabial angle. Shortening her nose has resulted in a longer upper lip. The basal view reveals a rounder tip lobule without bifidity.



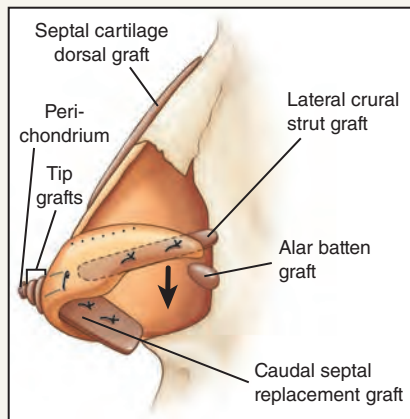
This 51-year-old woman complained of nasal deformities and obstruction. She had undergone a primary rhinoplasty 13 years before and a revision 1 year thereafter. On frontal view, her nose was deviated to the right. She also had collapse of the left upper lateral cartilage and pinching of the tip. On lateral view, her nose was under-projected with a mild polly-beak deformity. The basal view revealed left lateral wall collapse and nasal deviation to the right. Intranasal examination revealed a high left septal deviation obstructing the nasal valve and a right posterior septal deviation.

Surgical Plan

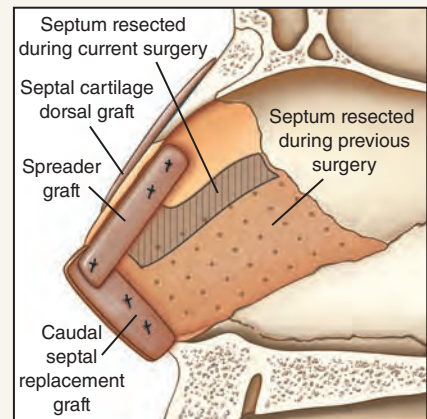
A secondary rhinoplasty was performed using the external rhinoplasty approach. Costal cartilage was harvested to obtain adequate cartilage for grafting. The patient had significant weakness in the nasal tip from previous overresection of the lower lateral cartilages. She had a severely deviated caudal septum that required replacement with a caudal septal replacement graft. This graft supported what remained of the lower lateral cartilages. Spreader grafts were placed to correct the middle nasal vault collapse. The weak, damaged lateral crura were stabilized with lateral crural strut grafts, and the lateral crura were repositioned caudally. Harvested septal cartilage was used for the lateral crural strut grafts to provide a softer nasal tip. Soft cartilage was placed over the domes to provide additional tip projection. A septal cartilage dorsal graft was placed to increase the dorsal height. The rhinoplasty worksheet illustrates the steps performed during her surgery.



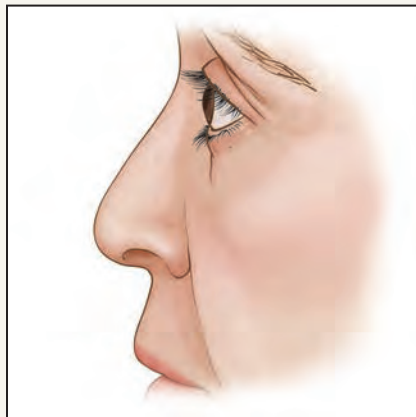
Nasal



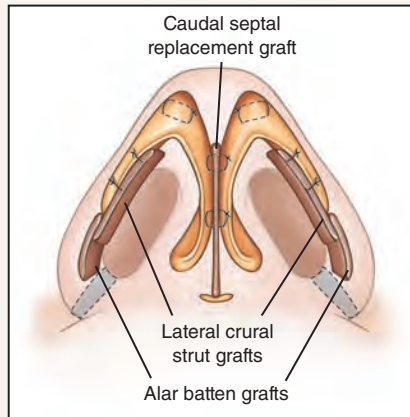
Lower lateral cartilage



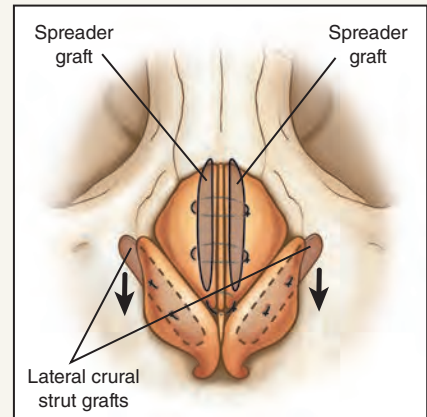
Septum



Lateral



Lower lateral cartilage



Upper and lower lateral cartilages

Surgical Steps

Right inframammary fold incision and sixth rib harvest

Inverted-V midcolumnellar incision connected to bilateral marginal incisions

Open septoplasty and removal of caudal septum because of severe caudal septal deviation

Bilateral costal cartilage extended spreader grafts

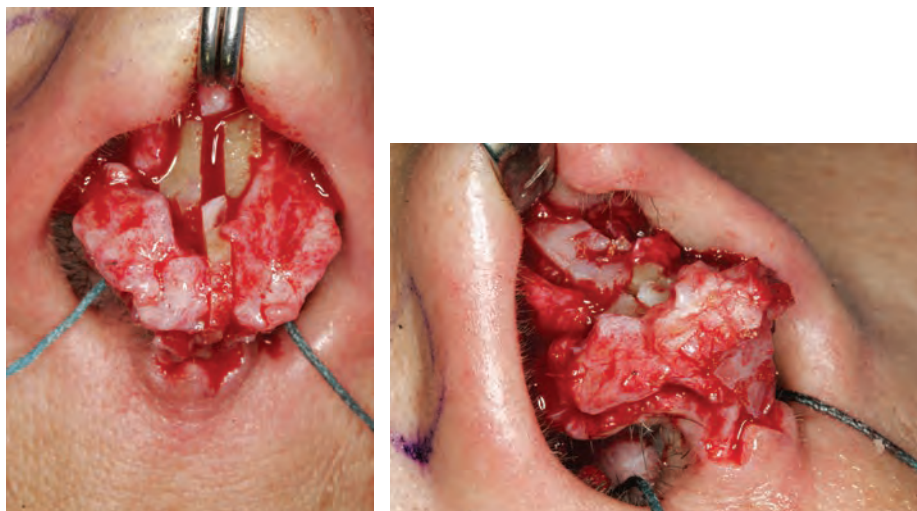


Costal cartilage caudal septal replacement graft sutured to notch in nasal spine and stabilized with spreader grafts

Bilateral septal cartilage lateral crural strut grafts to minimize tip rigidity, dome sutures, and lateral crura caudal repositioning

Bilateral septal cartilage alar batten grafts

Bilateral alar rim grafts



Crushed cartilage and perichondrium over domes

Septal cartilage dorsal graft and supratip graft

Bilateral alar base reductions



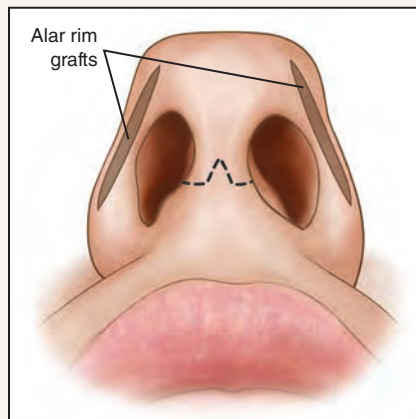
Twenty-six months postoperatively, the patient has excellent nasal respiration. On frontal view, her nose is straight, and the left upper lateral cartilage collapse has been corrected. On lateral view, she has a straight dorsum, increased projection, and increased rotation. The basal view reveals a straight, midline columella and supported lateral walls.



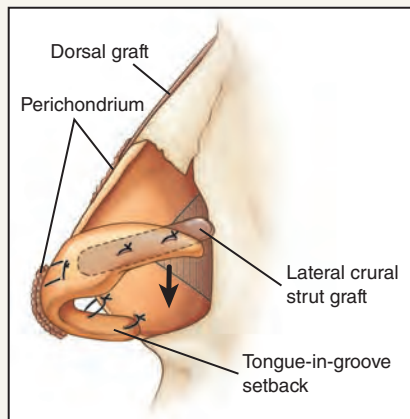
This 43-year-old woman requested correction of her nasal deformity and left-sided obstruction. The patient had undergone rhinoplasty 25 years earlier and gradually developed pinching and nasal obstruction. On the frontal view, she had a narrow middle vault, a wide, bifid tip, a hanging tip lobule, and retracted alae. Her skin was very thin, and the outlines of her lateral crura were visible. On lateral view, she had a hanging columella and retracted alae. The basal view revealed a trapezoidal configuration consistent with her wide tip.

Surgical Plan

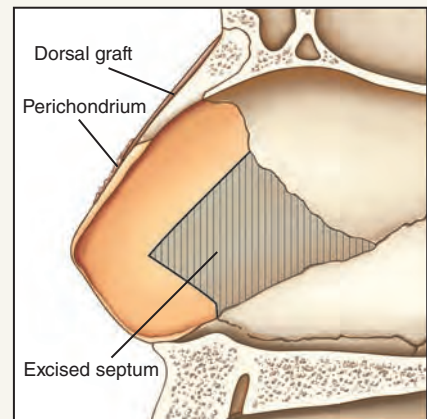
Significant grafting material was required to correct this patient's problems. Costal cartilage was harvested from the right side of the chest. Correction of the hanging columella required setting back the medial crura and suturing them to the caudal septum. This maneuver lifted the columella and improved the alar-columellar relationship. Complete correction of her deformity required dissecting the lateral crura from the vestibular skin, placement of lateral crural strut grafts, and repositioning into caudal pockets. This maneuver pulled both alae caudally into a more favorable position. Longer lateral crural strut grafts were needed to bring the ala down to the proper level. Additionally, alar rim grafts were placed to increase her nostril symmetry. A small dorsal graft was placed to provide proper dorsal alignment. Perichondrium was placed over the domes to camouflage any tip asymmetries.



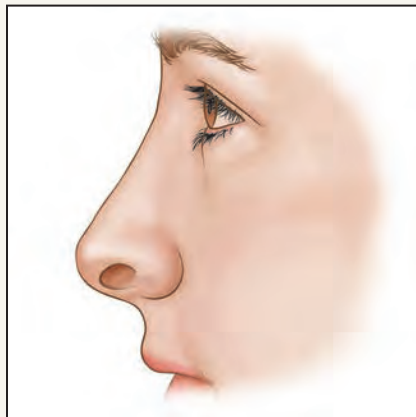
Nasal



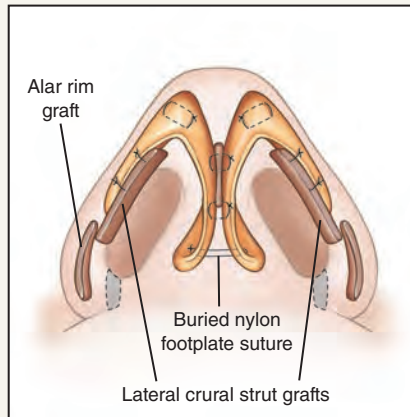
Lower lateral cartilage



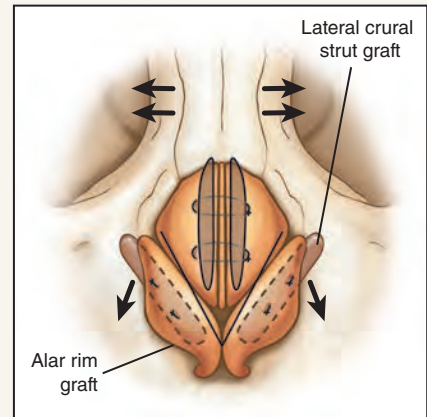
Septum



Lateral



Lower lateral cartilage



Upper and lower lateral cartilages

Surgical Steps

Right inframammary incision and seventh rib harvest



Inverted-V midcolumnellar incision connected to bilateral marginal incisions

Open septoplasty and remaining septal cartilage harvest

Bilateral spreader grafts, thicker on the left side

Tongue-in-groove setback of medial crura onto caudal septum



Bilateral lateral crural strut grafts, dome sutures, and lateral crura caudal repositioning

Bilateral alar rim grafts



Two layers of perichondrium placed over domes

Septal cartilage dorsal graft

Bilateral alar batten grafts



Thirty-four months postoperatively, the patient has appropriate dorsal width, a refined tip, and correction of her alar retraction and hanging tip lobule. On lateral view, she has a shorter nose with less columellar show and a more appropriate alar-columellar relationship. The basal view shows symmetrical nostrils and a triangular shape.

Concluding Thoughts

Refinement of the nasal tip requires control of nasal tip position and shape of the lower lateral cartilages. Stabilizing the nasal base provides a foundation for the tip modification. Once the nasal base is stabilized, the nasal tip cartilage can be modified using dome sutures, cephalic trim, and cartilage grafting. Some of the more common types of grafting include lateral crural strut grafts, alar rim grafts, and tip grafts. Using these grafts, the tip structures can be stabilized and the domes modified. Projection can be controlled using columellar struts, caudal extension grafts, and tip grafts. Use of cartilage grafting for tip contouring minimizes the need for reduction, which can weaken the tip structures, resulting in pinching and collapse. The structural approach to nasal tip refinement provides excellent long-term outcomes and minimizes the potential for tip deformity.

Clinical Caveats

Tip grafting is an integral component of nasal tip contouring.

Indications for tip grafting include increasing tip projection, prevention of post-operative loss of tip projection, nasal lengthening, straightening tip deviations, and correction of cephalically malpositioned lower lateral crura.

Important components of the tip profile are projection, rotation, the supratip break, the infratip lobular double break, and the alar-columellar relationship.

Important components of the tip frontal view are the tip highlight, symmetry, a smooth tip-alar transition, supratip shadow, and the alar-infratip lobule relationship.

Clear, realistic goals are necessary for a successful surgeon-patient relationship.

Judicious use of computer imaging by the surgeon is critical to establishing realistic patient expectations.

Careful incision design and meticulous skin-soft tissue envelope elevation facilitate a successful result.

Nasal base stabilization is a crucial first step for all tip grafting techniques.

Increased projection can be obtained with suture contouring, tip onlay grafts, and shield tip grafts.

Tip rotation can be achieved by suture contouring, caudal septal trimming, lateral crural resection or division and overlay, and fixation to the native or extended caudal septum.

Tip refinement can be improved by trimming the cephalic edge of the lateral crura, suture contouring, onlay and shield tip grafts, or lateral crura repositioning.

Lateral crural strut grafts can refine the tip, reposition the lateral crura, and correct retracted alae.

Alar rim grafts strengthen the external nasal valve and preserve a smooth tip-alar transition.

Close postoperative care and follow-up is important to recognize asymmetries and improve one's techniques.

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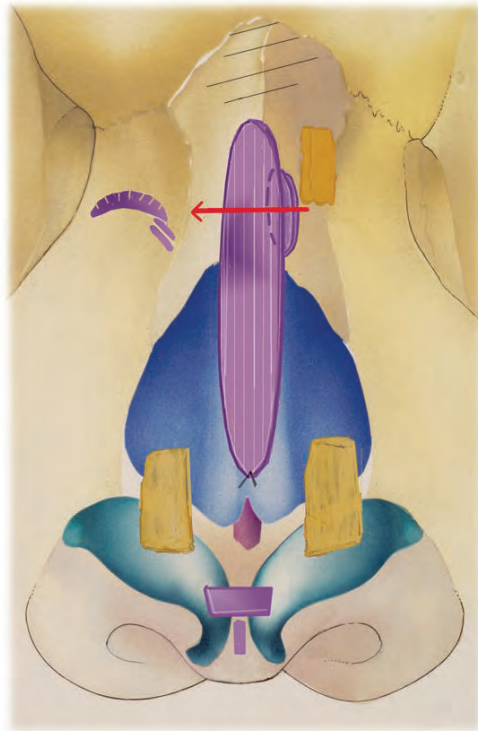
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CHAPTER 57



Secondary Rhinoplasty

GILBERT C. AIACH, OLIVIER F. GERBAULT,
MARTIN H. KELLY

In primary rhinoplasty, the surgeon is faced with numerous anatomic variations of the underlying skeleton as well as variable qualities of the soft tissue cover and the dynamics of the nose. Even if the surgeon manages to exert a positive influence over healing, complete control over the healing process after rhinoplasty is not possible and may alter the outcome after months and even years. Thus it is not surprising to observe defects of varying severity that have resulted from overresection or overcorrection that require a secondary procedure.

Defects observed after primary rhinoplasty are caused principally by these factors:

Errors in judgment: The rhinoplasty may have been technically well done, yet the nose is unbalanced, not fitting with the other components of the face or with the individual's overall appearance.

Technical mistakes: These vary in extent and can lead to distortion of the anatomy, asymmetry of the osteocartilaginous skeleton, and scarring soft tissue. This makes the dissection planes difficult to differentiate and affects the aesthetics and function of the nose.

Unpredicted poor results: In some cases, the planned correction is successfully executed, the surgeon is satisfied with the immediate result, and no apparent technical error occurred, yet the outcome is still suboptimal.

Secondary problems can be classified as minor or major defects.

MINOR DEFECTS Minor defects occur frequently, in 5% to 20% of cases, as assessed by the surgeon. These defects are often accepted by patients who are satisfied with their overall improvement. Some patients with unreasonable expectations may exaggerate minor defects, asymmetries, and prominences. These patients may complain of palpable imperfections. A frequent example is a small deviation of the dorsum or a minute asymmetry of the nostrils that is seldom noted before the operation but is immediately reported by the patient postoperatively. Slight asymmetry of the nasal tip that can be caused by retraction of soft tissue cover may follow the healing process.

MAJOR DEFECTS Over the past two decades, surgeons have become more conservative in their technical approach to rhinoplasty. Better teaching through videos, live surgery, rhinoplasty courses, numerous books, and the use of the open approach have decreased the severity of postrhinoplasty problems. Nevertheless, major defects still occur. These defects may result from excessive and asymmetrical resections or from a failure to understand the importance of the soft tissue environment, the dynamics of the nose, and, of crucial importance, the quality of support of the tip, alae, and middle vault, which have often been damaged.



Most often, major secondary defects are observed in noses that look unnatural and were operated on because of certain frequently encountered features. For example, as seen in this patient, the nasofrontal angle was underresected and the dorsum overreduced, leading to a shortened nose with a round, underprojected tip. In addition, the airway was compromised and internal and external valve function was altered. These defects were corrected through secondary rhinoplasty.

Anatomic and Technical Challenges Posed by Reoperative Surgery

Difficulties encountered during secondary rhinoplasty depend on the degree of nasal shortening, the extent and location of the bony and cartilaginous resections, the condition of the remaining cartilages, the medial crural support, and the suppleness and thickness of the skin cover.

Soft tissues can be scarred and adherent to the osteocartilaginous skeleton as a result of aggressive surgery on the muscular and subcutaneous layers or aggressive defatting. The cutaneous layers may be adherent to the mucosal lining when cartilaginous resections have been excessive. A lack of suppleness of the nostrils increases the difficulty of the exposure.

In patients with thick skin, certain defects can be masked by the thickness of the cover that cannot be thinned out. The most that one can expect in such instances is only moderate improvement, justifying preoperative preparation of the skin by a dermatologist. Limited dissection and placement of the dorsal and tip grafts are recommended to augment rather than reduce the nose. Dead space should also be eliminated.

The thin skin on the nasal tip and lateral aspect of the radix, where soft tissues become thinner toward the eyelid, is unforgiving. Thus the difficulties vary from case to case, and problems can exist at the level of the covering tissues, mucosa, and osteocartilaginous skeleton during the reconstruction.

The Reoperative Rhinoplasty Patient

The psychological profile of a patient undergoing multiple rhinoplasty operations is a key issue. Whereas primary rhinoplasty patients have not been sensitized by a disappointing result, secondary rhinoplasty patients are well aware of the risks of surgery and will frequently ask only for an improvement. As they recall the pitfalls of the first procedure, some may simply request restoration of their original form and function.

One must be careful when a patient's expectations are very high but the defect is significant and the outcome unpredictable. In major defects with excessive scarring, minor surgery is recommended, with placement of a dorsal onlay and alar graft using an endonasal approach with limited dissection.

Despite significant improvement from the primary rhinoplasty, some patients may still present with minor defects; they express confidence in their first surgeon but request further revision. The surgeon must be wary of unhappy patients who complain of very minor defects and expect perfection, or those who present with more significant defects and make disparaging statements regarding their previous surgeon. Sometimes such patients have consulted many experts, and their expectations may be too high.

Preoperative Assessment

Examination

It is important to take a detailed history and closely examine photographs and reports or worksheets of previous surgeries.

Worksheets accurately detailing the position, amount of resection, and grafts (see p. 2027) are very useful. This combination of information helps the surgeon to appraise the original deformities and understand how they were treated, whether the septum or other sites were harvested, and if any complications occurred. Examination of the nose should be conducted in the same manner as in a primary case. The

Number: _____ Last Name: _____ First Name: _____ Anesthesia: Dr. _____

Date: _____ Hospital: _____ Assistant: _____

Specifics: Primary rhinoplasty Deviation Racial
Secondary rhinoplasty Touch-up Other

Skin: Ultra thin - N + Very thick
Tip Projection: - - - N + + +
Cartilage (recoil): - - - N + + +

Surgical Approach:

Intercartilaginous Intracartilaginous
Marginal RETHI Other
Transfixing Hemitransfixing Partial

Lateral crus (left) = 6 mm

Domes: Resection Incisions Sutures

Shortening: Upper lateral cartilage Septum
Nasal spine Mucosa

EXTRAMUCOSAL DISSECTION

Septum: Resection Incisions Reinsertion

Dorsum: Osteotome Rasp

Grafts: Cartilage: Septum Ear Bone Other

- Radix
- Dorsum
- Spreader graft Lateral grafts
- Nasal Tip
- Columella Alae
- Premaxilla

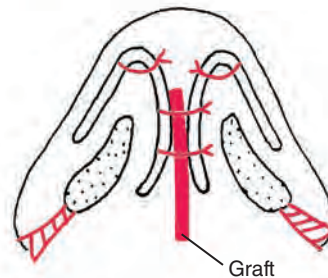
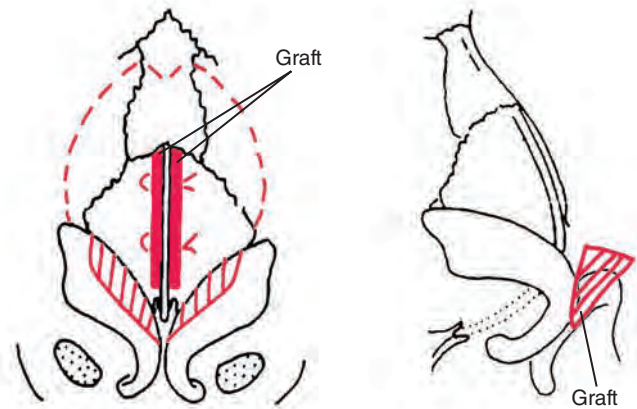
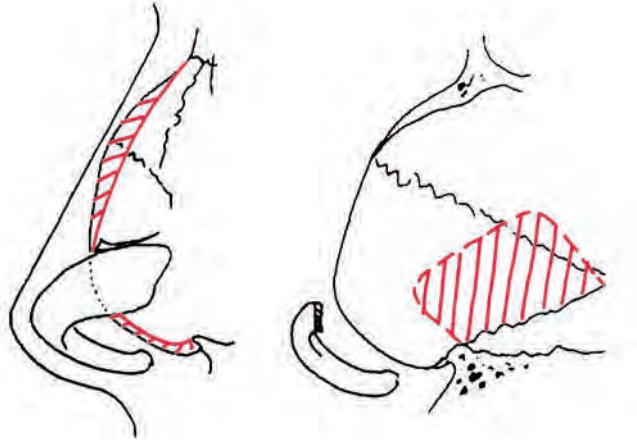
Osteotomes:

- Medial: Endo N Percutaneous
- Lateral: Endo N Percutaneous
- Low-to-low Low-to-high
- Bony wedges

Alae = 2 mm

Packing: Gauze Hemostatic ointment Tubes Plate

Commentary and Criticism:



soft tissues should be inspected and palpated to evaluate their condition and the presence of scarring in all areas.

Examination should proceed from the radix to the tip, assessing the position and projection of the radix, projection of the dorsum, and, by very meticulous inspection and palpation, any minor asymmetry of the bony and middle vault. The tip, alae, and middle vault supports are evaluated, as are alar configuration and symmetry, the alar-columellar relationship, and the nasolabial angle.

Endonasal examination may reveal septal deformities, external and/or internal valve collapse, perforations, and synechia. To determine whether the septum has been harvested, the surgeon can gently palpate the septum on one side with a smooth-tipped instrument while observing the other side with the aid of a headlight. If the septum has been harvested, a softness in the harvested area will be evident on the other side.

Consent

Obtaining informed consent from patients for revision or secondary rhinoplasty focuses more on gaining their trust than on securing their signature on an exhaustive list of potential complications. The simple statement, “There are no guarantees,” succinctly summarizes the requisite degree of understanding. A minimum of two consultations is necessary, in which the same message is communicated after a thorough explanation of the potential pitfalls of further surgery. The goal of the consent process is to allow patients to understand that they have an active, participatory role in what is essentially a journey back from a less than ideal result toward an aesthetic and functioning nose. The patient and the surgeon should make the journey as a team, and any problems encountered along the way are best dealt with as a team. Some problems can be anticipated, such as prolonged edema; some are unfortunate and unforeseen, such as infection or bleeding. Finally, a potentially hostile outcome between an unhappy patient and a defensive surgeon is more likely to be avoided by a close, caring relationship than by the patient’s being presented with an overly long and impenetrable consent form.

Secondary rhinoplasty is more demanding from the surgeon’s perspective, and the requisite few millimeters of form are more difficult to obtain in any direction. It is tempting for a confident nasal surgeon to condemn previous interventions as clumsy, decry the previous surgeon as inept, and promise great improvements. Such an approach, however, is ill advised. During consultation before the procedure, it better serves the surgeon’s goals to underplay the chances of a wonderful result. This will imbue the patient with a sense of wonderment if things go well—and lead at worst to resigned acceptance if they do not.

Preoperative Planning

Timing of Reoperative Surgery

Many early problems such as slight asymmetry, tip bulbousness, and lack of definition may resolve in the months following surgery. During this healing period, the patient needs good support from the surgeon. It is usual to perform a revision after 1 year, but a very early surgery may occasionally be performed during the first week if a severe defect can be quickly corrected. Examples include the removal of a displaced graft or correction of an overshortened nose by reduction of the caudal septum and nasal spine.

A minor defect such as a visible dorsal prominence can be rasped or shaved after a few months with the patient under local anesthesia with the use of a short intranasal incision and narrow instruments. Correction of secondary nasal tip deformities and thick or scarred soft tissues should be performed at least 1 year after the primary procedure.

Surgical Technique

The surgical approach depends on the surgeon's preferences. No single approach or technique is the sole correct one for performing primary or secondary rhinoplasty; it depends on the indications. The technique selected will also depend on the difficulties encountered, including unforeseen ones.

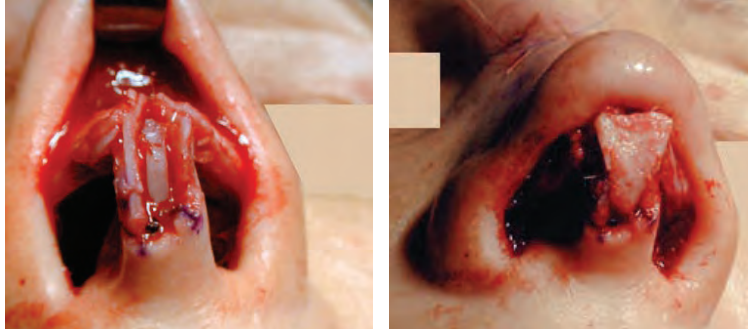
Intranasal Approach

An intranasal approach can be performed for minor defects, such as a dorsal prominence or tiny depression, nostrils of normal size and suppleness, and defects limited to the dorsum without significant asymmetry. A single pocket can be developed with accuracy through an intercartilaginous incision and a graft, bony or cartilaginous, can be inserted.

A transcartilaginous or intercartilaginous incision can provide adequate exposure for the desired corrections, particularly when the nasal tip is symmetrical and does not constitute a major problem. However, the surgeon should not hesitate to shift to the open approach if any difficulty is encountered or if the exposure does not permit adequate correction.

External Approach

We use the external approach in more than 90% of our secondary procedures. With the transcolumellar external approach, a better anatomic assessment can be made of the deformities and supportive structures. It provides easy access to the septum and usually makes harvesting septal cartilage possible, even when septal surgery has previously been performed.

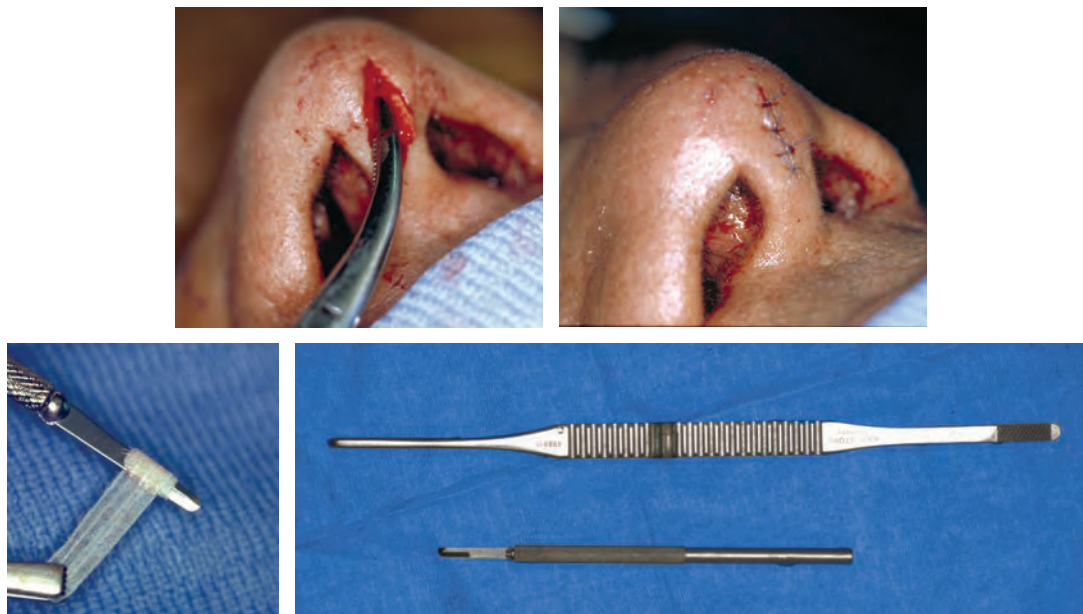


The external approach also facilitates corrections that can be achieved by judicious resections, suture techniques, and reconstruction of the cartilaginous framework and support with accurately fixated grafts.

INCISIONS A transverse columellar incision is placed at the narrowest part of the columella; the incision can be placed at the level of the base of the columella in the labiocolumellar crease when the columella is short with narrow columellar footplates. The extent of soft tissue elevation should be carried out according to soft tissue conditions. The dissection should be less extensive in overly thick skin and in patients with scarred, rigid soft tissues.

A transcolumellar incision is usually indicated for difficult cases in which the patient has small nostrils, a skin cover lacking suppleness, and major defects of the nasal tip. In multioperated patients or those who have undergone several transcolumellar-approach procedures (this is becoming more frequent), dissection of overly scarred nasal tip and columellar soft tissues is still very difficult. Doing so may worsen the scarring when there is thin, adherent soft tissue cover. An endonasal approach or a midsagittal columellar incision may be the last resort, which allows limited maneuvers but permits adequate and accurate placement of grafts.

The midline columellar approach has been used for decades, most often for correction of secondary cleft lip noses and multioperated noses. However, secondary cleft lip noses can often be considered as secondary multioperated noses with nasal tip deformities and significant scarring. The incision is usually placed in the midline of the infratip segment; its length is usually 4 to 6 mm, depending on the deformities. It can be extended anteriorly if the surgeon plans to work on the nasal tip, or posteriorly to introduce a large graft.



A tip graft is inserted through a short sagittal midcolumnar incision. Dissection can usually be performed easily and quickly. Because of the shortness of this incisional approach, maneuvers must be very carefully executed with narrow instruments and attention to the integrity of the skin edges. Narrow scissors, an elevator, and a Beaver blade protected with a strip can be used to dissect heavily scarred soft tissues when there is no more dissection plane.

Local anesthesia of the lobule alone frequently suffices and is less distressing than vestibular or total nasal infiltration. The postoperative course is reduced in time and magnitude. Such advantages allow the surgeon to minimize the significance of minor touchups (particularly our own retouches) in terms of duration and ease and represent less pain and lower hospital costs for the patient.

Dissection can be performed over and between the domes and extended laterally to the alae and upward to the dorsum. If the incision is extended posteriorly to the labiocolumellar junction, it may provide access to the membranous septum and straightforward placement of graft within the membranous septum and columella for correction of a retracted columella. A columellar strut can easily be placed through this approach, and tip projection can be augmented with a graft slightly longer than the pocket. The tip lobule can be grafted with a single or multilayered graft. For intratip and infracolumellar grafts, the skin should be conservatively dissected laterally to avoid tension and the risk of disruption or necrosis.

The best indications for this approach are heavily scarred or thick soft tissue cover with narrow nostrils that do not permit an endonasal approach, or in cases in which a transcolumellar approach is not desirable because of the presence of overscarring of the endonasal lining. Precise undermining can be performed to place a dorsal and tip graft, producing less postoperative edema.

The limitation of this approach is the short incision length, which does not allow the same degree of exposure and precise cartilage manipulations that more extensive dissection techniques permit.

Secondary Problems

Moderate and Minor Defects

Minor defects most often involve a cartilaginous or bony projection problem, a slight asymmetry or deviation, or a minor depression. Such defects may appear after several months, when the edema has completely resolved. Correction is usually simple and rapid and in most instances can be carried out with the patient under local anesthesia. A bony or septal prominence can be trimmed or rasped using a narrow 3 or 4 mm rasp, which, after an endonasal puncture incision, permits direct access to the prominence without preliminary undermining. A bony projection can be easily rasped, as can a slight excess of the rigid dorsal border of the septum.

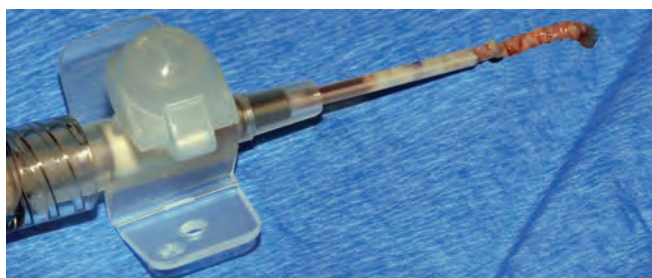
The danger in correcting these tiny defects lies in making the problem worse. Rasping a graft that has been bruised in the previous surgery or rasping a thin bone graft placed under thin skin may displace fragments of the graft and create more pronounced defects.



In this patient, a radix defect is evident on the lateral aspect, where the soft tissue thickness decreases. This slight dorsal prominence is shaved using a narrow rasp.



A small depression can be corrected by filling the area with crushed cartilage graft, preferably harvested from the septum. The crushed cartilage can be introduced after minimal tunneling. Diced cartilage is the preferred method when large defects must be corrected. Moreover, this allows a long-lasting correction.



Very finely diced cartilage can also be injected with a 1 cc Luer-Lok syringe and a 16- or 17-gauge injection cannula (the type used for fat grafting). Any kind of cartilage can be used, but the most practical procedure is to anesthetize the area with a local anesthetic, harvest concha, dice it, and reinject it through a small stab incision.

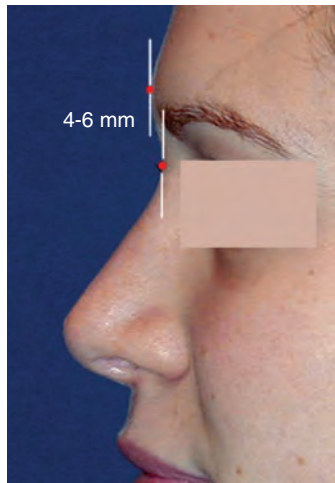
Small defects can also easily be corrected with fillers. The most frequently used fillers for this purpose are hyaluronic acid gels and Radiesse, which consists of calcium hydroxylapatite microspheres suspended in a sodium carboxymethylcellulose gel.

Hyaluronic acid is used preferentially in thin skin locations where a deep injection cannot be performed, such as the columella, and the tip in thin-skinned patients. Radiesse may be used in the radix, dorsum, supratip, and premaxilla. Early inflammatory reactions, foreign body granulomas, and allergic reactions are very rare with these fillers. Hyaluronic acid lasts 8 to 12 months; Radiesse lasts 2 to 3 years. It must be injected deep, on the top of the bone or cartilage. Caution is necessary when correcting an inverted-V deformity: the filler must not be injected close to the mucosa to avoid infection and decrease the risk of granuloma formation.

Discrete deviations are difficult to correct; they are often caused by a residual cartilaginous deviation or asymmetrical resections. It is often easier, and preferable, to correct them by limited procedures rather than carry out wide undermining and osteotomies, because there is a risk of incomplete correction and other sequelae. Placing camouflage grafts on the side opposite the deviation is sometimes a simpler and more effective solution.

Radix Defects

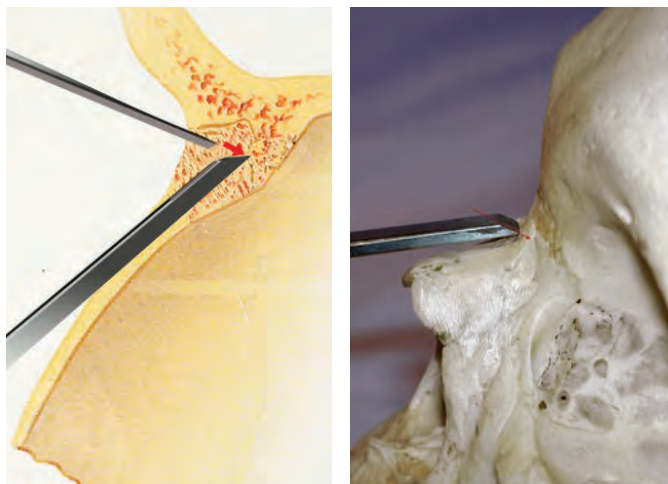
The position of the radix is crucial to a harmonious result. Radix projection and position influence the nasal length and nasofacial angle. The ideal radix position is between the supratarsal fold and the eyelashes and can vary from 10 to 12 mm (when overresection or overgrafting is being corrected).



Projection of the radix is 4 to 6 mm deep to the glabella (as noted by Guyuron) and 10 to 11 mm from the corneal plane (documented by Byrd). Projection of the radix can make a nose look longer, particularly if there is no clear delineation between the nose and the forehead, as with a Greek nose.

High Radix: Underresection

A high radix is frequently observed after a rhinoplasty. It is caused by underresection of the bony radix, which is difficult to correct because of the dense bony radix and the thick muscular layer (the procerus muscle).



Reduction of the radix is not an easy task. Bony radix reduction can be prepared by using a 2 or 3 mm osteotome introduced percutaneously to create a trench above the area to be resected. This facilitates resection with a beveled, well-sharpened osteotome; the surface of the bevel is angled to allow the osteotome to be directed at a better angle.

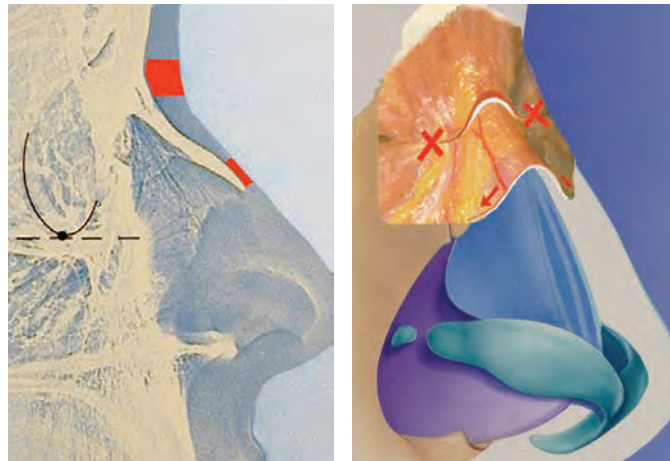
Adequate deepening of the radix is essential when a dorsal graft extends to the radix. Before a cartilage graft is placed, deepening should be limited to 1 mm. When using a bone graft, the surgeon needs to maintain sufficient thickness of the cephalic end of the graft to prevent a bony fracture. On the other end, the radix should be well prepared for a bony union and sufficiently deepened to prevent a shallow radix.

Resection of the procerus allows moderate (1 to 2 mm) deepening of the radix. The muscle is resected with scissors or a rasp. A vasoconstrictor-impregnated gauze pad is then placed in the radix area to decrease bleeding. This approach should be avoided in thin-skinned patients.

Excessive Bony Resection

Overresection of a dorsal hump resulting from use of an osteotome with the wrong orientation may create a high middorsal notch with a high radix or dorsal saddling, including the nasion area, which has been overresected, causing the glabella and nasal base to appear more prominent.

It is important before any radix reduction to palpate and pinch the soft tissue of the radix to assess thickness (average 7.5 mm) and laxity. Despite overreduction of the bony radix, an excess of soft tissue of the radix may be present, creating fullness and a wider appearance of the intercanthal distance. This is a result of poor soft tissue response after bony reduction.



The average soft tissue response (contraction and redraping) in the radix area is 25%, resulting from two factors: (1) the thickness and laxity of the covering soft tissues, and (2) the limitation of redraping laterally by the fixed inner canthal points.

Correction of a radix defect can be performed with cartilaginous grafts, deep temporal fascia, fillers, or diced cartilage. The cartilaginous graft is the benchmark procedure for correcting an overresected radix. The best adapted grafts are septal or lower lateral crural grafts. They are very effective, but their main drawbacks are edge visibility and displacement. To avoid those problems, undermining over the radix area must be limited on the lateral aspects. The sides of the grafts are beveled, the grafts are weakened (with incisions or slight crushing), and two percutaneous through-stitches are performed. Grafts can be superimposed if the radix needs more than 2 or 3 mm of augmentation.

Deep temporal fascia is very easy to harvest, and the resulting 3 cm scar in the temporal scalp is inconspicuous. This fascia can be folded on itself for more projection. Two percutaneous through-stitches are also used. Edge visibility is never an issue with the use of this fascia, but swelling is more prolonged than with a cartilaginous graft.

Acellular dermal matrix products such as AlloDerm can be used in place of deep temporal fascia, but partial resorption may sometimes occur for such allogenic materials.

Fillers are very practical for correcting radix defects. Radiesse may be more appropriate than hyaluronic acid, because it lasts longer. If hyaluronic acid is selected, a highly reticulated form is used (Juvéderm Ultra 4, Perlane). The injection can be performed in the office, and the resultant correction is immediate.

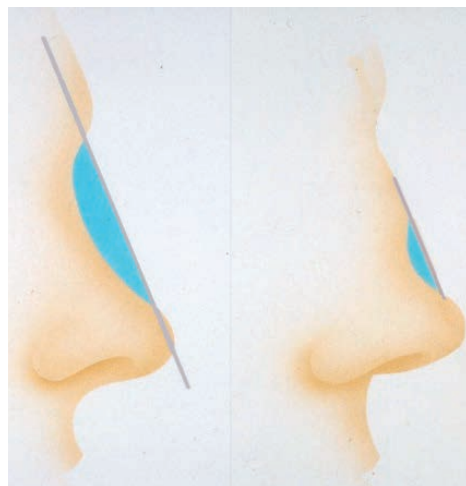
Diced cartilage is very useful in this location and produces a long-lasting result. This procedure can be performed with the use of a local anesthetic in the office.

Saddle Nose Deformities and Flat Nose

Saddle Nose

Saddle nose deformity can involve the entire dorsum from the root to the supratip region or only the lower dorsum, causing a “hatchet stroke” deformity with a more or less noticeable hump above it. Overresection of the dorsum with an osteotome, including nasal bone, upper lateral cartilage, and the dorsal edge of the septum, causes saddle nose, with middle vault collapse. However, saddling may also result from an underlying septal cartilage fracture or weakness, from collapse of the dorsal edge of the septum after a submucosal resection of the septum, or from harvesting too close to the dorsal edge of the septum.

Saddle nose deformity is commonly considered to affect the nasal width, length, and nasal valves. Posttraumatic effects may include broadened nasal width, with a flat appearance of the nasal vault and a more pronounced nasal base. Tip and columellar support may have been damaged by overresection of the nasal spine and septal caudal border, causing a retracted columella; these supports can be assessed by pressing backward on the nasal tip. Supratip saddling may also occur after overresection of the lower dorsum or a large septal perforation.

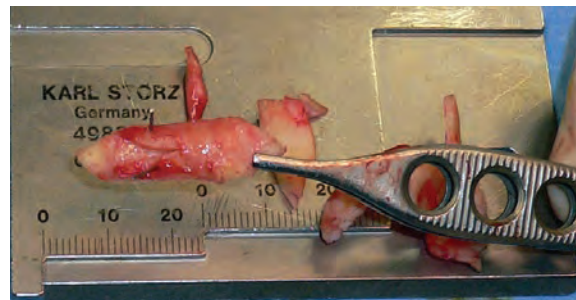


Saddle nose deformity from the radix to the supratip area after aggressive dorsal resection of the hump is illustrated on the left. Deformity of the lower dorsum causing a hatchet-stroke deformity with a more or less noticeable hump above it (true or false hump, respectively) is shown on the right.

Surgical correction of a saddle deformity consists of restoring the damaged supports and filling the defects by various means:

Repositioning of asymmetrical and displaced structures with restoration of the original septal height.

Reconstruction of the dorsum with single or multilayered cartilage, with diced cartilage wrapped in fascia, or, rarely, with bone grafts, depending on the magnitude of the deformity, the availability of cartilage, the quality of the recipient beveled graft, and the skin. Septal cartilage is best for augmenting the dorsum. Conchal cartilage will not provide a sufficiently long fragment, and its curvature is less suitable for the dorsum. The external portion of the concha may provide a long (3 cm) graft that can be flattened by a superficial partial-depth incisions followed by light bruising.



A longer graft can be obtained by overlapping two grafts as tandem grafts. But if support grafts must be used and if the septum is not of good quality (for instance, because it has been fractured, bent, or partially harvested previously), costal cartilage is the best option. Rib grafts allow the use of long, straight, solid pieces of cartilage for support and provide a sufficient quantity of cartilage to be diced and wrapped in the deep temporal fascia for dorsal augmentation. The *diced cartilage and fascia* (DCF) technique avoids the use of a monobloc cartilage trimmed from the costal cartilage, with its own risk of bending, and obviates the need for a K-wire to stabilize the graft to decrease the risk of bending.

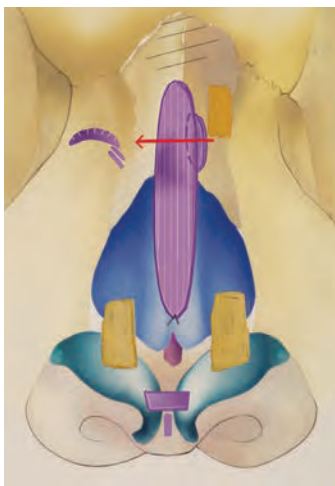
After an extramucosal dissection, the upper lateral cartilages are separated from the anterior septal border. An anterior septal deviation can then be corrected by cartilaginous incisions or cartilaginous struts to reinforce the septal buttress and to camouflage a deviation. The nasofrontal angle should be slightly deepened when the dorsal graft extends toward the radix. Medial and lateral osteotomies allow correction of an asymmetrical, flat, wide nose, but the surgeon must keep in mind that saddling creates the illusion of flatness and, after dorsal augmentation, the nose may appear less broad. Secondary osteotomies to correct a broad or asymmetrical bony vault are best achieved by external percutaneous osteotomies. Two-millimeter perforations allow the surgeon to trace a pattern along the desired osteotomy line, followed by gentle pressure only when all bony struts have been securely broken. This method also allows asymmetrical osteotomies to be safely performed to correct nasal bones that were malpositioned at the primary surgery.

The endonasal approach is sufficient if the dorsal deformity is isolated. When other defects are present, notably at the level of the nasal tip, a transcolumellar approach is used, particularly for a difficult nasal tip reconstruction.

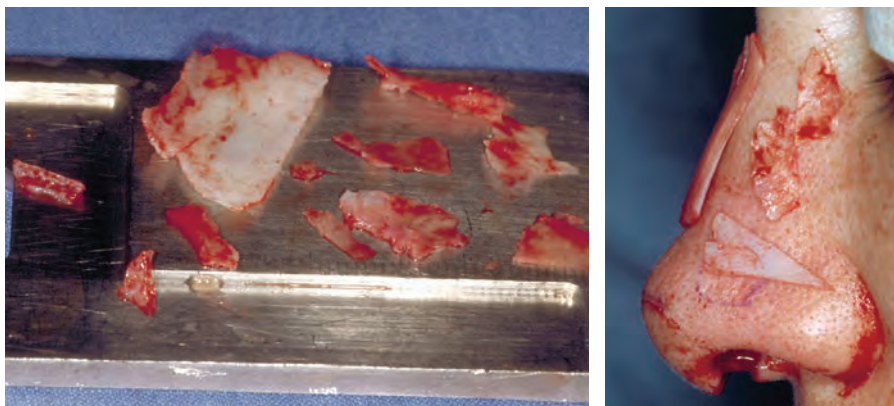
ASYMMETRICAL RECIPIENT GRAFT BED An asymmetrical recipient graft bed is quite common in saddle nose deformity because of previously undetected and untreated asymmetry, asymmetrical cartilaginous hump resection, uneven osteotomies, or multifragmented bone during hump resection.



An asymmetrical graft can sometimes be used to correct an asymmetrical recipient graft bed, as in this patient, who complained of a dorsal depression with asymmetry and impaired breathing. She desired a longer nose with a straight dorsum. On frontal view, on the right side, one can see collapse of the lateral bony and middle vault, which produced the optical illusion of a deviation. The defect was more discernible on the bone (with a vertical depression) than on the middle vault. The lateral view shows a slightly retrousse nose and an open nasolabial angle greater than 110 degrees. The basal view shows that the left dome was higher than the right and that there was a slight deviation on the left. The oblique view shows saddling of the upper dorsum. On forced inspiration, there was a discernible collapse at the posterior junction of the lateral crura and upper lateral cartilages.



A transcolumellar approach was used to correct the problem. After skeletonization, the radix was moderately freshened with an osteotome to obtain a radix recipient graft as flat as possible. The septum was approached dorsally, and major harvesting of cartilage and thin bone (vomer and perpendicular plate) was performed.



Reconstruction was achieved by placing grafts in different areas of the nose. Because the upper dorsum was quite asymmetrical, an asymmetrical dorsal graft was prepared. The main graft was bruised and two narrow grafts were placed at the under-surface of the right edge of the main graft to fill in the lateral depression. A small bony graft was placed laterally on the right side of the bony vault. The caudal end of the graft was fixed to the dorsum. Two flat, thin, bony fragments from the septum were positioned in the weak area at the upper and lower lateral cartilage junction.



A columellar strut and an onlay graft were placed to strengthen the columella and improve the tip definition and contour. No osteotomy was performed. The patient is shown 13 months postoperatively.

DICED CARTILAGE Diced cartilage rolled up in fascia (DCF) is the most appropriate technique for correction of saddle nose deformity. It consists of tailoring a composite graft of pieces of diced cartilage and wrapped in a layer of deep temporal aponeurosis. This initially malleable graft allows an effective dorsum augmentation (1 to 10 mm), which is adjustable until the end of the operation and even postoperatively. It can easily be introduced through a closed or open approach.

This graft is applicable to all primary and secondary augmentation rhinoplasties. However, the elective indications are for secondary augmentation rhinoplasties with cartilaginous donor site depletion or when cartilaginous grafts are of poor quality (because they are of insufficient length or are multifragmented), or when the recipient bed is uneven or asymmetrical. In this last situation, the DCF is prefabricated on the back table to fit the defect. After positioning the DCF on the dorsum, it is precisely and delicately molded onto the defect to fit the uneven recipient site. In all cases, the DCF is positioned at the end of the operation, after all the septal work has been done and all support grafts have been sutured.



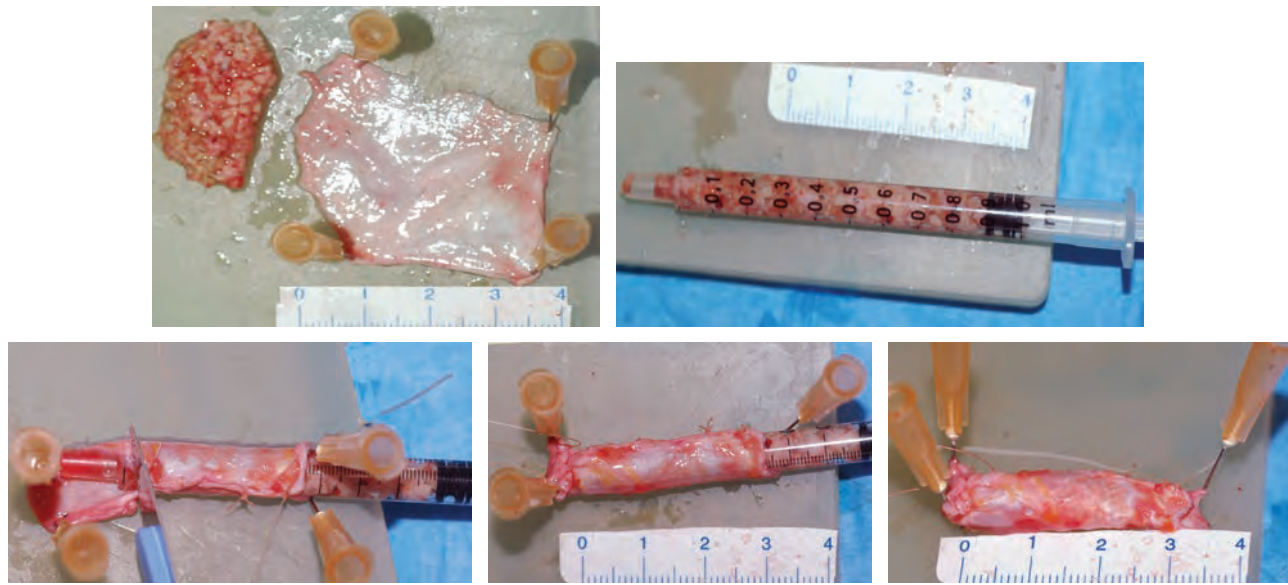
This patient had undergone three previous rhinoplasties through an endonasal approach to correct a wide, overprojected nose with a hump and wide nasal tip. Cartilage from one ear was harvested on the first revision surgery, and from the other ear for the second revision. The patient had not been able to breathe well since her first surgery. The frontal preoperative view shows an inverted-V deformity with a left nasal bone that was too lateral. The tip was too wide, bifid, and asymmetrical, and the nostrils were too visible because of alar retraction. On basal view the upper lateral cartilages were collapsed into the nostrils because the previous hump removal was performed without reconstruction of the internal valve.



The lateral and oblique views show an obvious lack of tip projection, tip bifidity, and alar retraction. A ninth costal cartilage was harvested; then a 4 by 4 cm deep temporal aponeurosis was harvested for the DCF.



A transcolumellar approach was planned. The intraoperative view on p. 2044 shows a complete transfixion of both lateral crura. The lower lateral cartilage had been overresected, and there was marked flaring of the middle crura. The central cartilage was to be used for the two spreader grafts, the columellar strut, and the tip graft. Slightly naturally bent slices of outer rib cartilage were used as alar batten grafts, extending caudally to lower the alar rims.



The remaining cartilage was diced to be used as a DCF. The diced cartilage was introduced in a 1 cc tuberculin syringe and compacted. The deep temporal aponeurosis was sutured around the syringe, and the hub of the syringe was cut. The distal part of the DCF was closed and the diced cartilage was injected in the aponeurosis tube. The DCF was then carefully molded on the back table.



Operative view after opening



Before closure



Tip graft and alar rim grafts

After approximating the domes with an interdomal suture, a columellar strut and shield graft was placed, and alar batten grafts were sutured to the vestibular skin and the cut end of the lateral crura. The aponeurosis tube was inserted on the dorsum at the end of the operation, after the supporting grafts were sutured; it was sutured to the remaining upper lateral cartilage, and its cephalic part was stabilized with two percutaneous stitches.



The patient is seen at 1 year postoperatively. The aesthetic dorsal lines are restored, the tip is smooth, and the alar notching is corrected.

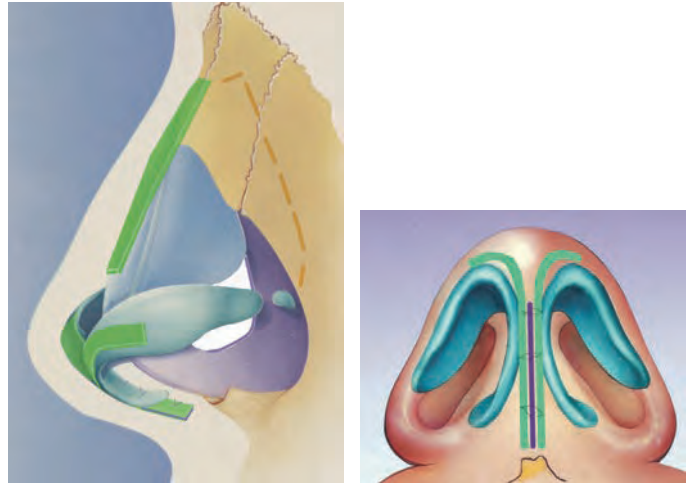
Flat Nose

A flat nose often results from trauma or a previous surgery in which the caudal septum and the lower lateral cartilages have been damaged or overresected, with significant loss of the tip supports. On examination, the interalar base distance appears wide in respect to the length of the columella. The nasal tip is easily depressed, with poor columellar and septal support, and on palpation alar cartilages appear weak and soft. A dorsal depression and retracted columella are caused by overresection of the dorsal septum or by a large septal perforation extending anteriorly.

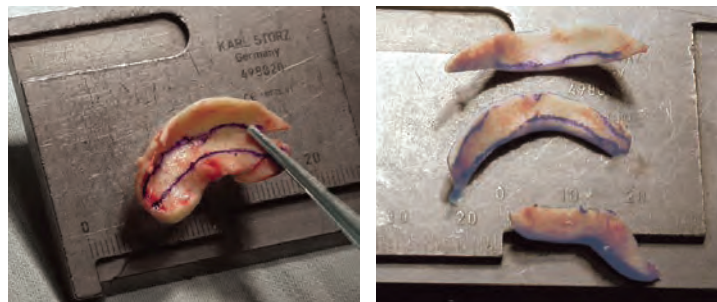
Correction of flat noses involves strengthening the anterior and caudal buttress and the tip and columellar supports and restoration of the septal deformity. In a moderately flat dorsum and nasal tip, extended spreader grafts are sutured to a wide columellar strut to provide a solid L-shaped strut. Then the medial and middle crura are sutured caudally to the columellar strut. It is sometimes necessary to conceal dorsal irregularities with deep temporal fascia or crushed cartilage. In a markedly flat dorsum and nasal tip, a dorsal graft and a long bony or costal cartilaginous L-shaped strut may be placed. This type of reconstruction is rigid and often does not look natural. Its aesthetic appearance can be improved by the use of a DCF on the dorsal part and by a columellar strut with the medial and middle crura sutured to it on the caudal part. If a costal or bone graft is used in the columella, it can be fixed to the nasal spine. The medial crura are then advanced on the strut and transfixion sutures are placed through previously made perforations on the strut.



This patient had undergone two previous rhinoplasties and septoplasty. She presented with a flat nasal base, short columella, and severe loss of nasal tip supports. On frontal view, there was a wide dorsum and a large interalar base distance with a flat nasal tip. On basal view, the scar of a previous transcolumellar incision was obvious; the columella was very short, with pseudoalar flaring caused by the severe loss of tip supports. Endonasal examination showed a large anterior septal perforation, precluding any septal harvesting.



The main problem was the loss of columellar support, which had to be reconstructed with a stiff columellar strut.



The conchae were harvested using a retroauricular approach. A transcolumellar approach was performed, revealing the poor laxity of the alar cartilages.



A pocket was developed on the dorsum for placement of a dorsal graft. The columella and nasal tip were reconstructed with a fleur-de-lis graft with the two lateral edges of the conchae. Because the cartilage was very soft, a rigid 0.5 mm thick battens of polydioxanone (PDS) plate (15 by 5 mm) was placed between the two cartilages and sutured to them to provide sufficient stiffness to the grafts. The divergent anterior extensions of the grafts were positioned on the top of the domes and sutured to the lateral crura. A single-layer graft was placed on the dorsum, and lateral and medial osteotomies were performed.



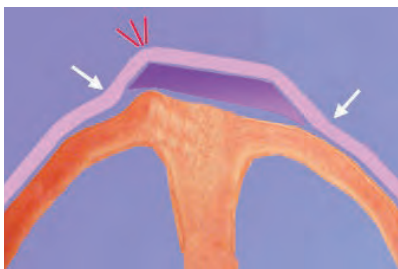
The patient is shown 12 months postoperatively. The PDS plate has been resorbed and replaced by connective tissue. The plate was used as a temporary scaffold to provide a stiff columellar support during the early stages of healing.

Graft Defects

Problems include defects that occur after placement of grafts in the radix, dorsum, or tip; in addition, secondary rhinoplasty in a graft-depleted patient presents a challenge. Grafting techniques are frequently used to augment, contour, balance, and reconstruct the skeletal structures that produce the nose's function and aesthetics. However, as in every technique, there are advantages and drawbacks, and various defects or complications may be seen during and after grafting. Besides the difficulties that follow graft placement, the surgeon may encounter the complications inherent in the harvesting process, such as these:

- Auricular deformity
- Retroauricular keloids
- Septal perforations
- Creation of a supratip hatchet defect after a loss of septal support
- Fracture of the perpendicular plate of the ethmoid after aggressive resection with forced twisting motions that may cause cerebrospinal fluid leakage
- Pneumothorax after rib graft harvesting

The problems that occur most frequently after placement of grafts are seen when using “visible graft” in the radix area, dorsum, and tip. They include undergrafting or overgrafting, prominence with graft visibility, asymmetry, and irregularities caused by warping of the graft; graft displacement; and a poorly prepared recipient bed.



An asymmetrical recipient graft bed will automatically cause displacement and asymmetry. Infection is rare, but it may occur with conchal cartilage and in severely scarred or thick, soft tissues; resorption may be seen, mostly after bone grafting, and may follow an infection. Skin discoloration and telangiectasis are more frequent after several surgeries in a patient with thin or scarred soft tissues. The incidence of such defects can be decreased by scrupulous attention to and management of the successive steps of grafting.

Radix Graft Defects

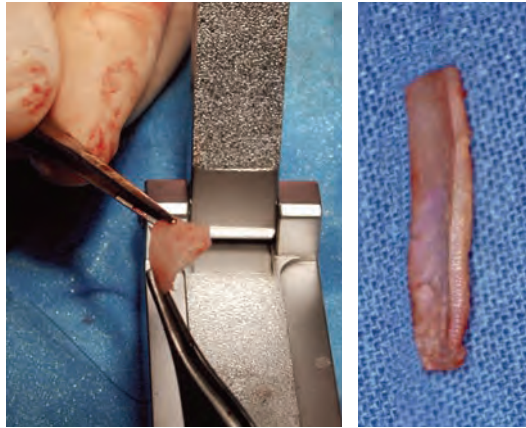
Radix defects may be observed after using grafts that have not been modeled by bruising, that are too wide, and that have edges that have not been beveled and do not feather with the adjacent areas. Visibility of a radix graft usually occurs laterally and caudally in areas where soft tissues are thin.

Soft tissue thickness varies over the bony skeleton; it is thinner over the rhinion (2 to 3 mm), where a step off may be observed when the graft ends at the level of the rhinion. Soft tissue thickens (7 to 9 mm) as one approaches the midline of the nose, but thickness progressively diminishes laterally toward the inner canthi. This explains why defects of radix grafts are seldom observed on the midline and are more frequent laterally and caudally.

Radix defects can be limited by careful preparation of the recipient graft bed with moderate, symmetrical undermining at the level of the radix, followed by light rasping to remove the soft tissue remaining on the periosteum. Bruised narrow grafts should be used, with particular attention to the preparation of the caudal end of the graft, where a smooth continuity with the dorsum should be obtained.

When the radix and upper dorsum are to be grafted, it is sometimes better to use a longer graft that extends from the radix to the supratip after slightly rasping the dorsum. This provides more stability to the graft and decreases the risk of a defect in the rhinion area.

Correction of radix defects is not easy and depends on the type and condition of the graft. The graft can be bone or cartilage (septal, ear, costal). If a septal graft had been placed, it can be rasped with a narrow rasp introduced intranasally. It is risky to rasp an ear cartilage graft or a cartilage that has been bruised. The prominent defect can be punctured percutaneously with a Keith needle if the defect is inconspicuous. In selected cases, a skin incision placed laterally provides a good approach and an easy correction with a narrow rasp and a Beaver blade. The scar will be scarcely visible. If the edge of the graft is visible and the defect is mild, injection of hyaluronic acid around the graft's edge can reduce its visibility.



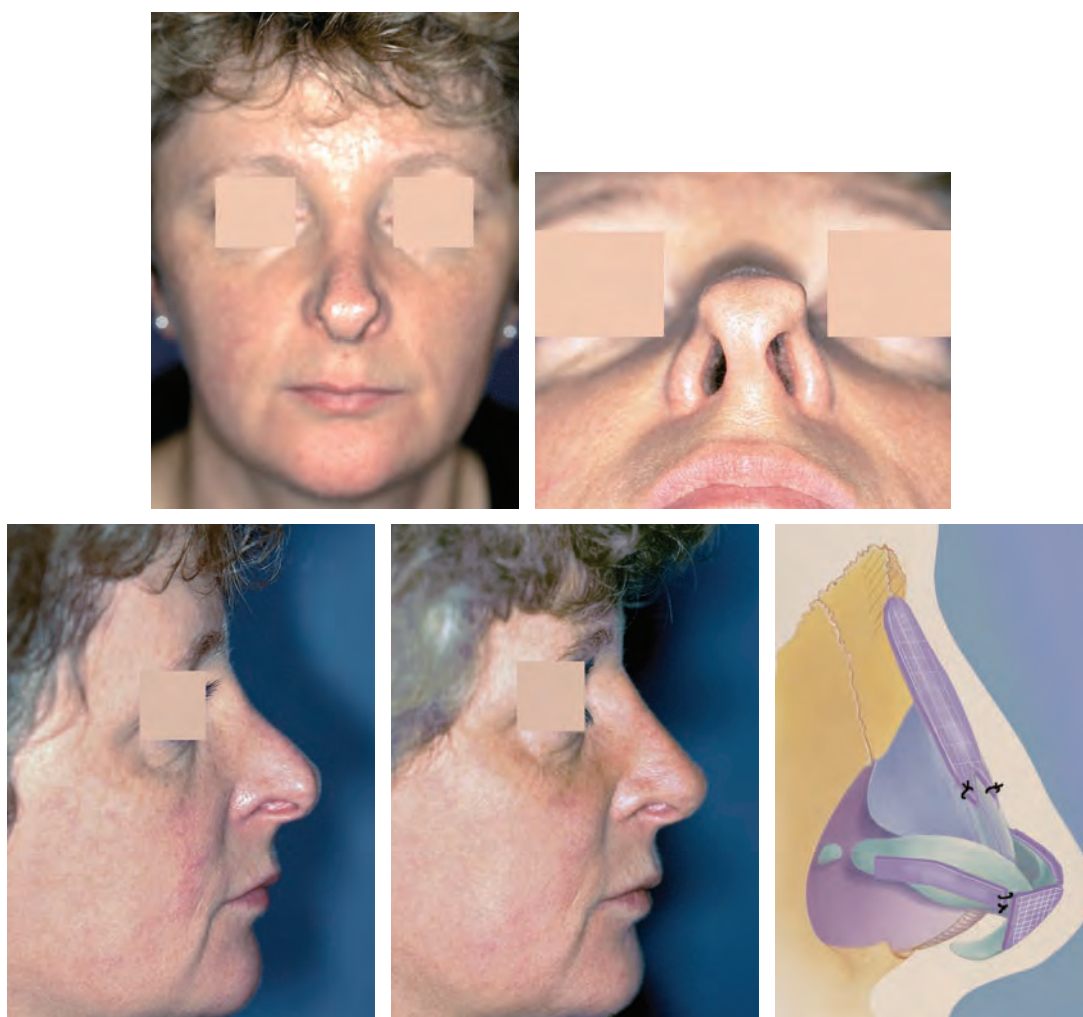
Bruising should be gentle and incremental. The graft should be checked after each stroke of the hammer to determine whether it has the requisite malleability to conform to the recipient graft bed, maintain its integrity, and not be visible at the skin surface. The best materials to use for radix grafting are the resected cephalic portions of a lateral crus or a bruised septal cartilage. A dorsal graft should be formed into a tilelike shape by bruising or partial-depth incisions.

Dorsal Graft Defects

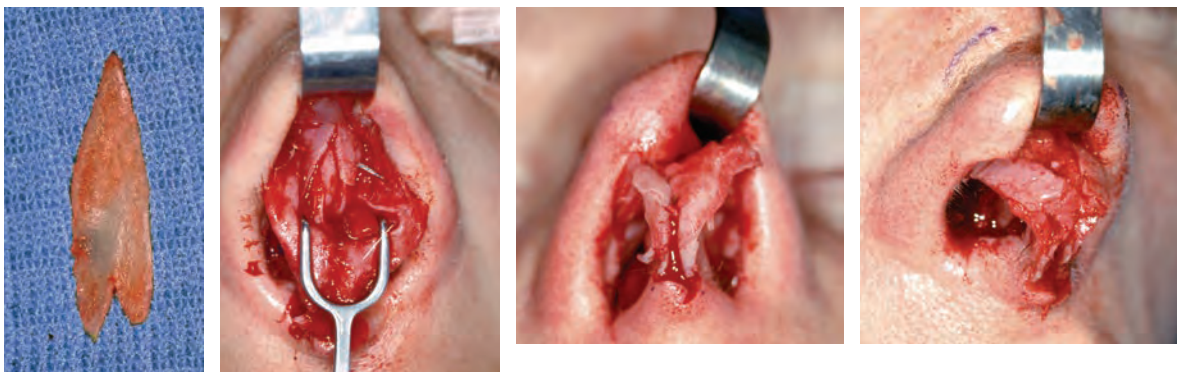
On the dorsum, besides overgrafting, undergrafting, and wrong positioning of the graft, defects frequently encountered are graft visibility and asymmetry caused by displacement of the graft. One can also observe a lateral depression along the lateral edges of the graft, mostly in patients with thin skin, when the graft has not been modeled by bruising or by longitudinal partial-depth incisions and when the dorsum is narrow.

Grafting the dorsum requires assessment of the shape and volume of the graft. This can be done preoperatively by using modeling paste or perioperatively by using templates of different sizes and shapes. Preparation of the recipient graft bed should be carefully checked by palpation with a wet finger on the skin surface and, if possible, by direct visualization to trim any projection or irregularity that would create an instability or displacement of the graft. If a bone graft is planned, one must flatten the bony dorsum and deepen the radix.

Correction of defects of the dorsum can vary in difficulty. A slight septal cartilaginous or bony prominence can be shaved. If asymmetry is severe, balanced resections and additional grafts will be needed. When additional grafts are required on the dorsum, it is better to insert the new graft at the undersurface of the main graft when the dorsal contour is correct. In some situations, it is better to remove the graft and replace it after better preparing the recipient graft bed and suture fixation.



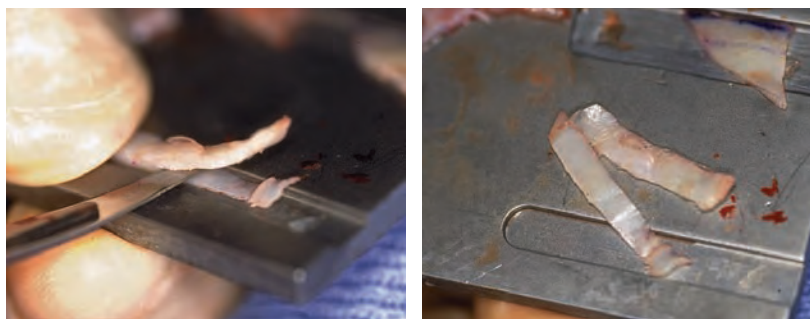
This patient had undergone two previous rhinoplasties that resulted in an overresected middle third of the dorsum and fullness of the radix and supratip. The infratip lobule had an increased angle of rotation. The alae were retracted and a hanging columella was evident. In addition to flatness of the middorsum (seen on the frontal view), the nasal base had a wide interdomal distance. The domes were markedly visible (more on the right side) in relation to a section of the lateral genu of the domes.



With a transfixing incision, the overexposed caudal septum (8 mm in height) was resected. The quadrangular septum was approached through this incision and major harvesting was performed, followed by placement of quilting sutures in the mucosal flaps with 5-0 Vicryl Rapide.

The alar cartilages demonstrated the asymmetry resulting from previous resections. The radix was deepened with a beveled osteotome. The dorsum was rasped slightly to remove soft tissue, and the caudal borders of the medial crura were trimmed by 2 mm to improve the columellar-alar relationship.

Reconstruction was achieved with a fishtail dorsal graft. The caudal end of the graft was notched to saddle the anterior septal border. The two parts of the tail were then folded over the lateral aspect of the dorsal septal border and sutured to it. This suture can include the anterior borders of the upper lateral cartilages. Such a graft may provide both an aesthetic and functional effect by leveraging the skin cover. After suturing, the dorsum was checked with a wet finger. Any excess can be shaved, or the notch can be extended upward. A percutaneous suture was placed in the upper portion of the graft, and the cut ends of the domes were approximated in the midline with an interdomal suture.



Alar grafts were prepared by splicing a thick septal fragment into two 0.5 mm thick batten grafts. These grafts were sutured to the remaining lateral portion of the domes. A bruised infratip shield graft was placed to improve the contour of the tip and infratip. No osteotomies were performed.



The patient is shown 19 months postoperatively.

Tip Graft Defects

Numerous defects occur in the tip from overgrafting or undergrafting, malposition, displacement, and graft visibility, which usually in thin-skinned patients.

Prevention

The risks that these defects will occur are limited with an open approach.

To correct a defect of the nasal tip, the surgeon should prepare the recipient site accurately by equalizing the height of the domes and the caudal borders of the intermediate and medial crura before placing an onlay or infratip graft. Suture fixation can prevent displacement.

For very thin-skinned patients, cartilaginous sutures should always be considered to treat the tip problems before using any visible graft. Capping the cartilage with deep temporal aponeurosis or with perichondrium or periosteum decreases the risk of early or late visibility.

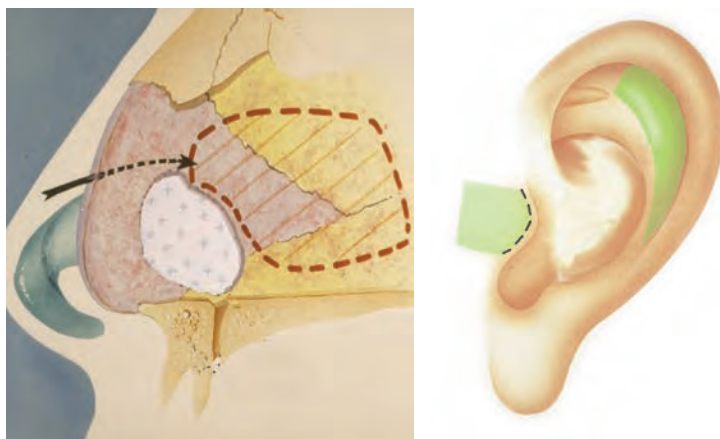
Correction

Inconspicuous defects can be corrected with an infracartilaginous incision for shaving a prominence of the graft or adding a thin graft to correct an asymmetry. A sagittal midcolumellar incision can sometimes be used, especially when tip tissues are fibrous after several rhinoplasties. A transcolumellar approach constitutes the best approach for correcting tip defects. Sometimes the whole graft must be removed and discarded when it is not usable. Otherwise, the graft can be reshaped if it is large and strong enough, or it can be covered with deep temporal fascia in thin skin.

Graft-Depleted Patients

Usually, part of the septum and at least one concha has already been harvested. It is sometimes possible to harvest more septum if only a small piece has previously been taken. Usually the remaining septal cartilage is behind and above the previous area where the cartilage has been harvested. If both conchae have already been harvested or if a small piece of cartilage is needed, ear cartilage can also be harvested on the scapha or tragus.

Finally, costal cartilage is always usable, and the associated morbidity can be very low with a good technique, but its harvesting is a little more lengthy and tedious. Costal cartilage allows the use of long, straight pieces of cartilage, which is not usually possible using ear cartilage or parts of the septum. Those straight cartilages are first used for the support grafts (spreader grafts, columellar struts, septal extension grafts, alar grafts, or alar rim grafts). Smaller pieces are used for tip grafts, sidewall grafts, and radix grafts. If augmentation is needed, especially dorsum augmentation, the remaining cartilage pieces are diced and used in the DCF technique.



Harvesting septal material is sometimes possible by approaching the septum close to its dorsal edge and dissecting above and behind the scarred area from a previous septoplasty. The ear may provide adequate fragments from the scapha and tragus.

Prevention of Graft Displacement

Preventing or Minimizing Graft Displacement

The following measures are instrumental in preventing or minimizing graft displacement and the effect on contour:

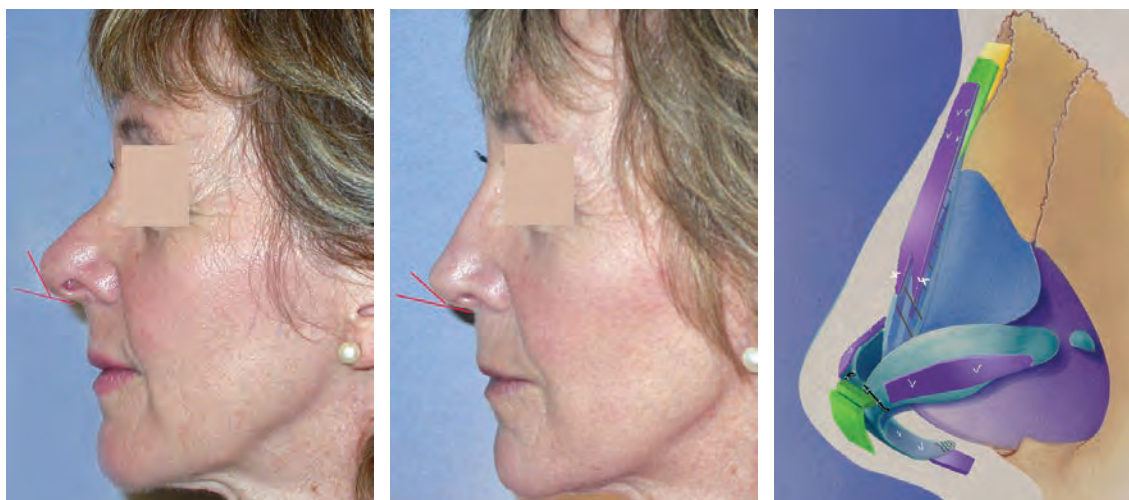
Create an adequately sized graft pocket.

Prepare a flat, symmetrical recipient graft bed and rasp the soft tissues over the skeleton. In the upper dorsum, prepare a solid, flat, bony foundation by rasping; however, it is more difficult in the lower part of the dorsum, where the recipient site is composed of the anterior border of the septum and upper lateral cartilages.

Select a graft that extends down to the supratip to stabilize the upper and caudal portions of the graft. A longer graft avoids a step-off, which can be observed in the transition zone (rhinion area) despite careful beveling of the lower end of the graft.

Use endonasal and percutaneous suture fixation.

Notch the two ends of the graft to create a fishtail shape for additional fixation. This is useful in radix, shield, and dorsal grafts: notching provides more stability by interposition of soft tissues.



After two previous rhinoplasties, this patient complained about several deformities and impaired breathing. On lateral view, she had saddling of the upper dorsum and radix highlighting the volume of tip and supratip. There was an obvious excess of the dorsal septum in the supratip, and the tip was unpleasant with an increased angle of rotation and a retracted ala, mostly on the left side.



On frontal view, there was an inverted-V deformity with disruption of the dorsal lines, and the tip was asymmetrical with a more prominent dome on the right side. On basal view, collapse of the middle vault, asymmetry of the tip, and collapse of the right ala were evident. The footplates of the medial crura were prominent. There was an internal valve dysfunction on both sides and a septovomerine deviation.

The objectives of surgery were to balance this nose by augmenting the upper dorsum, refining the tip symmetry, and improving function and contour. After harvesting the right concha, through a transcolumellar approach skeletonization was performed, revealing the deformities and the weakness of the alar cartilages. The supratip

excess was shaved by 2 mm and the radix freshened with a rasp. Major septal harvesting was carried out, and 2 to 3 mm of caudal septum was resected. Two spreader grafts were placed and the tip was corrected; better symmetry was obtained by dome resection, followed by suturing of the cut ends of the cartilages. The divergent footplates of the medial crura were resected.

A septal columellar strut was positioned within the medial crura to provide better tip support, and cartilage grafts were placed. A thin septal graft was placed on each lateral crus. The configuration, projection, and definition of the tip were improved with an infratip graft of ear cartilage; a buttress graft was positioned between the domes and the cephalic aspect of the shield graft to decrease the angle of rotation. A three-layered dorsal graft composed of vomer, ear cartilage, and septal cartilage was sutured together, and the caudal end of the septal fragment was notched in a fishtail shape with sutures of the two parts of the tail to the adjacent tissues to stabilize the graft. Results are shown 2 years postoperatively.

Guidelines for the Use of Grafts in Secondary Rhinoplasty

Preoperatively, assess the graft's length, width, and thickness using photos and modeling paste.

Never rush when choosing a design from harvested material. Carefully select the best fragment for every area. Assess the priorities if many areas are to be grafted.

Be very economical, because reconstruction often requires a large amount of graft.

During the procedure, use a template or sizers to avoid damaging the graft by repeated handling and insertions.

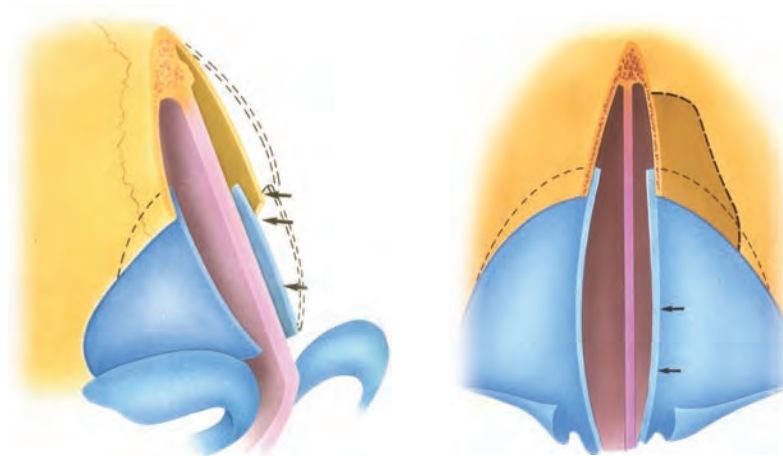
Middle Vault and Alar Deformities

The role of the lateral cartilaginous wall (the upper lateral cartilage, lateral crus, and soft tissue cover of the middle vault and alar wall) is often overlooked during routine preoperative nasal examination and during surgery. Postoperative deformities of the middle vault and alae are often caused by overresection and misidentification of unfavorable anatomic variants of the cartilages. Other predisposing factors, such as soft tissue cover and the anatomic configuration of nasal bones, may contribute as well. The result may be a narrowing of the middle vault, with an inverted-V deformity and collapse of the internal and external nasal valves.

Middle Vault Deformities

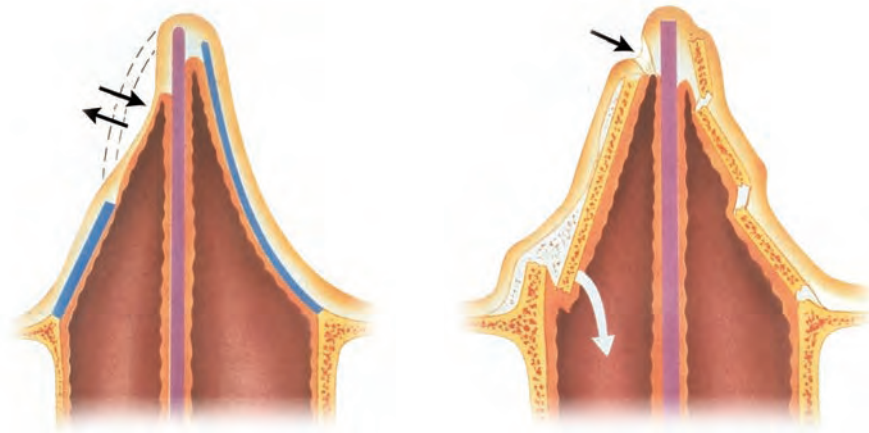
The middle vault is composed of the upper lateral cartilages, septum, and investing soft tissues. Support of the upper lateral cartilage is provided cephalically by a tile-like connection to the inner portion of the solid bony vault and medially by an anatomic and histologic continuity with the widened dorsal edge of the septum. The junction of the septum and the caudal margin of the upper lateral cartilage form the internal valve angle, which is normally 10 to 15 degrees.

After resection of the wide T-shaped extension of the dorsal septum, the middle vault narrows as a result of medial approximation of the free medial edges of the upper lateral cartilages. The degree to which lateral movement occurs depends on the intrinsic stability of the upper lateral cartilage (its shape, elasticity, and size) and soft tissue support, and on the pressure changes to which it is subjected during quiet and forced inspiration. In the absence of a lateral osteotomy of a broad bony vault, there is a high risk of middle vault collapse.



After a lateral osteotomy with a high cephalic fracture, the bony cartilaginous wall becomes mobile and can be moved toward the midline. However, when the nasal bones are convex and the high cephalic fracture is incomplete or too high, the degree of displacement of the bony portion is limited in respect to that of the flexible upper lateral cartilage. When the nasal bone (upper lateral cartilage junction) has been damaged, the upper lateral cartilages have a greater tendency to move inward. It is important to evaluate the length of the nasal bones, because short nasal bones provide less support to the upper lateral cartilages, as well as to assess the condition of the skin and cartilages.

Evaluating Operative Causes of Middle Vault Collapse



Factors that contribute to the weakening of the upper lateral cartilage and increase the potential deformation and collapse include the following:

- Avulsions or lacerations of the upper lateral cartilages as a result of aggressive rasping or excessive resections of these cartilages, causing a depression of the middle third of the nasal pyramid

- An osteotomy that is too high, with excessive resection of the tissue, especially along a large nasal hump

- Preexisting extensive soft tissue undermining

- Neglecting to mobilize and suture the upper lateral cartilages back to the midline after dorsal hump resection

Potential Problems

During preoperative examination, the surgeon observes the lateral walls for external abnormalities. Middle vault collapse may occur when there is a narrow cartilaginous vault, in contrast with a wide bony vault, or when the nasal bones are convex, and a slight demarcation exists between the nasal bones and upper lateral cartilages. Palpation may reveal a convexity at the lower border of the nasal bones that can be followed downward to a noticeable narrowing of the cartilaginous vault.

Endonasal examination may detect an aspiration of the lateral walls of the nose, with or without an alar collapse. The surgeon should look for mucosal scars in the form of synechia or bands, and deviation of the anterior septal border.

A cotton-tipped applicator is used to gently spread the alae from the septum to examine the internal valve for suppleness, integrity, valve angle, and mobility of its lateral border at rest and during forced inspiration.

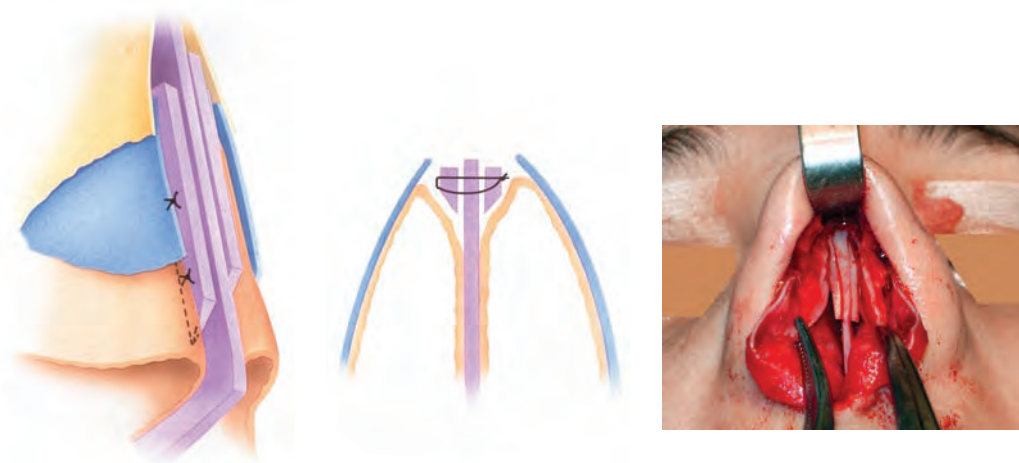
The inner surface of a large resected hump should be examined to assess the width of the septal T. After lateral osteotomy and medial displacement of the bony carti-

laginous flap, the surgeon can examine the oblique view from right and left and pass a wet finger on the lateral aspect of the dorsum to detect any interruption of the continuity between the upper lateral cartilages or a step-off—the sign of a collapse or weakening of the upper lateral cartilage.

Surgical Correction

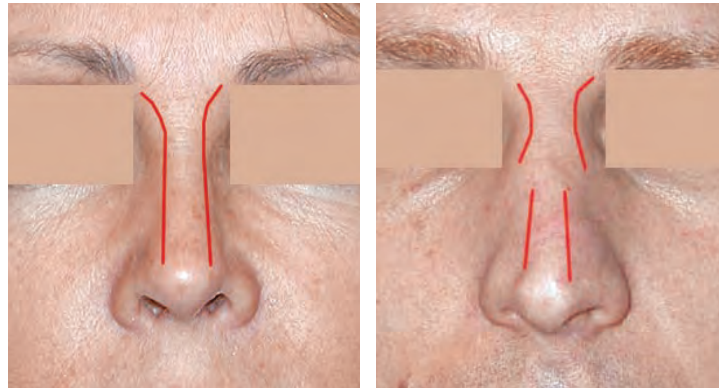
Middle vault collapse can be difficult to correct through an endonasal approach, and even more difficult when the nostrils are narrow. The external approach allows good exposure and accurate correction. The normal anatomy of the cartilaginous vault must be recreated; specifically, the septal T must be enlarged and a normal valve angle created.

After an extramucosal dissection has been performed, the mucosal domes can be approximated toward the midline. Various types of grafts may also be used for correction. The role of grafts is not limited to morphologic aspects; they are also used to prevent or correct functional problems. A cartilaginous dorsal graft placed over the dorsum may provide a spreading effect of the upper lateral cartilages by leverage of the soft tissue cover.



A spreader graft, as described by Sheen, can be placed via an endonasal approach in submucosal tunnels on either side of the anterior septal border but the open approach offers more accuracy in positioning and stabilizing the grafts. The spreader grafts should extend from the junction of the nasal bones and upper lateral cartilages to the nasal valve area. Their ends and posterior border should be feathered. Their thickness depends on the importance of the deformities. The caudal portion of the septum usually provides a thick 2 to 3 mm fragment. The surgeon can use a two-layered graft if there are thin fragments. When the septal mucosa has been widely elevated, the spreader grafts must be stabilized with two sutures of 5-0 Vicryl or PDS.

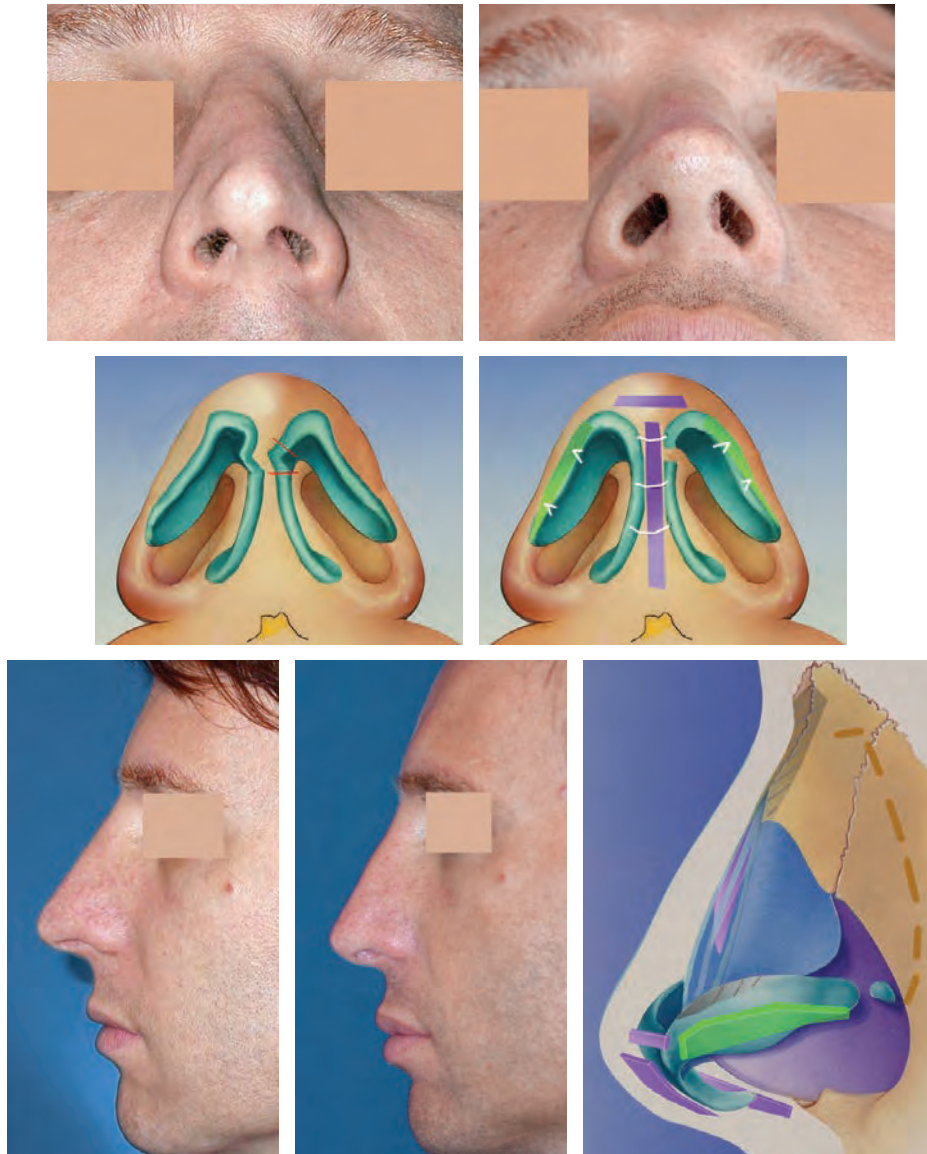
Septal cartilage is the best material for dorsal and spreader grafts. This cartilage can also be bruised and positioned superficially to the upper lateral cartilage to fill in a depression. In severe cases, with overresection of the upper lateral cartilages and collapse, a splay graft (Guyuron) allows a pleasing reconstruction. The splay graft saddles the middle vault with the two lateral portions of the graft being placed submucosally. Some patients complain of increased difficulty on quiet or forced inspiration, often associated with excessive movement of the nasal ala toward the septum (collapse).



Parallel dorsal lines should be obtained after a rhinoplasty (*left*). On the secondary rhinoplasty patient shown on the right, a disruption of these lines is caused by a middle vault collapse, highlighted by a broad bony vault with convexity more evident on the left side.



This patient had several deformities of his nose and difficulties in breathing. On frontal view, there was a broad bony vault. The middle vault was collapsed, with disruption of the dorsal lines, and a deviation with a concavity on the right.



On the oblique and basal views, one could see a concavity of the alar walls that was more significant on the right side, and a narrow tip lobule. Endonasal examination showed a septal deviation and an internal valve dysfunction, both of which caused the breathing impairment.

After harvesting the conchae through a retroauricular approach, an open approach was selected, exposing the deformities of the alar cartilages. The dorsum was slightly rasped and the radix lowered with a beveled osteotome. The septum was approached via the dorsal edge, and septal material was harvested. The deviation was corrected by repositioning the caudal septum in the midline. The nasal spine was conservatively resected, and the caudal septum was sutured to the soft tissues surrounding the nasal spine.

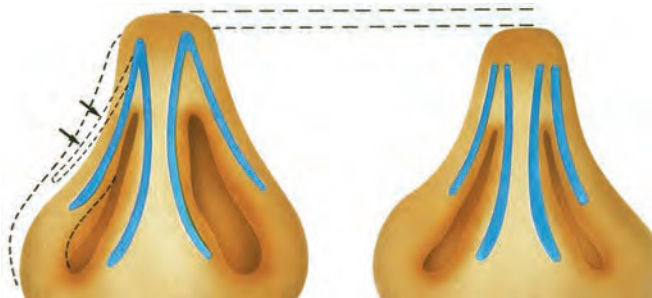


Endonasal and percutaneous medial osteotomies and endonasal lateral osteotomies were performed. Two spreader grafts were positioned at different levels, taking into account the configuration of the deformities. After placement of a columellar strut, alar grafts (ear cartilage) were sutured to the lateral crura. The tip projection and definition were improved with an onlay graft and a thin septal graft was positioned in the infra columellar area. The patient is seen 1 year postoperatively.

Alar Deformities

Alar deformities and collapse may be caused by overresection of the cephalic portion of weak, concave, long, or malpositioned lateral crura and by resection of the domes, which may lead to medial movement of the lateral crura or by muscular disruptions, particularly disinsertion of the alar base. Resections of significant portions of the lateral crura and postoperative soft tissue contraction can damage the external valvular support and impair the airway. The external valve, which is caudal to the internal valve, is composed of the cutaneous (external and vestibular skin coverings) and skeletal (lateral crura) support of the mobile alar wall. The lateral walls are observed for external abnormalities, such as an inward bowing of the alae on inspiration, with or without alar collapse. One should look for mucosal scars in the form of synechia or bands and deviations of the anterior septal border.

Potential Problems

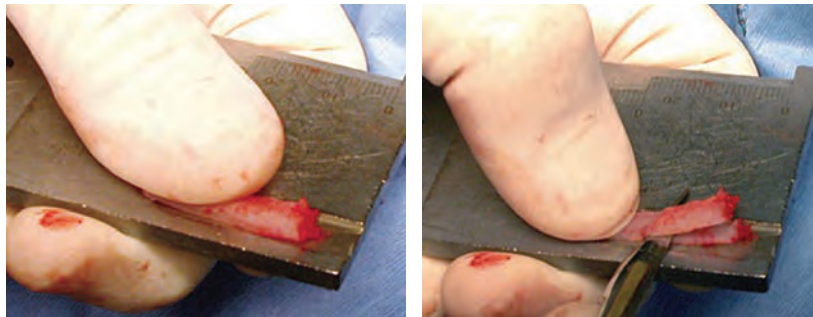


Alar collapse may occur when the lateral crura are long, weak, and concave. Dome resection and reduction of the height of the lateral crus exacerbate the condition if these factors exist.

Depending on the appearance of the soft tissue cover, the shape, length, and elasticity of the alar cartilages, and the extent of the collapse that is apparent on forced inspiration, the surgeon can reinforce the cartilaginous framework, modify its shape or the shape of the domes, and reinforce the tip supports and the junction between the lateral crura and the upper lateral cartilages. Careful external and endonasal observation of the motion of the ala is crucial, because it will show the affected area and consequently show where to position the graft.

Correction

Exteriorization of the lateral crura by a marginal incision or, preferably, an external transcolumellar approach allows these modifications to be made with accuracy. Lateral crura that are very concave can be corrected by modifying their curvature with light cartilaginous superficial incisions in conjunction with suture technique or thin cartilage grafts. In thin skin, the cephalic portion of the lateral crura can be resected, placed superficially to the concave lateral crura, and sutured to the remaining cartilage with apposition of the concave surfaces.



A thick septal fragment can be spliced into two 0.5 mm thick alar grafts, which is the average thickness of lateral crura. The fragment is placed in a groove 0.5 mm deep. The graft is firmly pressed with the thumb and, with the use of a No. 11 blade, it is meticulously split longitudinally. The procedure works well with septal and costal cartilage, providing slightly convex strips of cartilage. In thick skin and weak, concave cartilages, it is better to use more resistant cartilage, such as a fragment of septal or conchal cartilage that has been modified as necessary.

A wide base of the columella may be caused by a thick septum that needs to be thinned, or lateral edges of the nasal spine that need to be reshaped. The divergent medial crural footplates should be partially resected after the intervening soft tissue is excised and transfixion sutures are placed to ensure narrowing of the columellar base.

An excess of mucosal tissue at the base of the columella can form a bulge. To prevent this, the mucosa can be resected over the septum and the skin covering the columellar base can be advanced, after partial resection of the tail of the medial crura.



After a primary rhinoplasty, this patient had a narrow nose, asymmetry, and collapse of the middle vault (more noticeable on the left side), and a narrow nasal base with exposed nostril orifices. On basal view, the nostril orifices were narrow with a wide columella, and there was internal and external valve dysfunction. On lateral view, there was a round nasal tip, a slight supratip excess, and bilateral alar retraction.

The goal of secondary rhinoplasty was to improve her function by widening the middle vault and nasal base and to correct the alar retraction. A transfixing incision allowed a shortening of membranous septum (2 mm) and caudal septum (4 mm high); the nasal spine was conservatively resected. A transcolumellar incision provided full exposure and allowed major harvesting of septal cartilage and vomer. Cartilage and vomer grafts were placed in the middle vault and nasal base: two spreader grafts in the middle vault, the left one being thicker, and two vomer fragments placed superficially at the junction of the lateral and upper lateral cartilages. A cartilaginous alar graft was then placed on the left side and a vomer graft on the right. A tip graft was placed in the infratip to widen the tip lobule and provide better definition and projection. The patient is seen 13 months postoperatively. Her nose is more harmonious and her ability to breathe has improved.

Short Nose

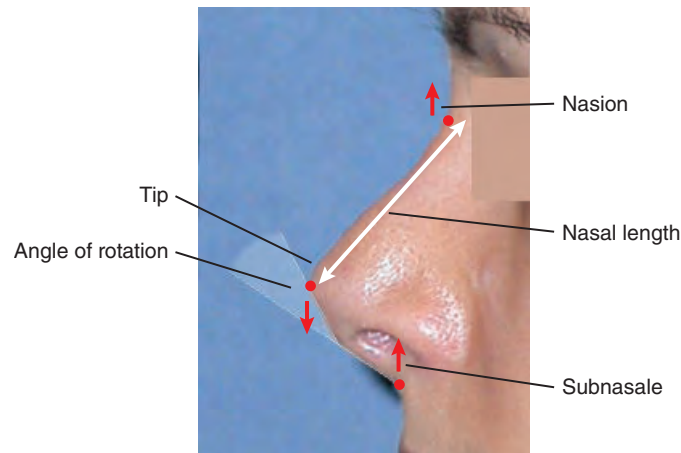
A short nose is defined as having a decreased distance from the radix to the tip and an obtuse nasolabial angle of greater than 110 degrees with increased show of the nostrils on frontal view. Whether primary or secondary, the foreshortened nose is considered one of the most difficult for rhinoplasty surgeons to treat, particularly when the covering tissues are scarred and adherent and there is a shortage of lining.

Causes

Why is the nose shortened? Assessing the causes of shortening may help to predict the potential lengthening of the mucosal lining and covering soft tissues. A short nose can result from excessive resection of the dorsum, the caudal and membranous septum, the cephalic portion of the lateral crura, and the caudal portions of the upper lateral cartilages. Cephalic rotation of the nasal tip can be caused by a columellar strut or by cephalic displacement of a tip graft, increasing the angle of rotation.

Diagnosis

A diagnosis of nasal foreshortening is based on different methods of measurement. The nasal length depends on the size and proportions of the other facial features and should be proportional to the forehead. Ideally, the nose lies within the middle third of the face. However, in assessing the length of the nose, there are several anatomic deficiencies and disproportions causing real as well as illusory perceptions of shortness. The optical illusion of nasal length is intimately related to the position of the radix and to the nasolabial angle that determines the position of the subnasion.



The position of the nasion is critical; the “ideal position” is a specific point at the deepest portion of the nasofrontal concavity. It is normally situated between the level of the supratarsal fold and the lower eyelashes. Surgical maneuvers can alter the position of the nasion. Grafting the dorsum may shift the position of the nasion upward, creating an illusion of lengthening. An obtuse columellolabial angle greater than 110 degrees with an increased nostril show on the frontal view increases the optical illusion of shortness. Infratip grafts decrease the angle of rotation, shifting the tip-defining points caudally.

Correction

The short nose has always been a difficult challenge. The foreshortened nose is caused by overresection, with retraction of the soft tissue envelope covering the overreduced and unsupported skeleton, thus moving the mobile nose (alar complex) cephalically. The principle of lengthening is to caudally extend the mobile nose. This requires large soft tissue undermining and extramucosal dissection, followed by releasing mucosal incisions and a lengthening of the underlying skeleton. Various procedures, grafting in particular, can be used to produce a real or optical illusion of lengthening. Significant improvement, including optical illusion as well as real lengthening, can be achieved by adequate soft tissue release, alar columellar complex release, and grafting to hold the tip in a more caudal position.

Approach

The transcolumellar approach is best for correction of overshortening of the nose, affording a wide and better access to external soft tissues and facilitating safe mucosal dissection. In correcting a foreshortened nose, there is no risk of overcorrection because of the limiting factors: a most important factor is the suppleness of the soft tissue envelope and the importance of lining contracture. The surgeon can also produce an optical illusion by shifting the radix cephalad, either by deepening a shallow radix or by grafting the dorsum and radix. This can also be done by decreasing a high tip projection and deepening an obtuse nasolabial angle by resection of a protruding nasal spine and caudal septum.

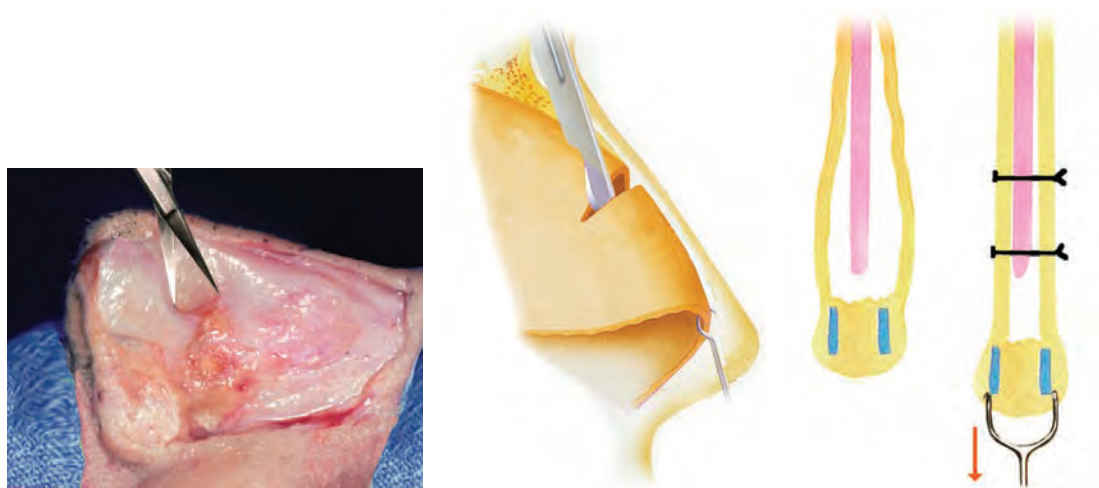
Soft Tissue Release

Wide undermining of the soft tissue cover should extend upward to the radix and widely over the lateral walls if a lateral osteotomy is not planned. The advantage of this undermining is that one is able to use the elasticity of the skin in the hope that it will adapt itself to the newly lengthened infrastructure. Good skin elasticity allows better adaptation of the undermined soft tissues.

In severely foreshortened noses, the undermining can be carried out beneath the nasal bones, the frontonasal apophyses, and the margin of the piriform aperture. Thus the cartilaginous vault is dissected off the bony vault, making it possible to extend the entire cartilaginous nose downward.

Release of the Mucosal Lining

Release of the mucosal lining and laxity of the membranous septum are essential. Dissection of the mucosa is possible when the mucosa is supple and nonscarred and when it has previously been easily dissected. Medially, bilateral mucosal undermining is performed as in an extramucosal dissection, beneath the upper lateral cartilages. This undermining extends up to the level of the piriform aperture.



The lateral crus is separated from the upper lateral cartilage by spreading motions of the scissors, followed by placement of a graft in the gap that has been created. The upper lateral cartilages are separated from the septum and, after traction has been applied to the tip with a hook, staggered and horizontal mucosal releasing incisions are made in the mucoperichondrium of the newly developed mucosal sleeve at the level of the middle third; this allows the lower lateral cartilage complex to be pulled caudally. Mattress sutures are then placed while traction is applied to the alar complex in a caudal direction above the caudal septal border to stabilize the new position of the mucosa. In severe cases, a significant tear of mucosal lining may occur that necessitates a composite conchal graft to fill the void.

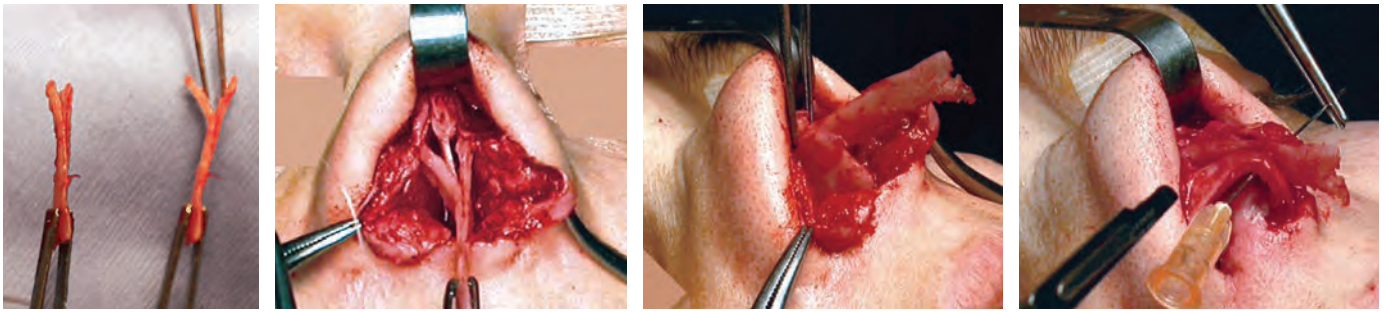
Grafting

The osteocartilaginous framework can be lengthened by grafting after the previously described preliminary but crucial maneuvers are performed, producing a real and/or optical illusion of lengthening. Dorsal grafts allow correction of saddle deformity and provide an illusory lengthening by shifting the nasofrontal depression upward. A long dorsal graft (as a bone or costal graft) extending to the tip can provide real lengthening by a forceful downward pull of the alar lobular complex, moving the tip and defining points caudally.

Caudal extension grafts can also be used. A long, rigid batten septal extension graft can be sutured along the lateral edge of the septum. This graft should be 3 cm long, its stiffer portion protruding caudally by 6 to 10 mm.



This patient was very depressed after a rhinoplasty that resulted in overshortening of her nose; the nostril orifices could be seen on frontal view, and the nasal base was flat and widened. Her principal request was correction of the shortening as well as widening of the nasal base, yet she wanted her dorsal hump preserved. On lateral view, she had a slight dorsal hump and a round tip without definition. The nasolabial angle was increased, and the facets were too visible on both sides. On basal view, one could note the signs of the loss of tip support: a short columellar distance, widening of the medial crural footplates, and alar flaring with soft tissue facet ptosis resulting from a loss of support that was more noticeable on the right.



Because the patient wanted to preserve her dorsal hump, the objectives were to provide some lengthening, improve the tip supports, narrow the nasal base, and give the tip more definition. A transfixion incision was first done to decrease the nasolabial angle with a triangular, posteriorly based resection of caudal septum, mucosa, and nasal spine. The incisions were sutured and a transcolumellar incision was made; after a dorsal approach to the septum and a large extramucosal dissection, this allowed major en bloc septal harvesting and releasing mucosal incisions at the level of the rhinion. A long, thick fragment from the caudal portion of the harvested material was found particularly appropriate for use as a septal extension graft. The thicker end of this fragment was split and placed as a tongue-in-groove at the caudal border of the septum and was fixed with 5-0 PDS sutures. Lateral elongation was obtained by spreading the lateral crura from the upper lateral cartilage using scissors. The alar complex was then extended caudally with a double hook, and a needle was placed to maintain the lengthening while transcolumellar sutures were performed with 5-0 PDS.

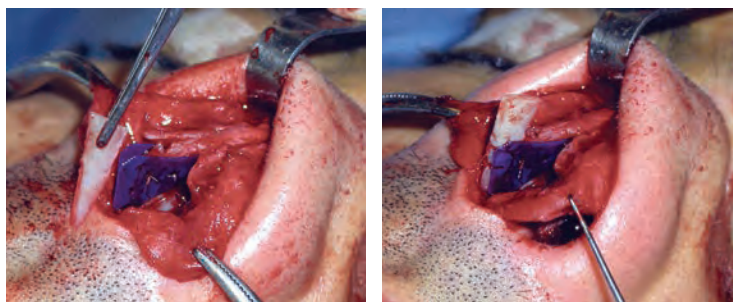


A shield graft was positioned in the infratip segment, and a septal graft was spliced, bruised, and placed caudally to the anterior base of the main graft to provide a smooth transition from the main tip graft to the adjacent facet.



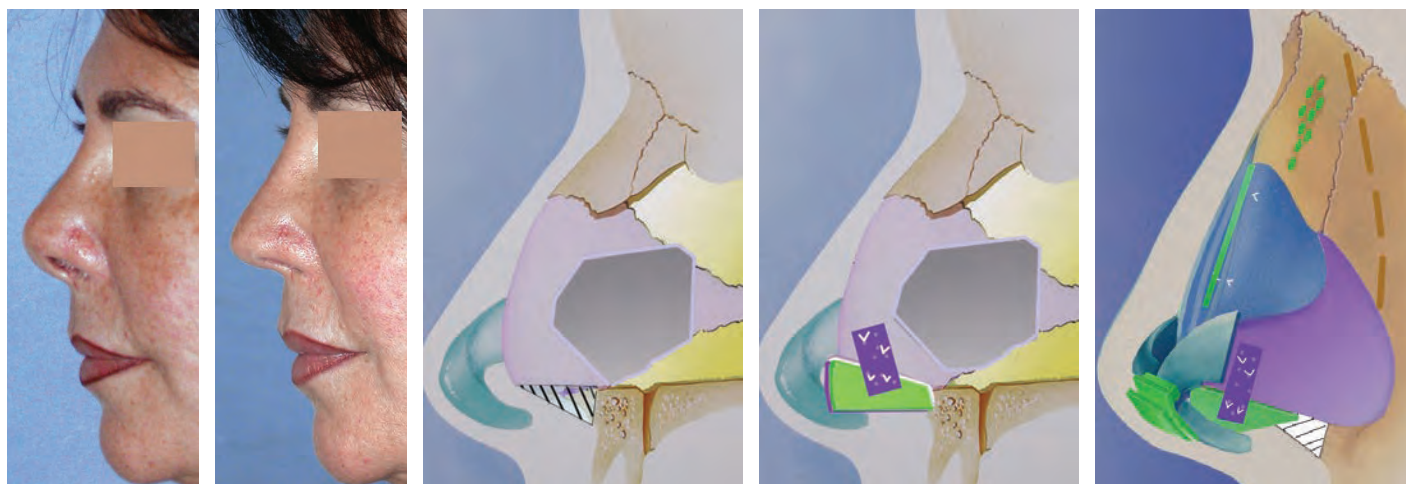
The patient is shown 8 months postoperatively. Her nose appears longer and its contours are aesthetically pleasing.

One can also use a triangular caudal extension graft based anteriorly (8 to 10 mm) and positioned within the membranous septum; its fixation to the caudal septum can be achieved with figure-of-eight sutures, transmucosal mattress sutures, and external splints. An excellent fixation can be achieved by securely splinting (sandwiching) the graft with two PDS battens.



Two PDS battens are sutured laterally to the caudal septum and then to the graft. Because PDS resorbs in 6 months, it provides a scaffold for a good stabilization by the fibrous tissue produced during the healing period.

Cartilage grafts to the tip may provide a lengthening effect by using multilayered grafts placed caudally to the infratip lobule. These grafts must be thicker anteriorly and feathered out posteriorly so as to decrease the angle of rotation. They can also improve contour and projection if necessary. Infratip grafts allow the surgeon to shift the tip defining points caudally and to provide a real lengthening. The recipient graft bed should be strong enough to resist the cephalic pull of the stretched skin flap. This is achieved by the caudal extension graft placed within the membranous septum and columella.



After having undergone two rhinoplasties and septoplasty, this patient complained of an overshortened nose with exposed nostril orifices and difficulty in breathing. On lateral view, the dorsum was straight, but there was an overtight rotation, and overshortening of the tip with an increased columellolabial angle at 130 degrees. There was some a prominence on the right ala and a slight depression of the left nasal bone and middle vault. Her soft tissues were quite thick.



On frontal view, the patient's overexposed nostrils are evident, and her upper lip appears too long. Rhinoscopy revealed a septal deviation on the left side, and on palpation of the septal mucosa with a soft instrument, it appeared that the septum had been partially harvested previously. The goal was to decrease the angle of rotation and correct the deformities. Because no septal cartilage was left after the previous septorhinoplasties, the right concha was harvested using a retroauricular approach. A transcolumellar approach was selected; a posteriorly based triangular resection of the caudal septum, nasal spine, and mucosa was performed through a posterior transfixing incision.

After skeletonization, direct visualization showed overresection of posterior portion of lateral crus and a slight prominence of the left dome. Dissection of mucosal flaps permitted to correct the septal deviation and harvest a small portion of septal cartilage. The domes were equalized by resection of the left dome. An alar graft was sutured to the remaining portion of the right lateral crus. A lateral low-to-low osteotomy was performed on the left side. A spreader graft was placed on the left side and diced cartilage fragments were placed laterally to the upper lateral cartilage–nasal bone junction to correct a depression. A triangular caudal extension graft based anteriorly was positioned in the membranous septum and stabilized with two PDS battens. A two-layered infratip graft was positioned and sutured, and a buttress graft was positioned cephalad to the anterior portion of the graft and sutured to the domes. A 2 mm alar base resection was then performed. The patient is seen 16 months postoperatively.

An obtuse nasolabial angle with overexposure of the medial crura footplates may be decreased by a resection of nasal spine and a triangular based resection of caudal septum and mucosa. A composite graft harvested from the concha is indicated if the gap between lower and upper lateral cartilage is large. The purpose of this graft is to fill the void. The dressing is positioned while the nose is maintained in extension with a double hook instrument.

Correction of a Short Nose

The short nose has always been a difficult challenge. Correction should resort to optical illusion effects as well as true lengthening effects. Before grafting, three crucial points should be considered:

- Undermine a large soft tissue cover.
- Perform a release of the alar columellar complex and mucosa.
- Graft so that the tip is in a more caudal position.

Retracted Columella

Columellar retractions may be observed after an excessive resection of the antero-caudal septum, the nasal spine, or the membranous septum. The columellar retraction can be located at the midcolumella or at the labiocolumellar junction, with an acute nasolabial angle as a result of septal or nasal spine overresection.



Gunter thoroughly described the alar-columellar relationship. On lateral view, the outline of the nostril is an oval, which should be separated in two equal segments by its long axis. The relationship of the columella to the long axis defines the retracted columella. It can be combined with a hanging ala, decreasing the columellar show.

Palpation with columellar mobilization allows evaluation of the nasal tip supports and the suppleness or rigidity of the membranous septum. Anterior rhinoscopy with palpation of the lining with a blunt instrument establishes the location of a septal deviation, the location and extent of a caudal septal resection, and whether septal material is available for grafting.

The open approach and transection of the upper lateral cartilage–septal junction after an extramucosal dissection allows a perfect exposure of the septum and facilitates assessment of the deformities or defects. Septal deviations are always corrected before any further correction is performed.

Correction of the retracted columella must be graduated, taking into account the retraction extent, the suppleness or laxity of the lining, the tip, and the position of the alae. Tip support has often been weakened and must be reinforced with sutures and grafts.

Moderate Columellar Retraction With Supple Lining

A columellar strut is sufficient for the correction. It is preferentially harvested from the septum, rectangle, measuring 15 to 20 mm long and 3 to 5 mm wide. It is placed between the middle and intermediate crus, slightly extending in the membranous septum. It is sutured with two or three 5-0 PDS stitches.

A columellar onlay graft extended toward the nasal spine may sometimes improve the columellar show.

An acute labiocolumellar angle caused by excessive trimming of the caudal septum, of the nasal spine and sometimes of the membranous septum can be corrected with a posterior-base triangular columellar strut. It leans against the nasal spine and extends into the membranous septum. Small pieces of cartilage can be added in the premaxillary region to lower the labiocolumellar junction.

Significant Columellar Retraction With Scarred Lining

When the alar-columellar distance is less than 1 mm, lengthening of the caudal septum must be combined with lengthening of the lining.

Lining Lengthening

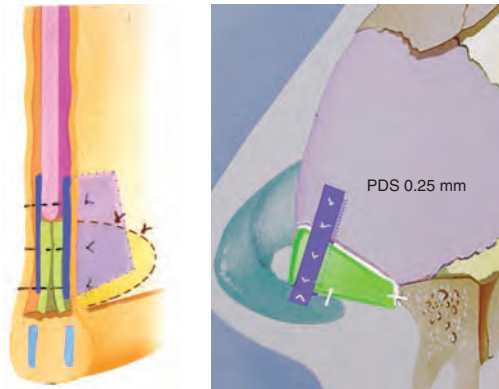
If possible, wide extramucosal bilateral undermining is first performed. Then staggered horizontal incisions of the lining are made in the middle third. Transfixion stitches are placed at the caudal edge of the septum while the lining is pulled inferiorly with hooks to keep the lining in a downward position.

When the scarred tissues cannot be undermined, a bilateral V-Y plasty can be done during lining closure. If not possible, composite chondrocutaneous grafts can be used. They are sutured in two hemitransfixion staggered incisions in the membranous septum.

Caudal Septum Reconstruction

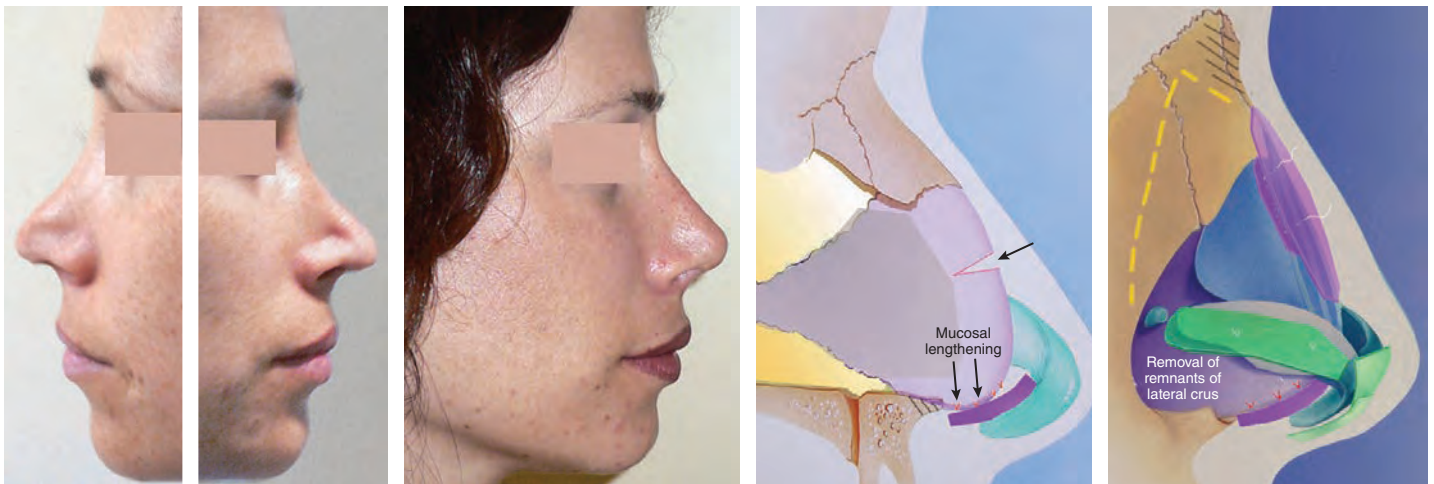
Columellar retraction is corrected by placing a graft that extends the missing caudal septum (septal extension grafts). This graft must be aligned with the straightened septum. If possible, it is harvested if possible en bloc at the posterior part of the septum, preserving at least 8 to 10 mm above and in front of the defect. A stiff, flat piece of cartilage is preferentially obtained at the posteroinferior part of the harvested graft, at the junction between the septum and vomer.

If the septum is not available for the septal extension grafts, the graft material can be harvested from the conchae. It can become straighter and stiffer by suturing two pieces of conchae with the concavities facing each other. A graft can also be harvested from the rib, especially if cartilage must also be used for dorsal augmentation or for other grafts. It is then taken in the central part of the rib and sutured after waiting at least half an hour to be certain that no late bending will occur.



Different types of septal extension graft designs exist. The triangular caudal extension graft is stabilized with PDS battens (0.25 mm thickness). Fixation of the graft to the nasal spine is made with 5-0 PDS after having placed the inferior edge of the graft in a groove made behind the nasal spine. If the spine has previously been resected, two converging drill holes are made in a V shape in the premaxilla to allow a strong fixation of the graft. Fixation of the graft between the middle crura is done only after having first temporarily closed the transcolumellar incision and assessed its impact on the columella position.

Finally, an infracolumellar graft can be added before closure if more lengthening is needed or if the columellar contour must be softened. Transfixion resorbable stitches are made through the septum and graft to prevent dead space. An endonasal splint and packing help to prevent fluid accumulation between the lining.



This patient underwent two rhinoplasties; the dorsum and caudal septum were over-resected. On lateral view, a light fullness of the radix could be seen, with saddling in the upper dorsum and a supratip convexity. The columella was retracted, particularly in its middle portion, highlighting the crooked aspect of the tip. Both alae were markedly concave and collapsed.



On frontal view, the dorsum was flat, with a rather narrow middle vault and a pinched tip lobule. On basal view, the infratip segment was concave and the columella appeared short. The objectives were threefold: correction of the retracted columella, the depressed dorsum, and the collapsed alae. After harvesting the conchae through a retroauricular approach, a transcolumellar approach was performed; dissection was tedious in the alar region because of adherent soft tissues. Operative findings showed some rests of the right lateral crus and a concave lateral crus on the left side. The radix was slightly reduced with a beveled osteotome.

The septum was approached via its dorsal edge and an extramucosal dissection was performed, allowing a large septal harvesting and conservative resection of nasal spine. Two horizontal staggered incisions were made in the midportion of the dorsum to provide some lengthening of the mucosal flaps. Mucosal lengthening was held in caudal extension with two hooks, and sutures were placed a few millimeters above the caudal border of the septum to stabilize the mucosal lengthening. Lateral low-to-high and medial osteotomies were performed. A 5 mm wide columellar strut was positioned between the caudal septum and the cephalic edges of the medial crura. It was sutured to the nasal spine and to the caudal septum. The rests of the right lateral crus were removed, and alar reconstruction was achieved with a conchal graft sutured to the dome. The left concave lateral crus was corrected by suture technique. Additional grafts were placed, caudally to the columella to provide additional exposure of the columella, and in the infratip region to correct the depression in this area. A two-layered dorsal septal graft was then placed on the dorsum. The patient is seen 12 months postoperatively.

Nasal Tip Deformities: Problems Associated With Soft Tissue Conditions

Secondary defects of the nasal tip are the most difficult to correct. The patient should be advised that revisions are increasingly difficult and the outcome even more unpredictable.

Secondary deformities of the nasal tip are often caused by excessive and asymmetrical resection of the alar cartilages, notably in the lateral portions and at the level of the middle crura. Depending on the skin condition, overresection can cause various types of defects, but thick skin provides some support to the alar cartilages and can also mask a projection or a cartilaginous defect. A wide range of deformities may be seen in the nasal tip area. The most common nasal tip defects include the following:

- Minor defects such as a slight asymmetry of the domes and lateral crura despite perfect correction via an open approach and perfect symmetry at the end of the procedure

- Malposition of the domes' height and projection, nasal tip deviation, and a tip lobule that is too narrow or broad

- Undercorrection that leaves an excess of tip projection, a wide lobule, tip ptosis, and cartilaginous projections

- Undertip projection of variable severity—from inadequate tip projection with a round nasal tip, frequently observed after a loss of tip support, to a major undertip projection caused by aggressive resection of the domes and lateral crura

- Overrotation of the tip, with an increased angle of rotation

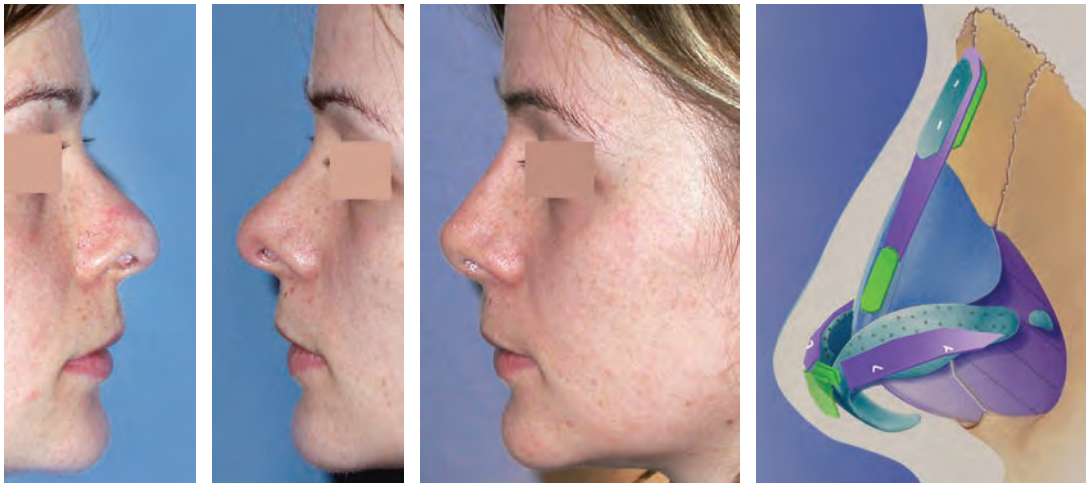
Overresection of the vestibular skin and mucosa can result in alar retraction that exposes the columella. Secondary problems may be worsened by scarred soft tissues that are very adherent to the underlying structures, making dissection very difficult. Collapse and depression of the nasal ala are often associated with overresection of the lateral crus: it weakens the cartilaginous support of the ala, creates alar notching or retraction, and may impede the external nasal valve.

Correction

Deformities of the nasal base should be corrected taking into account the aesthetics and the defects that are noted in other structures of the nasal pyramid, notably the radix and dorsum, to reestablish an equilibrium between the subunits of the nasal pyramid and to balance nasal harmony.

A transcolumellar approach is most often required to assess the deformities and the remaining cartilages. This approach allows a larger array of suture corrections, better positioning and accurate suture fixation of the grafts, and more accurate positioning of camouflage methods.

When after several surgeries soft tissues have become very scarred, a midcolumellar incision can be used for easy placement of a tip graft.



This young postrhinoplasty patient complained of an unbalanced nose: a wide nasal base, slight saddling of the dorsum, and bilateral alar retraction. On lateral view, the upper dorsum was too low and the alar retraction was very marked on the anterior portion of the alar rim.



The basal view showed an asymmetry of the nostril orifices. Soft tissues were moderately thick and tip support was poor. On frontal view, there was a narrow bony vault and a large, wide nasal base, with some irregularities on the surface of the tip lobule; in addition, the nostril orifices were too exposed. These deformities were obvious on oblique view, showing the flatness of the infratip. The objectives were to balance the nose on lateral and frontal views, improve the tip configuration, definition, and width, and correct the alar retraction. After harvesting auricular cartilage from the concha, a transcolumellar approach was selected. Dissection was difficult

because of a scarred supratip; defects were observed, particularly on the overresected lateral crura, which were reduced to some unusable fragments of cartilage for correct reconstruction and these were resected.

After rasping some irregularities of the dorsum, the supratip excess of septal cartilage was incrementally shaved, and a septal approach allowed for a major harvesting. Reconstruction had started by strengthening the columella support with a septal columella strut. A multilayered dorsal graft was composed of a long fragment of septal cartilage, a bruised fragment of the resected lateral crura placed superficial to the main graft on its cephalic portion, and a bruised auricular cartilage placed underneath to augment the radix area. Alar reconstruction was achieved with two septal battens positioned parallel to the alar rim and sutured to the vestibular skin. A tip shield graft of ear cartilage was placed in the infratip lobule, and two buttress grafts were positioned posterior to its anterior portion to decrease a large angle of rotation. No osteotomies were performed. Results are shown 2 years postoperatively.

Scar Tissues

Difficulties are encountered when soft tissues are very scarred, and dissection should be performed very careful to avoid dermal damage or skin perforation. This scar tissue will sometimes be left on purpose. It can be sculpted to get a better tip and supratip definition. It may also provide a solid foundation for graft placement and fixation. A thin layer of scarred soft tissue can be left at the surface of the alar cartilages to facilitate suture techniques.

Excess width and tip projection can be controlled with a bloc sagittal wedge resection of scar tissue in the dome area, followed by approximation of the edges with sutures.

An approach to the septum can be facilitated by sagittally splitting the section of scarred tissue with a blade, starting from the inferomedial crura space up to the tip and supratip.

Thinned Skin and Subcutaneous Tissues

From prior rhinoplasties, the superficial nasalis aponeurotic system (SMAS) and skin may have been traumatized and may become thinner and more adherent to the underlying structures. In those cases, sutures are favored to graft techniques whenever they are usable. However, a camouflaging maneuver can be useful to hide small cartilaginous irregularities or the graft edges. Usually a sheath of deep temporal aponeurosis is sutured on the top of the tip or the tip graft. Perichondrium can also be used for this purpose.

Reconstruction

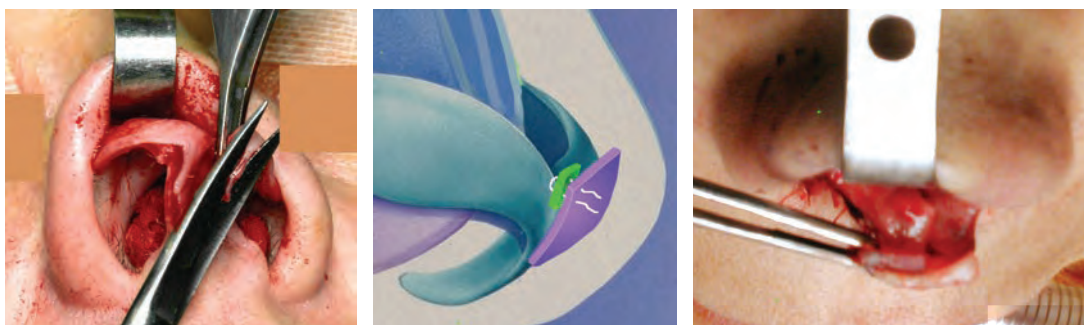
Reconstruction involves strengthening of the tip supports. After having harvested cartilage from the septum or other sites, the surgeon should, as in every rhinoplasty, establish a solid, stable, symmetrical foundation and strengthen the medial leg of the tripod. It is also essential to obtain a straight septum to correct any extrinsic tip asymmetry.

The dome height, position, and symmetry can be corrected only after a stable foundation has been established. If cartilage conditions are good, suture techniques may be used to improve symmetry and projection and to narrow a broad tip lobule. Sutures can also enhance tip definition if the skin is not too thick.

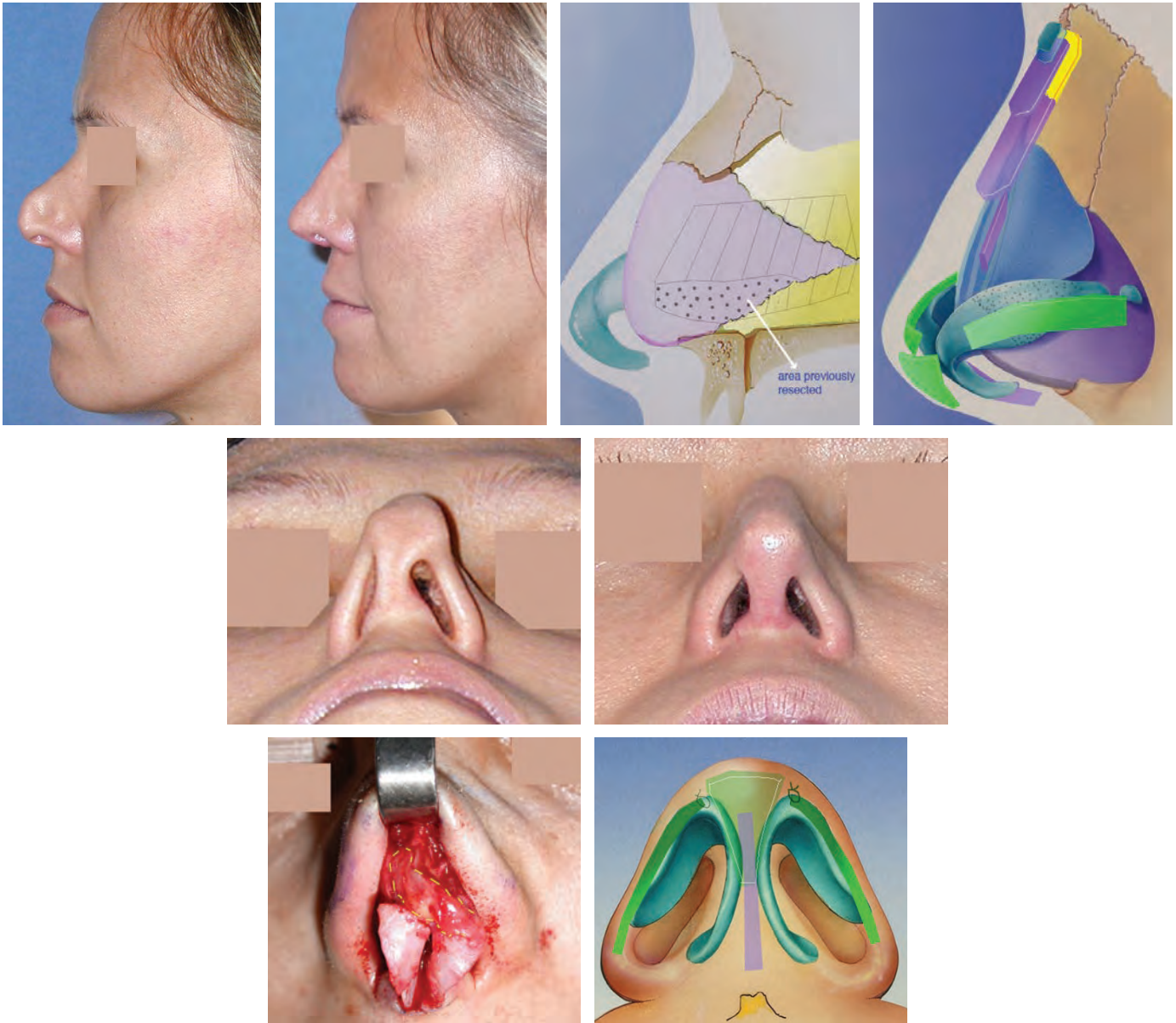
If the columellar graft is too malleable (ear or soft cartilage), its rigidity can be improved by assembling two grafts or sandwiching them with a thin fragment of vomer or a PDS plate. When the columella is retracted, the columellar strut is positioned within the membranous septum and medial crura. It should be wider than usual struts to allow a caudal shift of the medial crura. When alar cartilages are too soft or are unusable, it is sometimes better to resect and reconstruct them with cartilaginous graft.

Tip asymmetry after a correct septal alignment sometimes requires asymmetrical resection of the domes or middle crura. An interdomal suture is then placed to equalize the dome's height.

Various types of tip grafts are used to reconstruct the nasal tip and improve its contour, projection, position, and the alar-columellar relationship. The surgeon can use onlay, shield, or buttress grafts. These grafts are often used in combination.



A tip graft should always be placed on a well-prepared, symmetrical recipient graft bed. This can be created by judicious resection of the cartilaginous graft bed. The caudal edges of the middle crura are equalized to provide a flat, symmetrical graft bed, or an asymmetrical graft is placed (*left*). When it is difficult to obtain a flat, symmetrical recipient graft bed, a small graft can be positioned on one side, above the lateral portion of the shield graft, to compensate and correct an asymmetrical recipient graft bed.



This patient had severe deformities and impaired breathing after a septorhinoplasty. On lateral view, there was saddling of the upper dorsum and radix and a marked supratip convexity. The columella was retracted in its posterior portion. The soft tissue cover was thin, highlighting the deformities and projection of the cartilages.



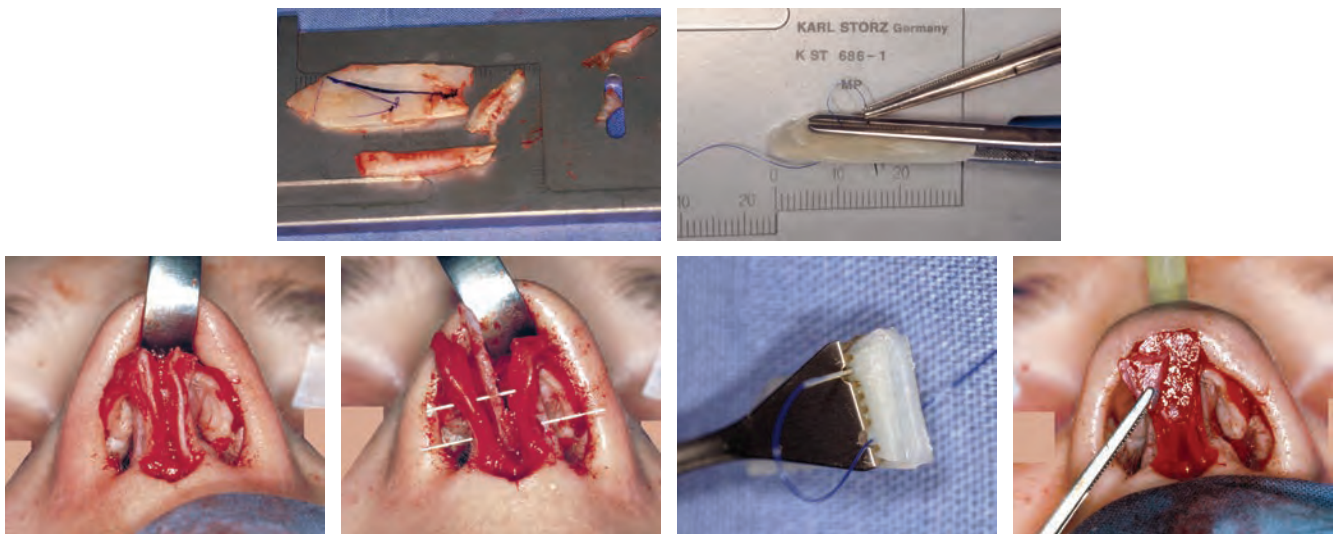
On frontal view, the bony vault was slightly broad in proportion to the width of the middle vault and the collapsed alae. The nasal base was very asymmetrical, with significant alar collapse on the left side. The tip and columella were deviated toward the right. Cartilage was harvested from both conchae, and correction was achieved with a transcolumellar approach and careful skeletonization in a subperichondrial and subperiosteal approach to preserve sufficient thickness to the covering soft tissues as much as possible. The deformities observed on direct view were marked, with asymmetry of the resections and scar tissue in the supratip. A large posterior portion of the right lateral crus had been resected, and the left lateral crus was very concave and thin. Scarred supratip soft tissues were trimmed, as well as 3 mm of the supratip dorsal edge.

Despite a previous septal surgery with its consequent scarred mucosa, harvesting of the posterior septum was possible. Reconstruction was achieved with a spreader graft on the left side and an autospreader graft with internal plicature of the dorsal edge of the right upper lateral cartilage. After resection of the rests of the domes and the left lateral crus, which was not usable, alar grafts (ear cartilage) were positioned on the alae. Multilayered grafts composed of two septal fragments were placed on

the upper dorsum, and two fragments of the resected lateral crus were placed superficial to the main dorsal graft in the radix area. Results are shown 2 years postoperatively.



This 23-year-old patient had undergone two prior rhinoplasties. On the lateral view, the nose was short and unbalanced, with a low upper dorsum, a high cartilaginous dorsum, a round tip with no definition, and an increased angle of rotation. The frontal and oblique views further demonstrated the bulbosity of the nasal tip and low upper dorsum. On palpation, the soft tissues of the tip lobule were thick and lacked suppleness.



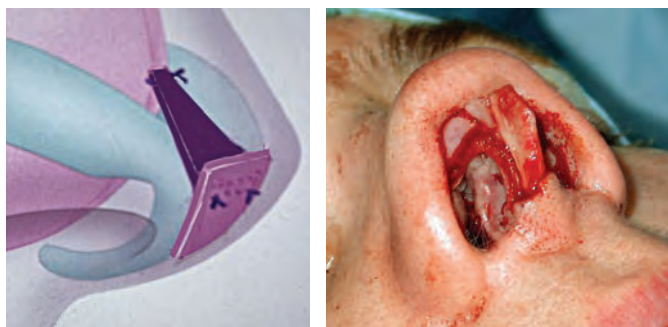
A triangular posteriorly based resection of mucosa and caudal septum was performed using a transfixion incision. After a transcolumellar approach and skeletonization, the fibrous, scarred soft tissue of the supratip was resected and the dorsal border trimmed by 2 mm. Operative findings showed the previously resected domes and a slight tip deviation on the right side. A major harvesting of septal cartilage was then performed using the hemitransfixion incision.



A two-layered, bruised cartilage was placed on the upper dorsum. The cut ends of the previously resected domes were sutured after some adjustments. A columellar strut was then placed within the medial crura and fixated with 5-0 PDS. A double-layered shield graft was then placed in the infratip to augment tip projection and the length of the nose. The patient is shown 18 months postoperatively.

In major undertip projection, multilayered grafts can be used. A long and stiff columellar strut resting on or fixed to the nasal spine can be covered by multilayered onlay grafts. All of these grafts (septal or ear cartilage) are accurately positioned and sutured with 6-0 PDS.

Buttress Graft



A long infratip shield graft projecting several millimeters above the domes can also be used. However, the anterior extension of the tip graft should be buttressed with a graft placed cephalad to the main graft and sutured to the anterior septal border or to the domes to prevent the anterior portion of the graft from being folded cephalically by an inelastic or rigid soft tissue cover.

When alar flaring is associated with an undertip projection, it should be corrected only after nasal tip reconstruction. Any residual flaring can be assessed and then corrected.

Problems Associated With Soft Tissue Conditions

At the end of a rhinoplasty procedure, the result may appear satisfying. The dressing often consists of adhesive tapes that put some pressure on the supratip. There will be residual supratip fullness caused by edema, which can persist for several weeks and will require massage or prudent injections of corticosteroids. After a few months, one can assess the nose for a definitive polly-beak deformity.

Polly-Beak Deformity

Polly-beak deformity, one of the most obvious signs of a previous nasal operation, is characterized by a supratip convexity that appears more pronounced when it is associated with a lowered dorsum and underprojection of the nasal tip. It may result from a technical mistake or a lack of appreciation of the dynamics between skin cover and the underlying skeleton, with inability of the soft tissue cover to redrape properly over the new skeletal structures.

Causes of Polly-Beak Deformity

CARTILAGINOUS UNDERRESECTION Cartilaginous polly-beak deformity is more frequently caused by a lack of sufficient septal resection (anterior angle) than to insufficient lateral crus resection (cephalic border at the dome junction). At the end of the procedure, it is common to underevaluate the levels of difference between the domes and the dorsal border of the septum in the supratip area; 5 to 6 mm is appropriate in thin skin and up to 10 mm in thick skin. Any cartilaginous excess must be resected if the nasal tip support and projection are appropriate and if skin elasticity is good. Otherwise, more tip projection must be obtained, either through sutures (septocolumellar sutures are the most useful for this purpose) or through the use of a long columellar strut on which the medial crura are shifted anteriorly, or a tip graft.

CARTILAGINOUS OVERRESECTION Excessive resection can lead to the same deformity as underresection, although by different mechanisms. Two main preoperative factors favor a cutaneous polly-beak deformity:

Thick and loose covering tissues that will not retract in the supratip area.

Preexisting tip with inadequate projection: incisions and resection will increase the lack of tip projection. If not corrected, this lack of projection creates bulk in the supratip area.

The common operative factor is a large resection of the cartilaginous hump with loss of nasal tip support. This excessive hump removal occurs more frequently when the radix is low and is not corrected. Poor redraping of the soft tissues over the osteocartilaginous skeleton remains the primary cause; in a patient with thick skin and poor skin elasticity, the surgeon should not hope that the skin will redrape to the new skeletal structures. Polly-beak deformity is often associated with a lack of definition of the tip lobule or a round tip.

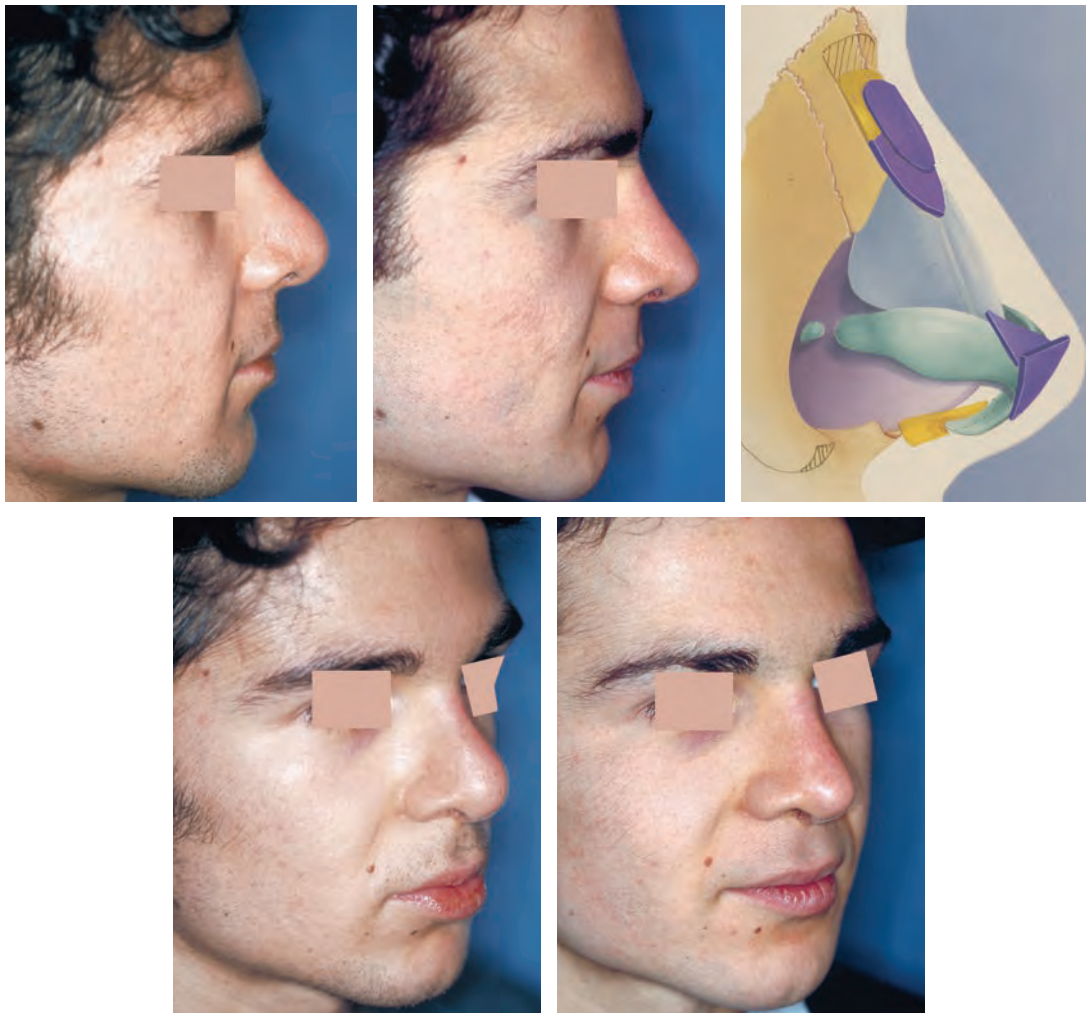
Surgical Correction

It is easy to use morphing software to preview a pleasing nose for the patient, but what really matters is that the patient leave the operating room with a satisfying long-term result. This is achieved by establishing an adequate underlying skeleton with good tip support, taking into account the dynamic balance that should exist between soft tissue cover and the underlying skeleton.

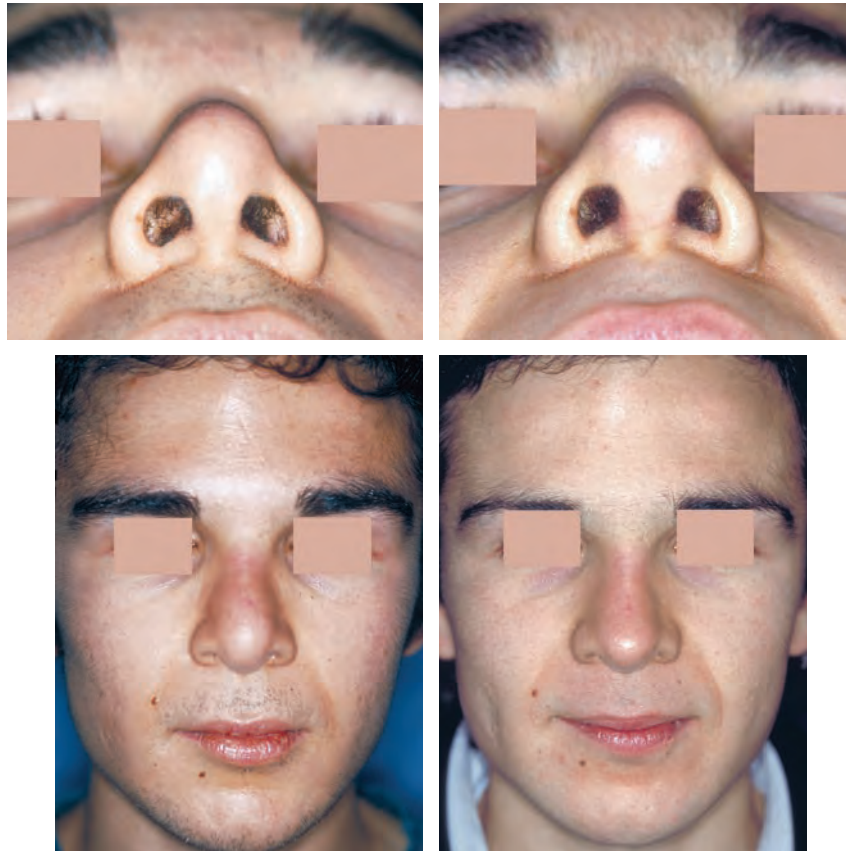
In thin, elastic skin, excesses of the anterior dorsal border of the septum, upper lateral cartilage, and cephalic edge of the lateral crura can be easily trimmed. In the nasal tip, a single or multilayered onlay graft or a rigid infratip graft will provide better projection and definition.

In thick skin, a conservative surgery should be performed with dorsal and nasal tip augmentation that would make the supratip excess disappear. The tip supports should be strengthened, and tip projection should be augmented. If a tip graft is positioned in the infratip, it should pass 3 to 4 mm beyond the level of the domes and be adequately buttressed to prevent folding of the graft under pressure from a rigid soft tissue envelope.

The supratip subcutaneous tissues can sometimes be gently trimmed with scissors. Caution is paramount, and preferably this resection is done without turning over the supratip skin. Any dead space in the supratip area should be eliminated by approximation of the dermis to the underlying septum.



This 20-year-old patient had undergone two previous rhinoplasties and septoplasty. His main request was to have a thin, narrow tip lobule. On lateral view, there was supratip fullness with a round nasal tip and a slightly depressed upper dorsum, as clearly seen on the oblique view.



The frontal and basal views showed a broad tip lobule with no definition and the alae looked flared. On palpation, the soft tissue cover was thick and difficult to pinch, precluding any tip reduction. The objectives were to augment the upper dorsum and to give the tip more definition.

After skeletonization through an open approach, the supratip dorsal excess was trimmed. The radix was slightly deepened with an osteotome, and the upper dorsum was rasped for removal of soft tissues and placement of a dorsal graft. A large septal harvesting was performed through a hemitransfixion incision, and the grafts were positioned. On the upper dorsum, a two-layered graft composed of one piece of cartilage and vomer was placed. An additional graft was placed superficially.

A columellar strut (fragment of vomer) was placed within the medial crura, and the tip was grafted with a rigid infratip graft extending 5 to 6 mm above the domes. The pressure of the soft tissue cover was pushing the tip graft cephalically. A buttress graft was placed above the tip graft and was sutured to the dorsal septal edge to prevent cephalic displacement and provide the graft with strong anterior projection. Because of the soft tissue thickness, there was no risk that the graft would be visible. A 3 mm alar base resection was performed. The patient is seen 2 years postoperatively.

In a large nose with thick skin, sometimes the only alternative is a vertical fusiform resection in the supratip area. This provides the tip with better definition, but at the price of a scar. Would the patient prefer a scar that is often not noticeable to a supratip convexity with lack of harmony? The decision lies with the patient.



After having undergone two previous rhinoplasties, this patient presented with a long nose and a polly-beak deformity, as seen on the lateral view. On the frontal view, the tip was bulbous with no definition.



Sequelae of radiation therapy prescribed by a previous surgeon for correction of the polly-beak deformity were observed in the supratip area. On palpation, there was significant laxity of the tip and supratip soft tissue cover. Because this patient was tall and had a long, large nose, a reduction rhinoplasty was contraindicated, so a skin resection was planned to reduce the supratip skin excess. This patient was a participant in this decision, taking into consideration the poor quality of the skin surface and a horizontal scar at the superior limit of the supratip.

After a horizontal, full-thickness resection of the supratip soft tissue cover and skeletonization, the hump was resected with an osteotome. Septal cartilage was then harvested through a hemitransfixion incision, and an onlay tip graft was positioned

through the supratip opening. After lateral osteotomies and alar base resections, subdermal and running sutures were carefully placed. The patient is shown 32 months postoperatively; the horizontal scar is scarcely visible.

In a patient with loose skin without elasticity that can be easily pinched because the subcutaneous layers are very loose, correction also includes a nasal tip augmentation and, when possible, dorsal augmentation with cartilage grafts.

Polly-Beak Correction

Assessment

- Soft tissue thickness and scarring
- Tip supports
- Septal alignment
- Tip asymmetry

Reconstruction

- Septal alignment and harvesting
- Strengthening of tip supports
- Providing balance with other subunits
- Ensuring tip symmetry with resections, suture techniques, and grafts
- Use of tip grafts for contour, projection
- Use of alar grafts

Complications

The term *secondary rhinoplasty* in this chapter is taken to mean surgery on a post-surgical nose. This frequently includes patients who have undergone three, four, or more extensive operations on their noses. As the catalog of previous procedures lengthens, the proportion of cicatrix in the nose increases, and the flexibility of the tissues diminishes for further reshaping. It is not easy to separate unfavorable results and complications, because they overlap to a certain extent, a complication being considered an unexpected sequela.

A *surgical complication* means a mishap that occurs during the operative or healing phase of surgery that could possibly have been avoided by the surgeon. In secondary rhinoplasty, however, it describes any unfavorable outcome. Failure to meet the goals set out before surgery is almost always interpreted by the patient as a complication, despite a repeated and meticulous process of informed consent. Allied with the unfavorable anatomic and psychological terrain, the inevitable postoperative

scrutiny that accompanies secondary rhinoplasty makes it inherently prone to functional and aesthetic complications. The most common complication is postoperative bleeding. Infection usually responds well to antibiotic therapy. Severe complications during and after rhinoplasty are rare. Some are anecdotal.

Hemorrhage

Excessive bleeding may occur during or after surgery and is said to occur more commonly when associated septal or turbinate work has been done. Overall, it occurs in approximately 2% to 3% of rhinoplasties. Intraoperative bleeding may become problematic during inferior turbinectomy unless excision of the bone is carried medially at its posterior end to avoid the vascular pedicle that arises from the lateral nasal artery. This, and septal bleeding, usually respond to anterior nasal packing if the source of bleeding cannot be identified; the use of pressure balloons, posterior packs, and, very rarely, vessel ligation may become necessary. Postoperative hemorrhage usually stems from anterior septal ulcerations, which are cauterized with silver nitrate sticks in a setting with good lighting and suction available.

The removal of packs in itself may unveil septal ulcerations and cause bleeding, thus throwing into question the need for routine packing in the nose. The use of a headlight and absorbable transeptal sutures after septal harvest (septoplasty), with splints as necessary, obviates the need for bulky, uncomfortable intranasal dressings, which are a source of sinusitis as well as bleeding.

Infection

Infection after rhinoplasty is rare, as would be expected of clean elective surgery in such a richly vascularized territory. Routine administration of antibiotics is not advised, but some surgeons feel more comfortable giving them if grafts have been used. Although rarely indicated in secondary rhinoplasty, any alloplastic material would justify preoperative antibiotic cover with a single intravenous dose. The most common organisms are staphylococci, especially *Staphylococcus aureus*. When infection does occur, the consequences can be serious. There may be an extremely bothersome, localized graft infection that necessitates removal of the graft. Rarely, infection can spread to become severe cellulitis, sinusitis, or even intracranial sepsis. Nasal packing and splintage incurs a small (16.5 per 100,000) risk of toxic shock syndrome in susceptible patients, with a mortality risk of 5% to 10%. Although one may culture nasal flora preoperatively for TSST-1, the staphylococcal toxin responsible, these statistics further underscore the argument for avoiding the use of foreign material in the nose if at all possible.

Localized infections respond to routine measures, such as using targeted antibiotics and direct incision and drainage. Systemic signs of hypotension, rash, and pyrexia with late desquamation signify toxic shock and should be treated aggressively. Menin-

gitic symptoms occurring shortly after rhinoplasty should also be linked to the surgery until proved otherwise, and prompt medical attention must be sought from a medical team.

Columellar Scarring

Secondary rhinoplasty may present an opportunity to revise an unfavorable transcolumellar scar. Any one of the numerous patterns for this incision (chevron, stairstep, curved) may become thickened, hyperpigmented, or, most commonly, depressed, with a visible shadow that interrupts the smooth lines of the columellar pillars.

Depressed horizontal scars can usually be excised at the beginning of the secondary rhinoplasty, with the contours restored by bringing the healthy skin borders together at the end of the operation. Eversion of the columellar skin with carefully placed mattress (6-0 nylon) sutures affords a certain degree of protection from future indentation.

Occasionally fullness is seen at the angles of the scar as it turns into the vestibular incision. This causes the columellar flap to resemble a pincushion, which is evident on the oblique view. When the elevated corner is resutured, it should be delicately thinned of scar tissue with curved Iris scissors and inset under mild tension to flatten the columellar flap over the outer aspect of the medial crus.

Vestibular Scarring

Because nature abhors empty spaces, fresh scars in a multioperated nose are prone to contraction across the vestibule. Webs distort the normal relationship between vestibular skin and nasal mucosa, creating stenosis and synechia. There is usually little choice other than to use standard approaches when reoperating in these cases, releasing any contractures as they are encountered. Some of the more obstructive bands of scar may be resected and resurfaced using adjacent skin or mucoperichondrium, but in the apex of the dome this becomes difficult. Wide release of scar tissue and reapposition of the nasal lining using peanut packs sutured together and placed high against the undersurface of the domes is a useful maneuver in such cases. In refractory cases, perforated nasal splints made of silicone that fill and shape the vestibule are custom made and fitted for as long as the patient will tolerate them.

Severe vestibular scarring in the mucosal lining warrants the use of buccal mucosal grafts, taken from the midlateral cheek and secured with Vicryl sutures. Petrolatum gauze impregnated with antibiotic ointment is necessary for 5 days. Rarely, hinged septal mucoperichondrial flaps based anteriorly on the anterior septal branch of the superior labial artery may be required to resurface a severely scarred dome (Burget), with care taken not to draw the mucocutaneous junction too far caudally below the leading edge of the septum.

Septal Perforation

Septal perforation is a late complication characterized by a complete breach across the septum and its mucosa in the same place. Unless such a tear is meticulously repaired under direct vision and without tension, sometimes with the help of septal splints (using x-ray film or a similar material), a small perforation will result. This may crust and bleed, and whistle during inspiration. It may then be enlarged, repaired using advancement flaps and cartilage grafts, or closed using a septal button if all else fails. Superinfection compounds the problem of trauma.

Traumatic Complications

Traumatic complications result from trauma to the nose itself and adjacent areas, namely, the orbital region, where significant but rare complications may be observed. By the nature of its scarred planes and altered anatomy, the secondary nose is necessarily prone to inadvertent tearing of the SNAS and skin during undermining. Thickening the soft tissue envelope immediately before its dissection by injecting saline solution or a local anesthetic percutaneously can reduce the risk of tearing. Scarring after buttonholing is made more conspicuous if it becomes adherent to the underlying structural framework. It is essential to anticipate this scarring by repairing the SNAS layer if it is identifiable, and by everting the cutaneous sutures.

Osteotomies can damage the lacrimal sac. Intracranial injury and blindness have been described, caused by direct mechanical trauma to the frontal lobe or the optic nerve. Fracture through the cribriform plate may occur after aggressive manipulations with twisting motions on the perpendicular ethmoid plate during a septoplasty.

Concluding Thoughts

The outcome in revision and secondary rhinoplasty depends on many factors, including difficulties of correction that cannot always be predicted. These difficulties may not reflect the severity of the defects. Thus a severe defect may be easier to correct than a very minor one when there is no shortage of graft material and soft tissues conditions are favorable.

Because the nose is positioned in the center and midline of the face, minor defects or asymmetry always bother a more observant and demanding patient. The difficulty frequently lies in convincing a patient who has had a significant improvement with prior surgery to avoid any revision for very minor defects.

If most defects are caused by overbalanced and unbalanced resections and unrecognized anatomic variants, some well-performed rhinoplasties with no apparent defects may still be found to lack harmony and finesse.

In past decades, the open approach and cartilage grafting have been used more frequently. Thus a new set of deformities is emerging, with scarred soft tissues making the external approach more difficult, if not impossible, along with frequent shortages of graft material.

Before undertaking a primary and, a fortiori, a secondary rhinoplasty, the surgeon must ask two questions: (1) Am I able to improve the appearance and/or function of the patient's nose? and (2) Will the patient be satisfied?

Clinical Caveats

The patient and surgeon should make the journey as a team, and any problems encountered along the way are best dealt with as a team.

Secondary rhinoplasty defects require an accurate preoperative analysis of the deformities and assessment of the functional problems.

An aesthetic sense and good knowledge of dynamics and skeletal support are essential to achieve the goals of secondary rhinoplasty.

The open approach provides excellent visualization of the deformities and facilitates graft placement and fixation.

A large skin sleeve cannot redrape over the reduced skeleton.

Because grafting is frequently performed for correction of secondary rhinoplasty defects, harvesting and preparation of grafts are of crucial importance.

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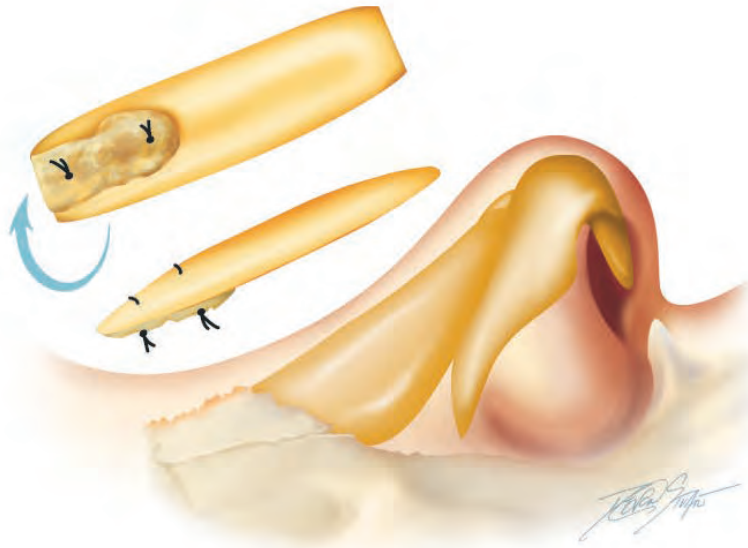
This book is a comprehensive textbook on the primary and secondary rhinoplasties performed through an open approach with its specific philosophy and strategy. A chapter is dedicated to the secondary rhinoplasties, the preoperative analysis, the up-to-date corrections with an emphasis on the grafts and the sutures.

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CHAPTER 58



Ethnic Rhinoplasty

WILLIAM D. LOSQUADRO, DEAN M. TORIUMI

The term *ethnic* can be applied to a group of people who share a common racial, cultural, national, religious, or linguistic heritage. It is commonly used in the United States to describe nonwhite minority groups. According to the American Society of Plastic Surgeons, cosmetic procedures for ethnic patients increased 11% in 2008, with Hispanics, those of African descent, and Asians leading the list, respectively. The American Academy of Facial Plastic and Reconstructive Surgery reported that rhinoplasty was the most common facial cosmetic procedure for both Hispanics and individuals of African heritage and was second only to blepharoplasty in Asian patients. Multiple factors have been attributed to this rise, including the increased socioeconomic status and improved social acceptance of plastic surgery among these ethnic groups. As the populations of United States and other industrialized nations continue to diversify, the number of ethnic rhinoplasties will surely increase.

Pertinent Anatomy

Anatomic descriptions in the plastic surgical literature, such as high dorsum, and low radix, traditionally refer to the ideal white (European) nose. However, this custom does not mean that characteristics described for a white individual's nose are the universal aesthetic ideal. Cultural norms and preferences dictate aesthetics: the model Asian nose differs from the model white nose. Nevertheless, the global pervasiveness of Western popular culture has made the ideal white nose a frequent goal for ethnic rhinoplasty patients.

Long ago, the term *Hispanic* described all people from the Iberian peninsula. Modern usage, however, describes only people from countries formerly colonized by Spain, including Mexico and various Caribbean, Central American, and South American countries. The term *mestizo* represents a subset of Hispanics with mixed European and American Indian ancestry. Neither term is fully inclusive of the other (Hispanics may be of pure Spanish ancestry, whereas mestizos may be of Portuguese ancestry), although the difference is semantic rather than clinically relevant. Nevertheless, Hispanic patients exhibit varied anatomic features unique to their individual Spanish and American Indian heritages.



At one end of the Hispanic spectrum is the so-called Castilian nose, with long nasal bones, a high dorsum, and normal tip projection. This represents primarily Spanish ancestry and is essentially a white nose. At the other end of the spectrum is the mestizo nose, with thick skin, wide alae, a retracted columella, an overall short nose, and a broad, underprojected tip. Any anatomic combination along this continuum may be seen, depending on the patient's specific genetic makeup.



The nose of a person of African heritage is characterized by a wide, low dorsum and a broad, underprojected tip. A wide piriform aperture splays the upper lateral cartilages and creates a broad middle vault. Thick skin and interdomal fat contribute to the bulbous tip. The medial and lateral crura are often short, thin, and weak. An acute nasolabial angle is caused by both an underrotated tip and bimaxillary protrusion. The nasal base is often wider than the interalar distance, and the underprojected tip contributes to excessive alar flaring.



The Asian nose typically has a low radix, low dorsum, and broad, underprojected tip. Thick, sebaceous skin contributes to a round tip with poor definition and blunted soft tissue triangles. The columella is commonly retracted. Asian patients frequently exhibit an acute nasolabial angle and retrusive premaxilla. Cartilages within the Asian nose tend to be weak, especially the caudal septum. The cartilaginous septum is frequently very small, necessitating the harvest of cartilage from a secondary location.

Preoperative Assessment

The surgeon elicits specific reasons for seeking rhinoplasty at the initial consultation and reviews the patient's cosmetic and functional concerns. It is vitally important to understand an ethnic patient's aesthetic goals. Some request cosmetic enhancements that preserve their unique ethnic characteristics; others will seek a more Western or white/European standard. Fastidious patients may voice their concerns using accurate terminology, whereas others will have difficulty identifying features they like and dislike. For the latter, photographs of desirable noses will help to focus the conversation.



Computer imaging is particularly helpful in these situations. A consensus can quickly be reached based on the visuals, and imaging facilitates discussion of realistically achievable results. For example, a petite nose will be unattainable in a black or mestizo patient with thick skin and a broad, underprojected tip. Imaging can demonstrate realistic, balanced results that will help the patient and surgeon develop an appropriate surgical plan.

Some patients express the desire to maintain their ethnicity, yet present photographs of a white person's nose. In the senior author's (D.M.T.'s) practice, Asian patients frequently provide photographs of Asian actresses, many of whom who have undergone prior augmentation rhinoplasties, rendering their nose more Western. Although they may ask for modest, ethnicity-preserving changes, they may be dissatisfied postoperatively if their dorsum has not been fully raised or their tip is left rounded and less refined.

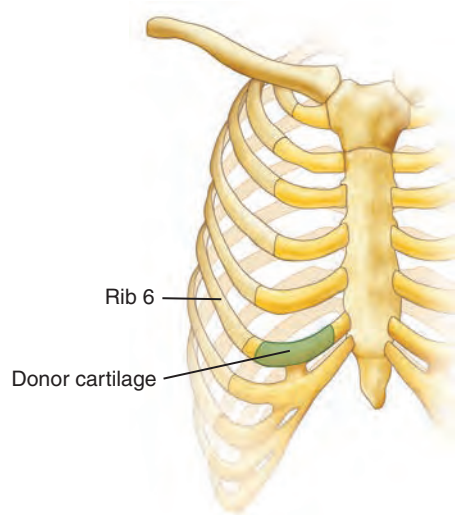


Ethnic patients who request revision procedures must be screened for prior implants. Alloplastic implants are frequently used in Asia for augmentation rhinoplasty, particularly silicone L-strut implants. Implants can damage skin, particularly of the dorsum, leaving it thin, irregular, and telangiectatic. Silicone L-strut implants may also thin the tip skin, because the implant genu is the point of greatest tension. Implant removal frequently requires replacement with an autologous costal cartilage graft. This greatly increases the complexity of surgery and must be fully discussed with the patient.

The potential use of autologous grafting materials such as auricular or costal cartilage must be discussed with the patient preoperatively. If harvesting of costal cartilage is anticipated, knowledge of prior breast augmentation is important for both operative counseling and intraoperative technique. The scar from inframammary implant placement or breast reduction may be useful for costal cartilage harvest if it is still located within the inframammary fold.

The risks of costal cartilage harvesting and implantation should be carefully explained to the patient. In addition to the standard risks of pneumothorax, scarring, and graft warping, the patient should understand that he or she will have increased nasal stiffness postoperatively. This will soften over time, but the nose will always remain more rigid than it was preoperatively. Chest pain may range from nonexistent to moderate for 3 or 4 days postoperatively. Discomfort when lifting heavy objects may persist for 1 to 2 months before it subsides completely. Dorsal augmentation with costal cartilage in Asian patients stretches skin near the medial canthus, and changes to the epicanthal fold may occur.

Preoperative Planning

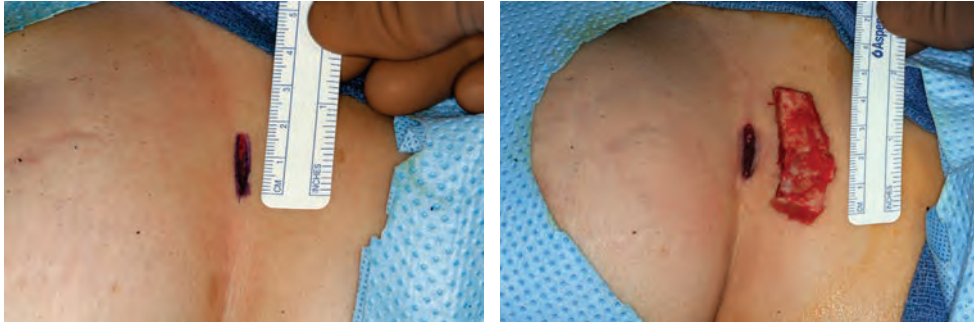


Multiple factors must be considered when designing the incision for costal cartilage harvest. The senior author preferentially harvests the sixth rib because of its position at the inframammary fold and less acute genu, which permits harvest of longer straight segments. Ribs five and seven may be accessed through the same incision when additional grafting material is needed. Fifth rib harvest can be more difficult, because it requires dissecting under the breast tissue in women and through the pectoralis muscle in men. The fifth rib has a more continuous curve than the sixth rib, making it difficult to harvest a long, straight segment. Seventh rib dissection frequently increases postoperative pain, because it constitutes a variable portion of the rib cage free margin, depending on the length of the eighth rib. Removal may cause a slight but noticeable depression and can potentially produce a less stable rib cage.



In women the incision is ideally placed in the inframammary fold. The right side of the chest is preferred for a right-handed surgeon; thus the patient's rib pain will not be confused with cardiac pain. In larger-breasted women, an incision can easily be hidden in the inframammary fold. If future breast augmentation is a consideration,

the incision should be made lower to anticipate the new inframammary fold. In some women the incision should be placed slightly more lateral so that it is not visible when the woman is wearing a dress with a low neckline. In patients with breast implants, the inferior extent of the breast pocket must be determined before the incision is made to prevent implant injury or violation of the implant capsule.



The size of the incision depends on a number of factors. Asian patients scar poorly on the chest, so incision length and placement are critical to a favorable outcome. Muscular or obese patients and those with pectus excavatum require larger incisions to accommodate the greater depth of dissection needed; in thin patients with superficial ribs, smaller incisions are required. Longer incisions are necessary for harvesting longer pieces of rib. Incisions as small as 1.2 cm can be used to harvest 4 or 5 cm of rib in patients with the appropriate chest characteristics. Harvesting rib through a small incision is more difficult and time consuming but is a cosmetically superior approach. Surgeons with less experience harvesting costal cartilage should use a larger incision to avoid damaging the pleura.

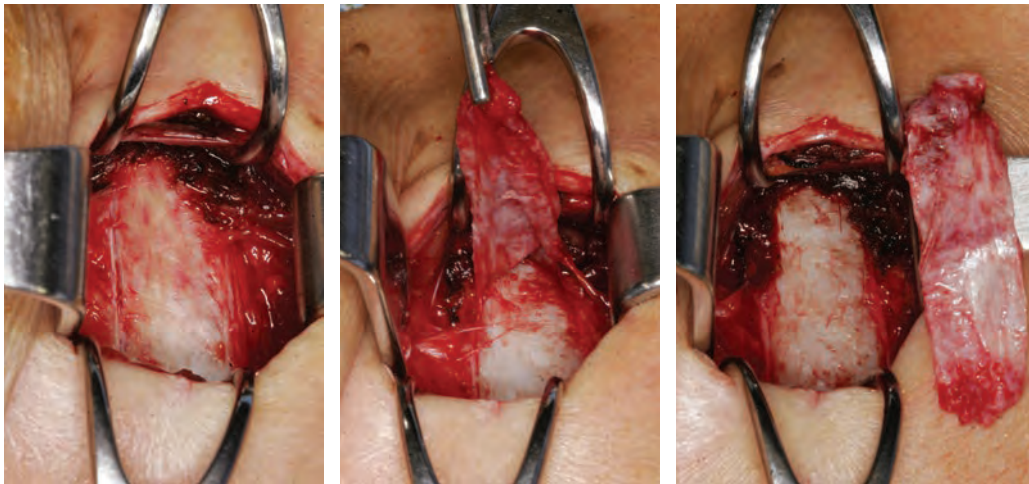
Operative Technique

The procedure is typically performed with the patient under general anesthesia in the supine position; the patient's head is placed on a small soft support, such as a doughnut. We prefer to use general anesthesia with endotracheal intubation to protect the airway from blood that may drip down to the larynx during the septoplasty portion of the operation. We typically prepare the ear in case additional cartilage is needed. With secondary rhinoplasty or augmentation rhinoplasty, we will prepare the chest to allow costal cartilage harvesting if needed.

Harvest of Costal Cartilage

The septum is unlikely to provide sufficient grafting material for ethnic patients undergoing augmentation rhinoplasty; invariably, auricular or costal cartilage harvesting is necessary. Graft warping is a potential complication when using costal cartilage, but the risk can be mitigated with meticulous technique. Early graft harvest and sequential carving allows time for bending and warping tendencies to present and be managed intraoperatively.

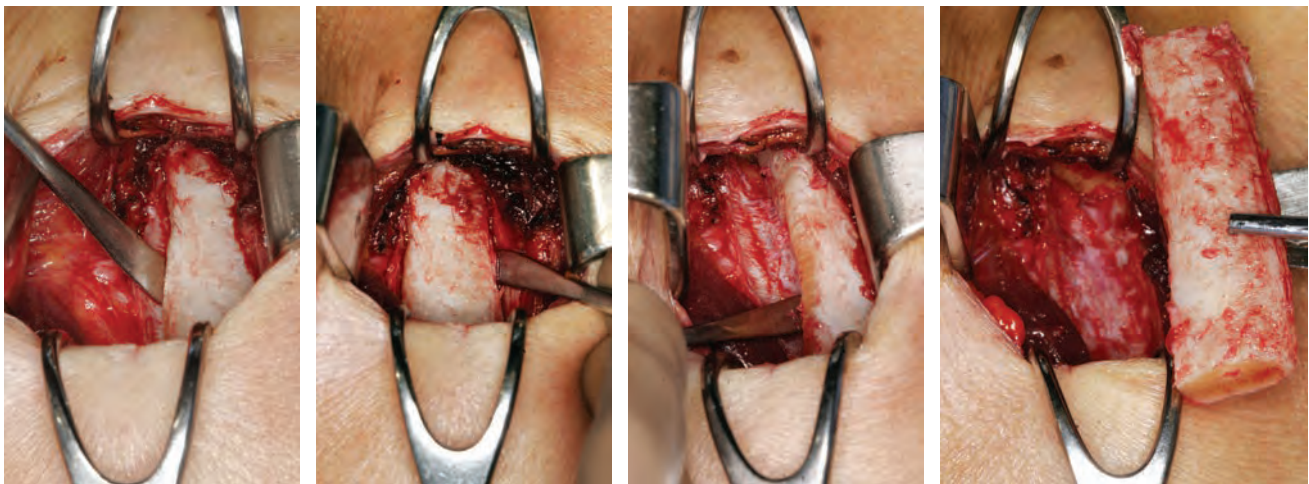
Harvesting of costal cartilage can often be performed before opening the nose in ethnic patients because of the insufficient septal cartilage and the obvious need for grafting material to augment the nose. The skin is incised with a No. 15 blade, and the subcutaneous fat is sharply dissected. Ragnell or Senn retractors are used to expose the muscular fascia. Frequent palpation with a 27-gauge needle ensures a proper trajectory of dissection and identifies the bony-cartilaginous junction. The rectus sheath and pectoral fascia fuse to form the fascial sheath above the sixth rib. A cruciate incision is made through the fascia, and any muscle is bluntly dissected to expose the rib. Blunt dissection minimizes bleeding and postoperative pain.



The thick, fibrous rib perichondrium is excellent material for camouflaging grafts, especially when performing tip grafting and dorsal augmentation. The outer layer of rib perichondrium may be excised initially or removed once the rib is harvested. Larger sheets can often be harvested by excising the perichondrium first. The perichondrium is incised with a No. 15C scalpel; the smaller profile of the 15C blade permits greater visualization through a small incision. The perichondrium is then elevated from lateral to medial with a Freer elevator, and the pedicle is divided with scissors after sufficient material has been raised.

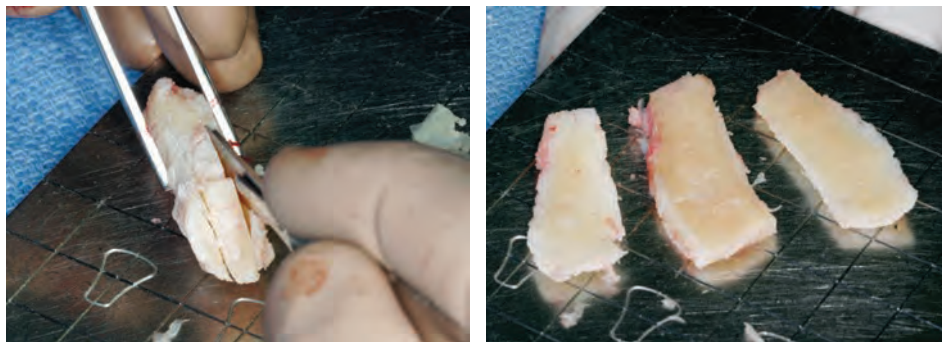


Shallow transverse incisions are made with a 15C scalpel near the bony-cartilaginous junction and as far medial as the patient's needs dictate. Leaving a thin rim of cartilage at the bony junction allows sharp edges to be rounded after the rib is removed. The incisions should be superficial to avoid violating the inner perichondrium and pleura. Costal dissection is easily performed with the sharp end of the Freer elevator. Younger patients have soft, white costal cartilage, whereas older patients have yellow-brown cartilage with varying amounts of calcification. Often there are islands of calcification at the rib periphery, and dissection must proceed around them. Rarely is the entire segment calcified and unusable.



When freeing the perichondrium from the superior and inferior edges of the rib, it is best to err slightly into the rib itself. Leaving a thin cuff of cartilage helps prevent inadvertent transection of the often-attenuated deep perichondrium. There is frequently an interchondral joint between the sixth and seventh ribs near the rib genu.

The attachment may be fibrous, a synovial joint, or a solid cartilaginous connection that requires division with a Freer elevator. After the rib has been dissected circumferentially, the Freer elevator is used to bluntly elevate the rib off the deep perichondrium. The undersurface of the rib and the deep perichondrial sleeve can be viewed directly to ensure that the pleura is not violated. Significant resistance when trying to bluntly elevate the rib often indicates incomplete dissection at one of the corners, especially medially, where the rib is thicker. Care must be taken when elevating an older, more brittle rib to ensure that it does not fracture. After the rib is freed, a double-pronged skin hook facilitates removal from the pocket. The medial and lateral rib edges are trimmed and smoothed with Takahashi forceps. The inner perichondrial sleeve is inspected and irrigated with saline solution; a Valsalva maneuver performed by the anesthesiologist confirms pleural integrity. The rib is placed in an antibiotic-infused saline solution.



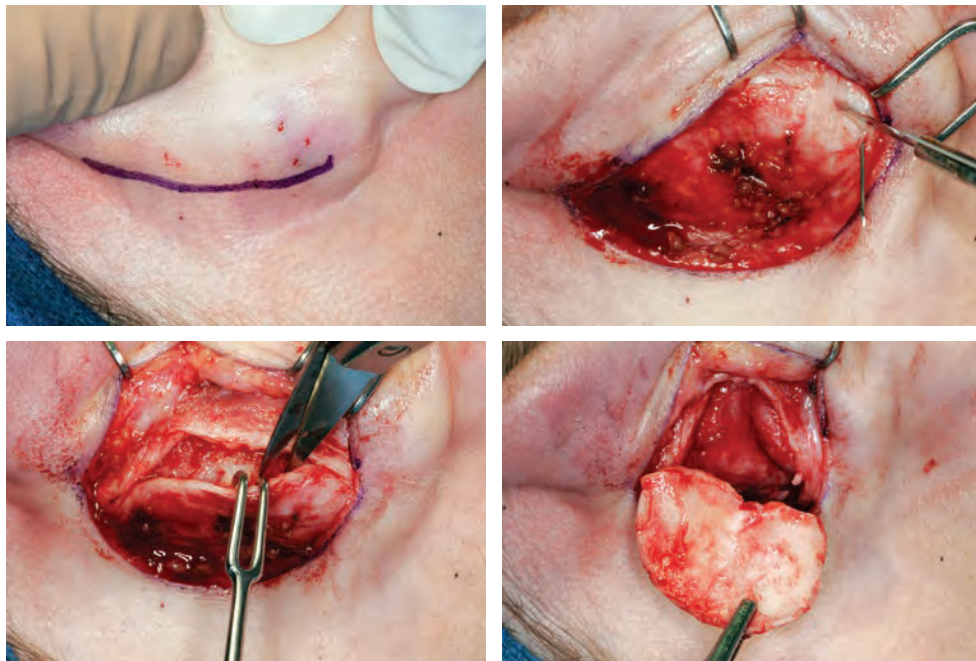
Carving often begins after opening the nose. Carving is best performed on a flat carving block with a No. 10 blade. Toothed forceps provide a secure grasp of the rib; non-toothed forceps may eject grafts off the carving block. Carving the rib into three segments maximizes the number of useable grafts. The thickness of each segment varies according to the patient's needs. The central portion of rib often warps least. Outer segments have a fibrous component that causes greater warping in younger patients but helps maintain graft integrity in older, more brittle ribs. The segments are thinned initially and placed back into the antibiotic-infused saline solution.

Final cuts are made just before the grafts are placed. Carving the grafts in this manner allows warping tendencies to manifest intraoperatively and to be used for curved grafts. For example, dorsal grafts placed concave side down will lie flat after skin-soft tissue envelope compression, whereas lateral crural strut grafts can be placed convex side up to better support the airway. Older calcified rib is more difficult to harvest, carve, and suture but maintains the distinct advantage of warping very little. Younger cartilage is easy to carve and suture but can warp dramatically and is less predictable.

Incision Closure

Careful closure of the chest incision minimizes scarring and visibility of the scar. Unused pieces of costal cartilage are placed back within the perichondrial sleeve. The muscular fascia is closed with 3-0 PDS sutures, and breast tissue or subcutaneous fat is closed with 4-0 PDS. The breast is pushed medially and inferiorly in women to assess for puckering that represents improper dermal tethering to the deep closure. The epidermal edges in small incisions are often macerated by retraction. A No. 15 blade can be used to trim the wound edge up to, but not around, the incision apex; trimming circumferentially elongates the incision. The skin is then closed deeply with 5-0 PDS and cutaneously with a running locking 6-0 nylon vertical mattress suture. Local anesthetic is injected after closure is completed. Bacitracin ointment is applied, and the wound is covered with nonadherent gauze and a transparent dressing.

Harvest of Auricular Cartilage



Auricular cartilage is easily harvested through a postauricular incision placed on the pinna above the postauricular crease. This incision placement ensures that scars will not be visible and prevents blunting of the postauricular sulcus. The incision is carried down onto the posterior perichondrium, which may be harvested or left in situ. The entire conchal bowl can be harvested without changing the external auricular appearance; violation of the antihelix, however, will cause a cosmetic deformity.

Transauricular needles can help demarcate the area to be harvested. The cartilage is incised with a No. 15 blade and bluntly dissected from the anterior perichondrium with a Freer elevator.

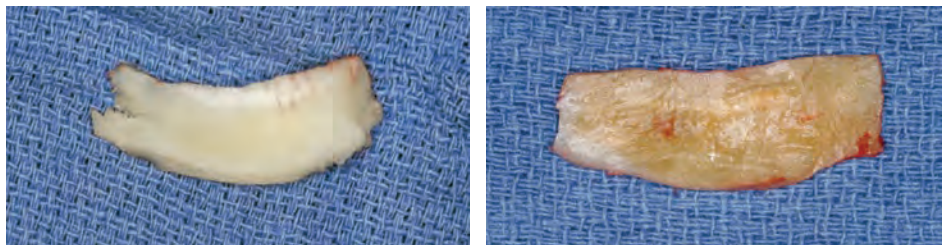
Hemostasis of the anterior skin–perichondrial flap is obtained with bipolar cautery; judicious use prevents damage to the flap. The skin incision is closed deeply with 6-0 Monocryl and superficially with 5-0 fast-absorbing gut suture. A Penrose drain is trimmed and left exiting the inferior extent of the incision. A cotton bolster coated in antibiotic ointment is sutured through and through the conchal bowl with 3-0 nylon; the posterior bolster can be lassoed within the suture loop.

Elevation of the Skin Flap for an External Rhinoplasty Approach

Details regarding the incision and dissection are discussed in Chapter 56. Ethnic patients frequently require increased projection, and it may be prudent to place the transcolumellar incision slightly lower to accommodate eventual superior movement of the scar.

Dorsal Augmentation

Most ethnic rhinoplasties require dorsal augmentation, although some patients may present with dorsal humps that require reduction. The cartilaginous convexity is first reduced with a No. 15 blade. If a bony component of the hump exists, the cephalic extent of the reduction is perforated with a 2 mm straight osteotome placed perpendicular to the nasal bones. This maneuver creates a weak point for the 12 mm Rubin osteotome to exit through and counteracts the tendency for overreduction. Reduction of the dorsal hump often creates an open roof deformity that requires lateral osteotomies to close. High-low-high lateral osteotomies are performed with a 3 mm straight osteotome. Intermediate osteotomies are rarely needed, except for an extremely wide dorsum.



Thoughtful graft selection for dorsal augmentation can help minimize postoperative complications. Septal cartilage is often preferred over auricular or costal cartilage for dorsal augmentation, because it does not curl or warp. Unfortunately, the septum is often insufficiently thick or is depleted and harvesting auricular or costal car-

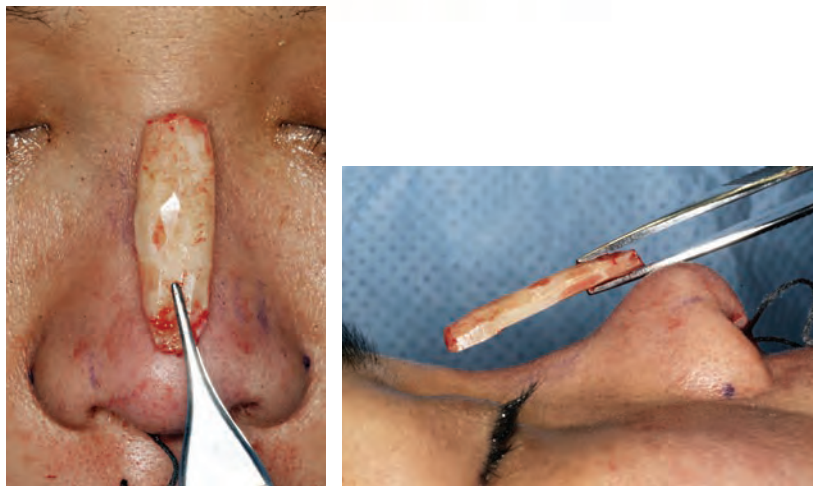
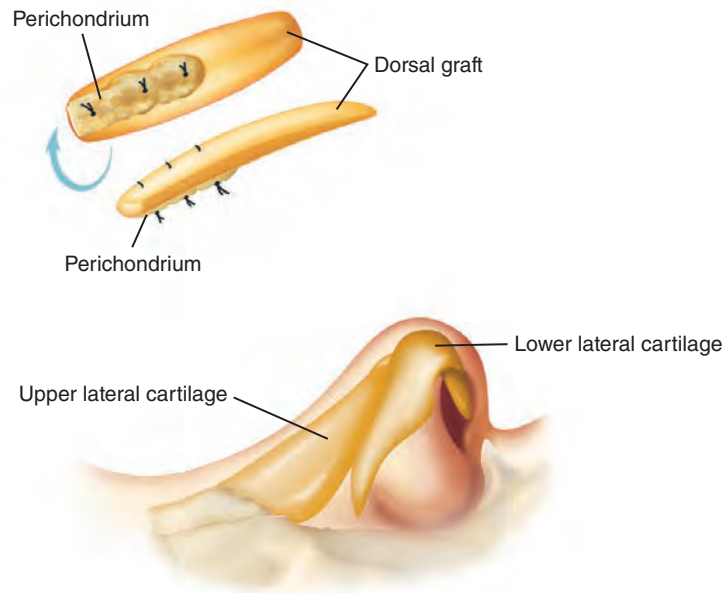


58-1 Nasal dorsal augmentation



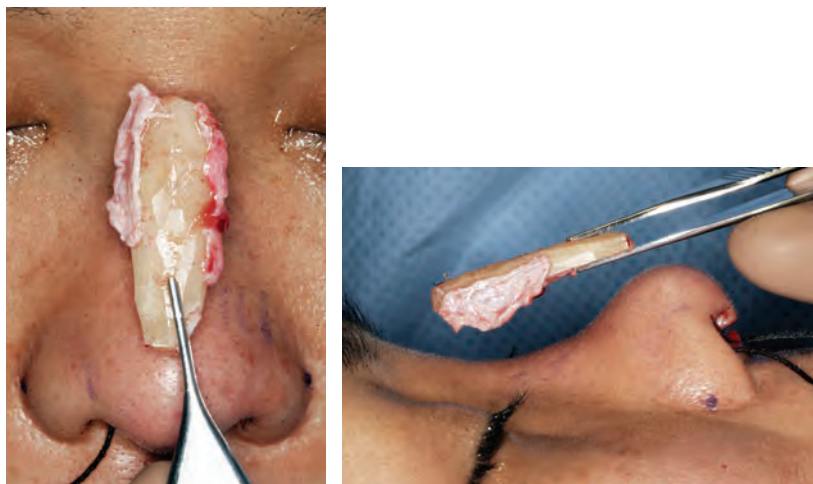
58-2 Dorsal hump reduction:
high horizontal dorsal osteotomy for more precise control

tilage is necessary. Auricular cartilage can curl at the edges and create a deformity when used for dorsal augmentation. The costal cartilage of older patients is typically brown and more calcified and brittle; although carving and suturing are more difficult, older costal cartilage warps less. Conversely, younger costal cartilage is white, softer, and easier to carve, but warps more.



Dorsal grafts are carved into a canoe shape: flat or slightly concave on the under-surface, gently rounded on the edges, and tapered at both the caudal and cephalic ends. The specific dimensions depend on the needs of the patient.

Ideally the dorsal graft is slightly curved so the graft can be set into position with the concave surface facing downward. This orientation protects against any chance that the graft will curve upward, leaving the patient with a prominence in the supratip and radix.

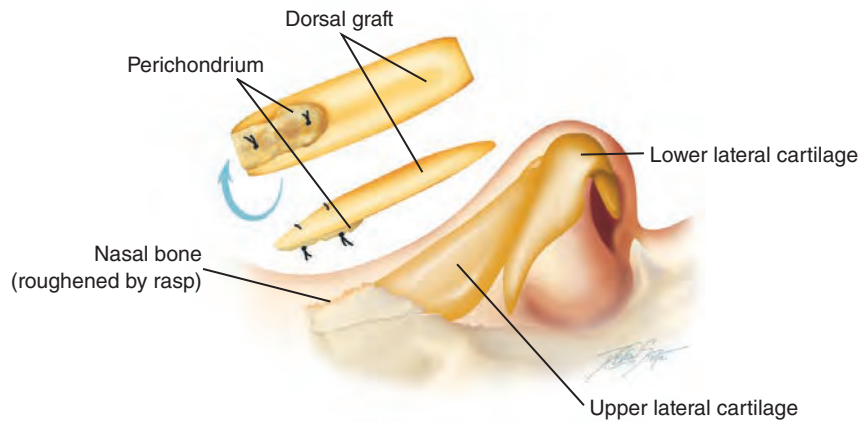


Graft edges often need camouflaging to prevent visible postoperative step-offs, especially in thin-skinned patients. Dorsal palpation is critical, since intraoperative edema will obscure minor irregularities. Perichondrium can be sutured along the graft edge with 6-0 Monocryl. Alternatively, the entire graft can be covered in perichondrium.

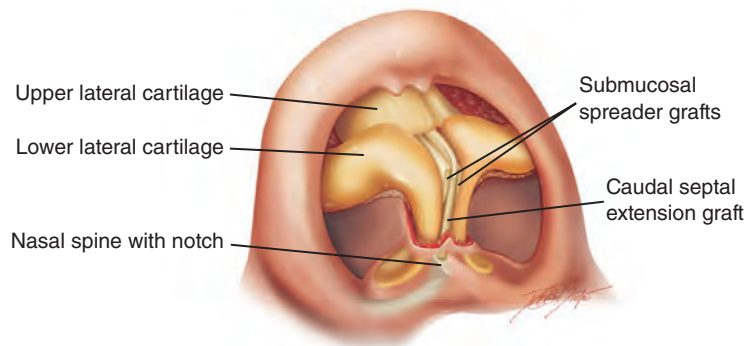


Graft size and placement are individualized for each patient. Greater dorsal augmentation creates a narrowing effect on the frontal view that must be balanced with anticipated changes to the tip. Ethnic patients frequently have wide tips that resist significant narrowing and necessitate restrained dorsal narrowing to preserve tip-dorsum harmony.

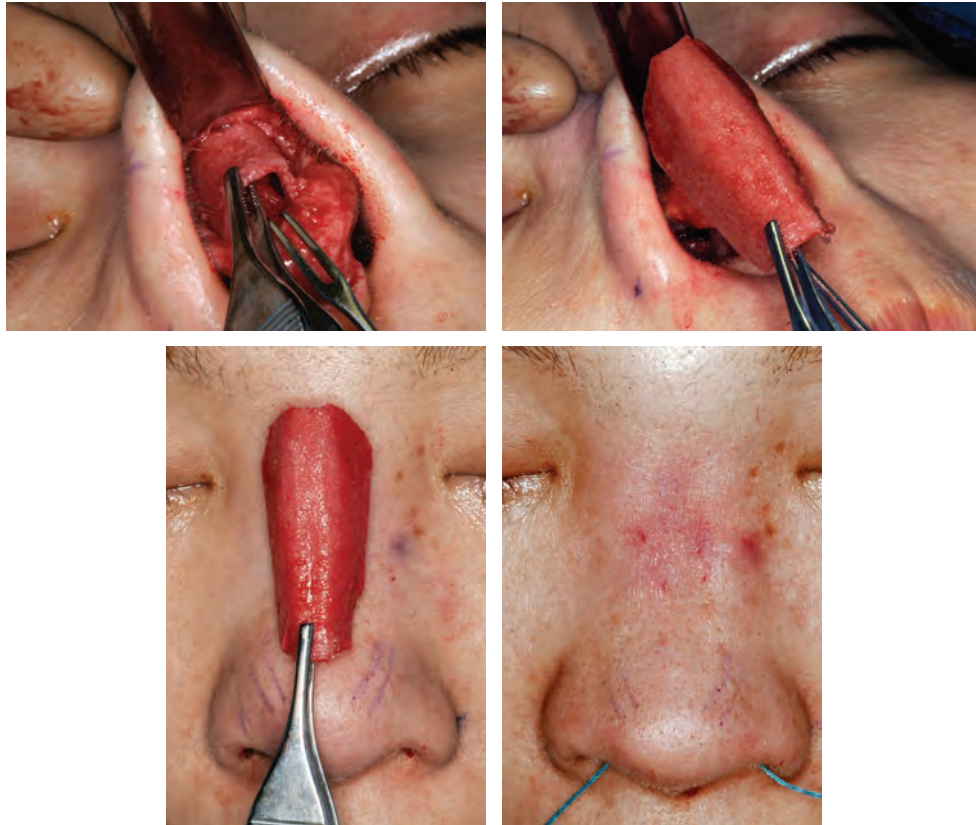
The radix of white/European individuals commonly lies between the superior lash line and the upper lid crease, whereas the radix of Asian patients typically lies at the midpupillary level. Dorsal graft placement thus depends on the degree of ethnic characteristics the patient wishes to maintain.



In primary augmentation rhinoplasties, dissection of a narrow dorsal pocket facilitates tight graft placement. For grafts extending over the bony dorsum, graft adherence can be improved by roughly rasping the dorsum and suturing perichondrium to the graft's undersurface. This will create a bone-perichondrial interface that promotes graft adhesion in the early postoperative period. The graft can be secured caudally to the middle vault with 5-0 PDS.



In complex revisions, the L-strut may need to be reconstructed. After building the dorsal component of the L-strut with extended spreader grafts and a septal extension graft, a separate dorsal graft can be placed on top of the stable middle vault. Placing the dorsal graft on top of extended spreader grafts permits minor movement independent of the L-strut.



Removal of large alloplastic implants in patients undergoing revision procedures requires wider dissection and often results in a large pocket. Grafts can be sutured to adjacent soft tissue or transcutaneously using 6-0 Monocryl. In the rare patient in whom graft stability cannot be obtained with suture fixation, a transcutaneous threaded Kirschner wire can be drilled through the dorsal graft and into the underlying nasal bone. On postoperative day 7, the wire can be removed or clipped at the skin surface.

Tip Contouring

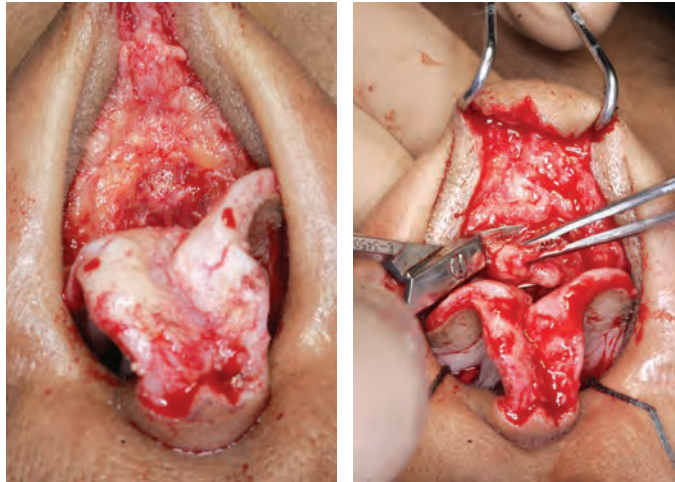
The tip in ethnic patients is often bulbous and underprojected, and lacking in definition. Frequently used techniques include cephalic trim of the lateral crura, dome binding and interdomal sutures, and shield tip grafting. Repositioning of the lateral crura is seldom performed, because it can accentuate the hanging ala commonly found in ethnic patients.

Slightly increased projection may be obtained with onlay tip grafts in selected ethnic patients with thin skin. These rectangular or elliptical grafts are sutured horizontally over the domes with 6-0 Monocryl to simulate the natural horizontal tip highlight. Soft cartilage, such as auricular or trimmed lower lateral cartilage, is ideal for this purpose, and approximately 1 to 2 mm of increased projection can be achieved.



Thick-skinned patients frequently require shield tip grafts with lateral crural grafts to increase projection, stretch the skin, and refine the tip. The shape of the shield graft simulates the divergent medial crura and domes. Shield grafts are sutured to the medial crura with 6-0 Monocryl. Large grafts creating substantial increases in projection (greater than 2 mm) are often supported with buttress grafts and/or lateral crural grafts. Both grafts maintain postoperative tip projection by preventing cephalic rotation of the shield graft once the skin–soft tissue envelope is sutured closed. Lateral crural grafts are sutured on top of the native lateral crura, whereas lateral crural strut grafts are sutured to the undersurface of the lateral crura. In addition to supporting the shield graft, lateral crural grafts smooth the transition from the tip to the alae and preserve the natural tip-alar highlight. Shield tip grafts can be carved from any type of cartilage, although stronger septal and costal cartilage is preferred to weaker, more flexible auricular cartilage.

Tip refinement can often be obtained with dome binding and interdomal sutures. When a shield tip graft is used, the tip width is set by the leading edge of the graft. Soft tissue or perichondrium can be placed over and around the tip graft to provide additional camouflage.

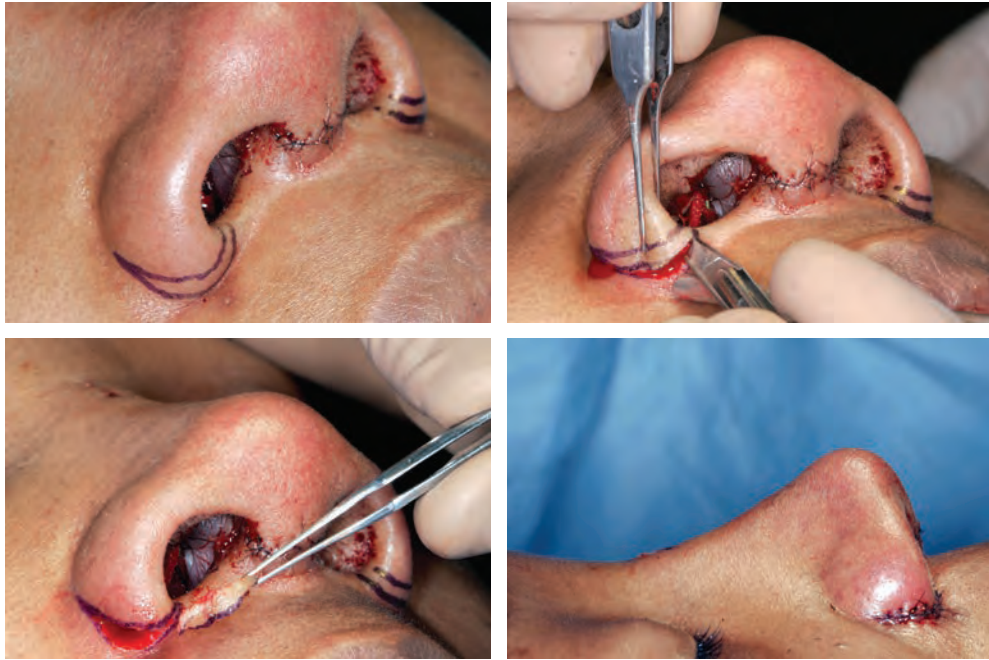


Patients of African descent in particular have a large amount of fibrofatty tissue within the tip. This can be cautiously resected to increase tip definition; care is taken not to injure the subdermal plexus of the skin flap.

Weak alae can be supported with alar rim grafts. Rim grafts are thin, sliver-shaped grafts inserted into pockets dissected caudal to the marginal incision. They are secured with a single 6-0 Monocryl suture, and the medial edge of the graft is crushed with Adson-Brown forceps to prevent visibility within the tip. Rim grafts help form a triangular base by straightening concave alae. Correcting alar concavities eliminates shadows that isolate the tip and interrupt the tip-alar highlight.

The transcolumellar incision is closed deeply with a single 6-0 Monocryl to align and reduce tension on the skin edges. The skin is then closed with interrupted vertical mattress 7-0 nylon sutures oriented perpendicular to the incision. The marginal incisions are closed with 5-0 chromic gut, and the septal mucoperichondrial flaps are reapproximated with a 5-0 plain gut quilting suture.

Reduction of the Alar Base



Alar base reduction, if necessary, is the final step during rhinoplasty. Different intraoperative maneuvers have variable effects on the final alar position. For example, increasing tip projection decreases flare, whereas lateral crural repositioning increases flare. Regardless, ethnic patients frequently benefit from some form of base reduction. The degree of flare, nostril size, and native alar/sill anatomy determine incision placement. The noses of thick-skinned mestizo patients or individuals (particularly males) of African descent frequently have a smooth, rounded internal ala-to-sill transition. Base reduction incisions made across the nostril sill are at a high risk for visible scarring. These patients are better candidates for external alar reductions unless the nostrils are very large. Patients should be counseled preoperatively that their thick, sebaceous skin makes them more likely to scar unfavorably.

The amount to be resected is first outlined with a marking pen. Conservative excisions are preferable, because additional ala can be excised postoperatively at a later time. The ala is excised with a No. 11 blade. The incision is closed deeply with a single 6-0 Monocryl suture, and the skin is closed with interrupted vertical mattress 7-0 nylon sutures. Meticulous technique is necessary to prevent visible scarring.

Problems and Complications

Close postoperative follow-up is important after augmentation rhinoplasty to monitor the dorsal graft. Mild graft warping or shifting can be treated with nasal compression exercises for 1 minute 10 times daily until the graft position stabilizes. Severe warping or migration necessitates operative revision.



Dorsal irregularities are often camouflaged by thick skin in ethnic patients. Small visible bumps can be treated with a needle shave in the office. The area to be treated is first marked and then injected with a local anesthetic. A 16-gauge needle is inserted, and the bump is rasped with the needle's bevel. Depressions, unfortunately, cannot be treated in this manner. Revision surgery is needed to fill the depression with cartilage or soft tissue grafts.

Wide, underprojected tips are susceptible to postoperative loss of projection if not properly stabilized. Correction requires operative revision to stabilize the nasal base. Grafting material is needed to place a caudal septal extension or replacement graft to which the lower lateral cartilages can be secured.

The thick skin of many ethnic patients can cause prolonged postoperative edema. This can be especially problematic in the supratip area, where edema can lead to scar formation and create a polly-beak deformity. Edema that has persisted 4 weeks after surgery can be treated with nightly nasal taping. Recalcitrant edema can be treated with injections of 0.2 to 0.3 ml triamcinolone acetonide 10 mg/ml.

Pneumothorax can occur during rib graft harvest. Meticulous technique, especially blunt dissection within the perichondrial sleeve, is the best defense against this morbid complication. If a pleural tear is discovered intraoperatively, a red rubber catheter can be inserted into the defect. The wound should then be closed with the catheter in place. After closure, a Valsalva maneuver can be performed as the catheter is withdrawn to remove as much air as possible. A postoperative chest radiograph can confirm the presence of any residual pneumothorax and help to determine whether chest tube placement is necessary.

Scarring of the columella, alar base, and chest is more common in thick-skinned ethnic patients. Asian patients in particular scar poorly on the chest. Three weeks after surgery, patients are given Silastic sheeting to place on their incisions each night. The compression from the Silastic is thought to enhance the scar's appearance. Triamcinolone acetonide injections can also be used to treat hypertrophic scarring.

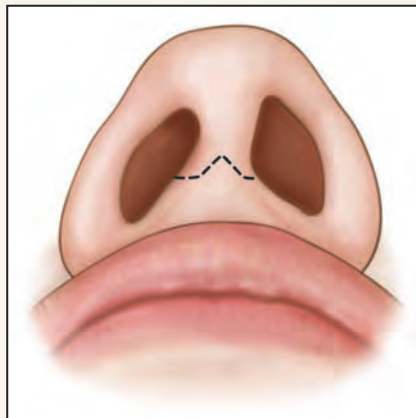
Results



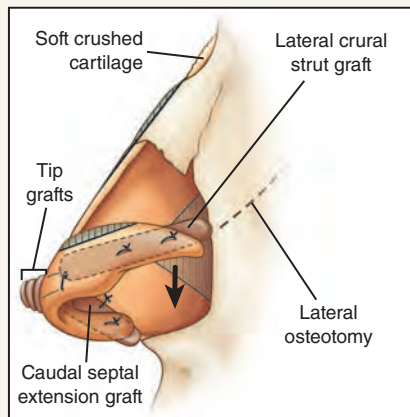
This 37-year-old woman requested correction of her nasal deformity and left nasal obstruction. The frontal view revealed a narrow dorsum, wide tip, prominent infratip lobule, and an underprojected chin. On lateral and oblique views, she had a dorsal hump, a hanging tip lobule, and an underprojected and underrotated tip. On basal view, she had columellar deviation to the left, a flared right footplate, and nostril asymmetry. Intranasal examination revealed a left septal deviation.

Surgical Plan

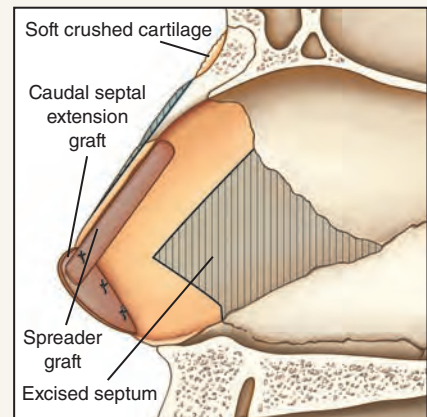
The surgical plan for this patient was to perform an external rhinoplasty approach. She had a hanging tip lobule and underprojected tip, so stabilizing her nasal base was very important. She had a very small segment of septal cartilage; costal cartilage would provide material to graft her nose and augment her tear trough. Auricular cartilage was an option but would have required using both ears. A caudal septal extension graft was used to support the base, shorten the nose, and rotate the tip. Extended spreader grafts were used to stabilize the extension graft. Placement of a small radix graft and dorsal hump reduction helped improve her profile. Repositioning the lateral crura helped to improve the alar-columellar relationship. Her rhinoplasty worksheet details the maneuvers performed during the surgery.



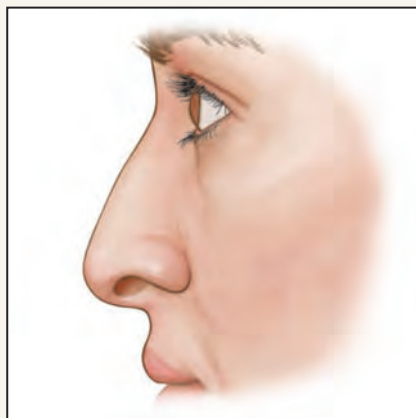
Nasal



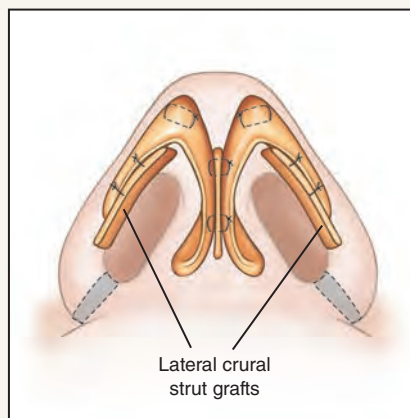
Lower lateral cartilage



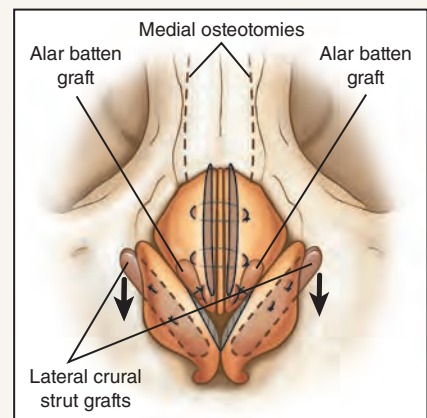
Septum



Lateral



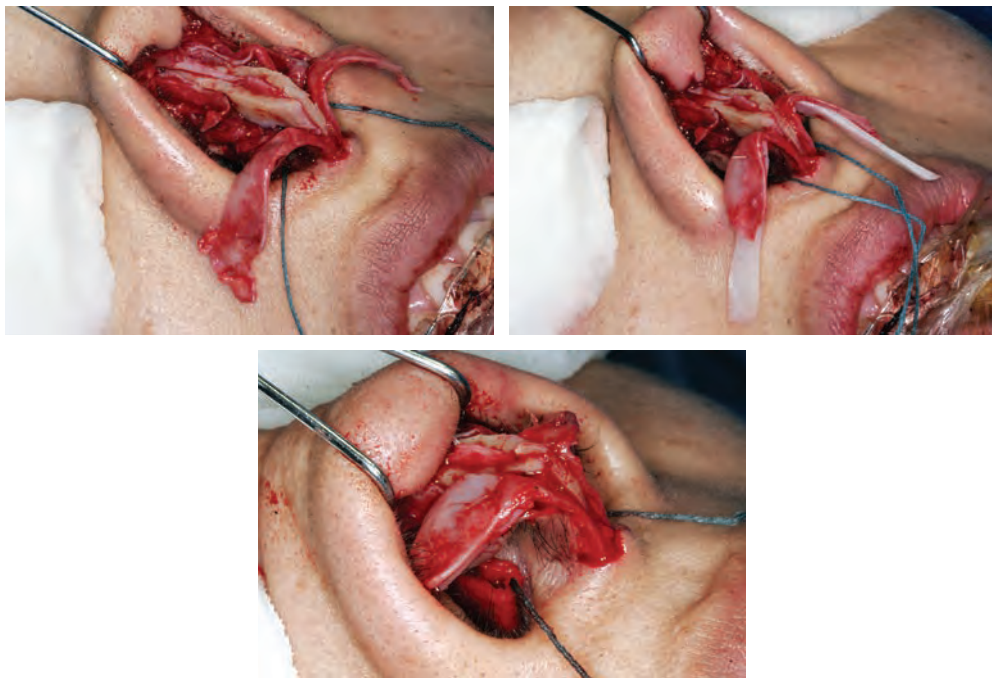
Lower lateral cartilage



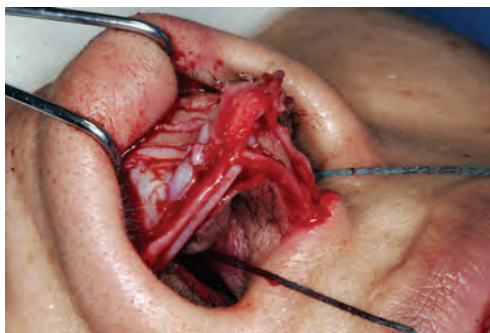
Upper and lower lateral cartilages

Surgical Steps

Right inframammary fold incision and sixth rib harvest
 Submental incision and placement of medium silicone prejowl chin implant
 Inverted-V midcolumellar incision connected to bilateral marginal incisions
 Open septoplasty and septal cartilage harvest
 Dorsal hump reduction and rasping
 Bilateral lateral osteotomies
 Costal cartilage spreader grafts
 Bilateral cephalic trimming of lateral crura
 Costal cartilage caudal septal extension graft sutured to spreader grafts



Bilateral septal cartilage lateral crural strut grafts, dome sutures, and lateral crura caudal repositioning



Interdomal suture and crushed cartilage over domes
 Crushed cartilage radix graft
 Bilateral costal cartilage alar batten grafts
 Full-thickness alar base reductions
 Bilateral transcutaneous lower lid blepharoplasty with fat repositioning and costal perichondrial grafts to the tear troughs



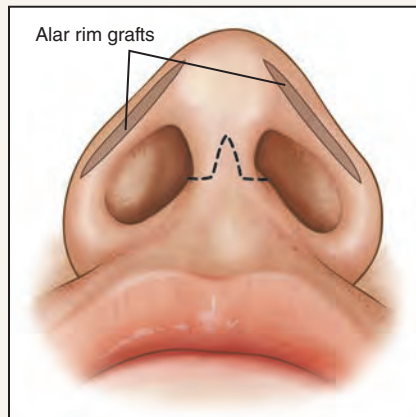
Nine months postoperatively, the patient has appropriate dorsal width and smooth brow-tip aesthetic lines. She has a narrower tip and more aesthetic alar-columellar relationship. On lateral view, she has a smooth dorsum and increased tip projection and rotation. Her basal view reveals a straight midline columella and improved nostril symmetry.



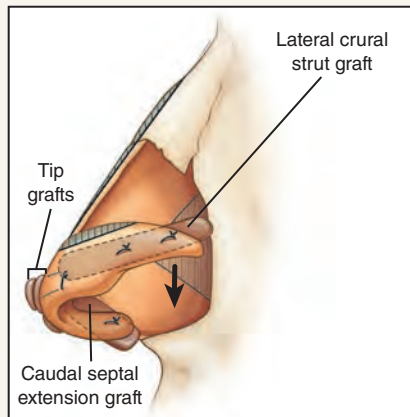
This 24-year-old man requested rhinoplasty; there was no nasal obstruction. On frontal view, he had a hanging infratip lobule and high alar insertions. On lateral view, he had a deep radix, a dorsal hump, and an underprojected tip. His basal view demonstrated a very slight columellar deviation to the right. Intranasal examination revealed a right posterior septal deviation.

Surgical Plan

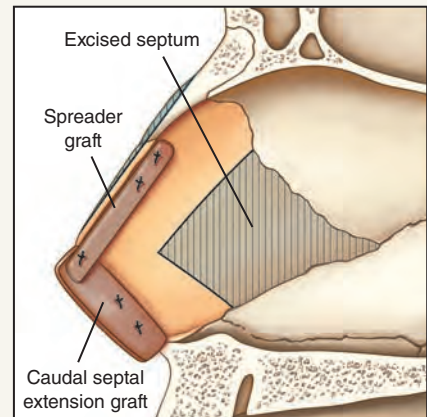
The surgical plan was to improve the patient's profile by performing a dorsal hump reduction and increasing his nasal tip projection. Costal cartilage harvest was necessary to obtain enough cartilage to lower his nostrils. Auricular cartilage was an option but is generally less effective because it is weaker. A caudal septal extension graft was used to stabilize his nasal base and prevent postoperative loss of tip projection. Correction of his flared nostrils was achieved by placing lateral crural strut grafts and repositioning the lateral crura more caudally. His rhinoplasty worksheet details the steps taken during the surgery.



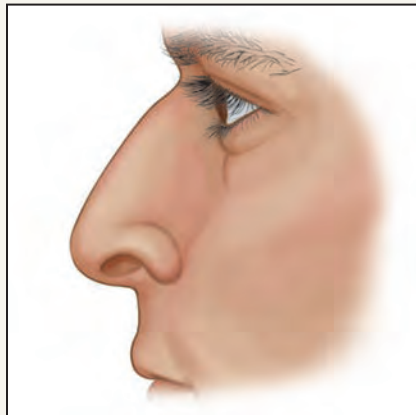
Nasal



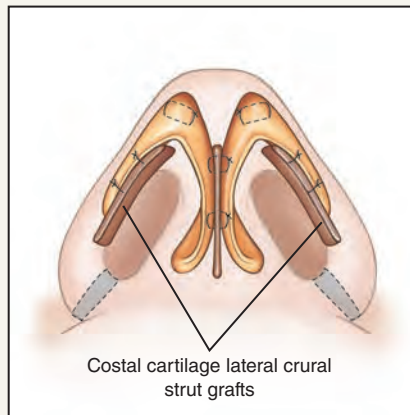
Lower lateral cartilage



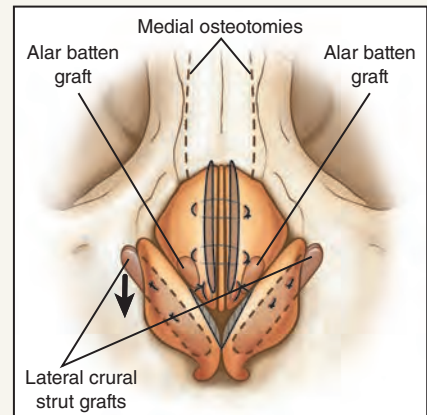
Septum



Lateral



Lower lateral cartilage



Upper and lower lateral cartilages

Surgical Steps

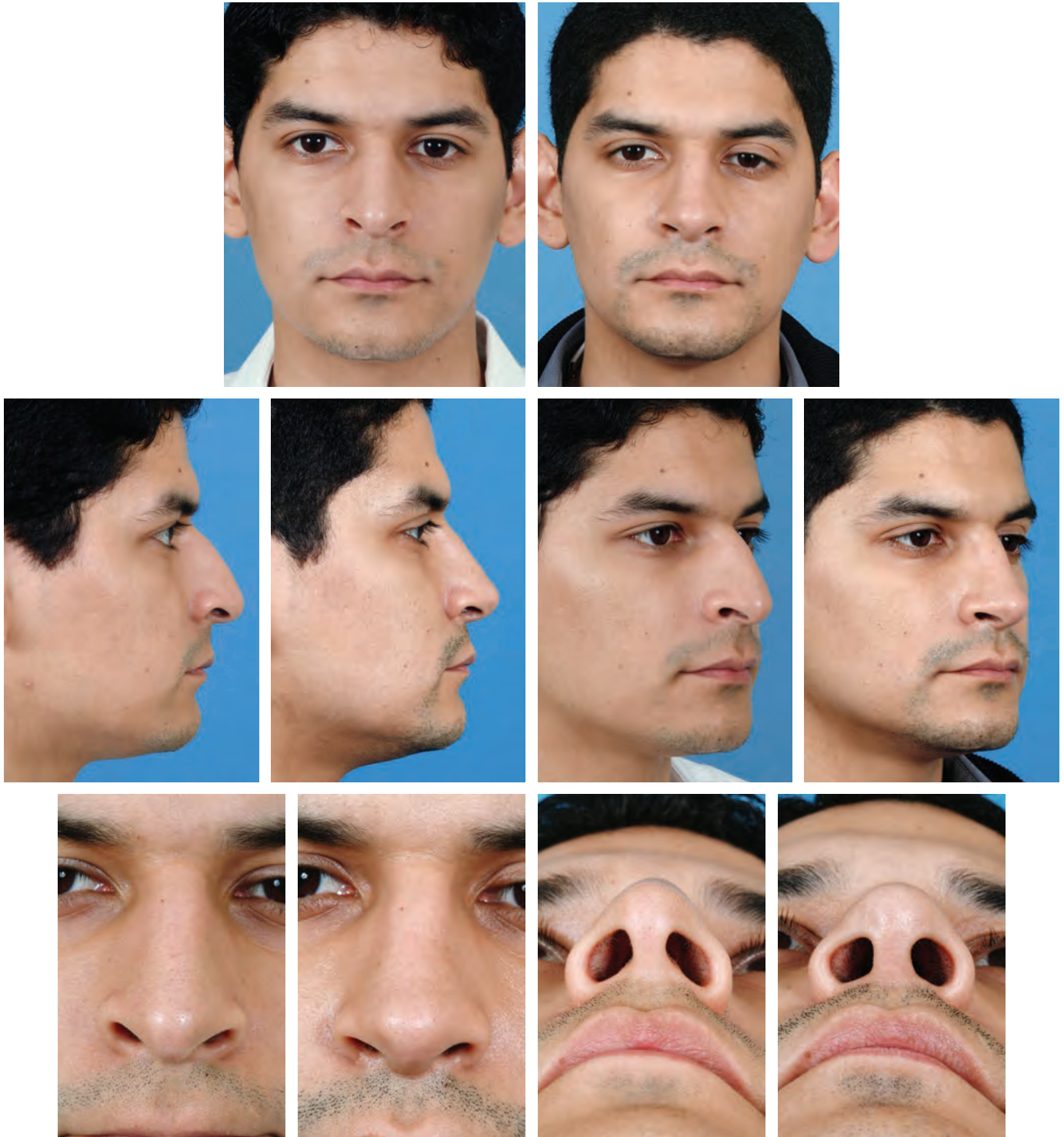
Inverted-V midcolumellar incision connected to bilateral marginal incisions
Open septoplasty and septal cartilage harvest; two fractures within septal cartilage
Dorsal hump reduction and rasping
Bilateral lateral osteotomies to narrow upper third
Right chest incision and sixth rib harvest
Bilateral costal cartilage spreader grafts



Costal cartilage caudal septal extension graft overlapping left caudal septum
Bilateral cephalic trimming of lateral crura



Bilateral lateral crural strut grafts, dome sutures, and lateral crura caudal repositioning
Interdomal suture and crushed cartilage placed over domes
Crushed cartilage graft to infratip
Bilateral internal alar base reductions



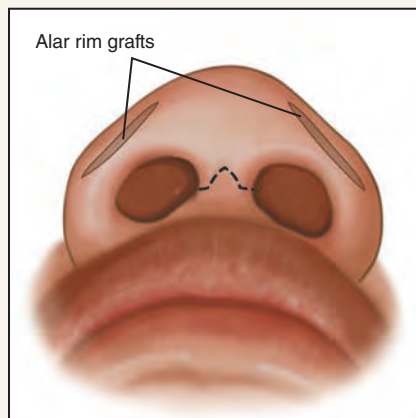
Thirteen months postoperatively, the patient has an improved alar-columellar relationship as a result of moving his lateral crura to a more caudal position. On lateral view, he has a higher radix, lower dorsum, and increased tip projection and rotation. The patient has a very subtle residual dorsal convexity that looks appropriate in many male ethnic patients.



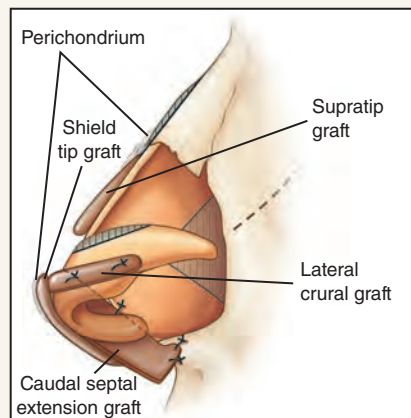
This 36-year-old woman requested rhinoplasty. On frontal view, she had a wide middle vault, nasal base, and tip. On lateral view, she had a dorsal hump, low dorsum, underprojected tip, acute nasolabial angle, and underprojected chin. Her basal view revealed a wide, underprojected tip with large, round nostrils.

Surgical Plan

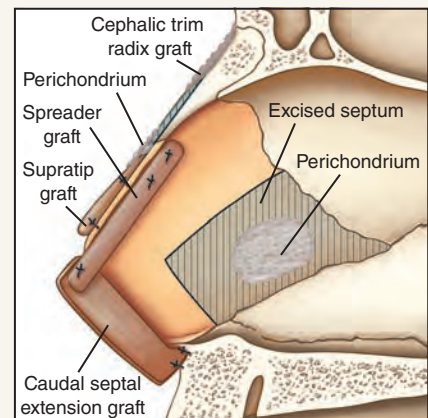
The plan was to perform an open septorhinoplasty and stabilize the patient's nasal base. She had a very small segment of septal cartilage, and costal cartilage was harvested to provide adequate grafting material. A large caudal septal extension graft was needed to stabilize the base. A shield tip graft with lateral crural grafts was necessary to provide adequate tip projection. A radix graft helped align her profile. Chin augmentation helped balance her profile with the increased tip projection. Her rhinoplasty worksheet illustrates the steps performed during the surgery.



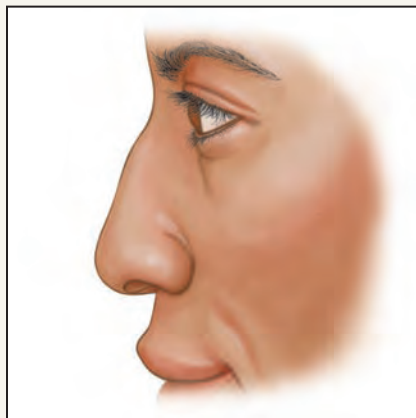
Nasal



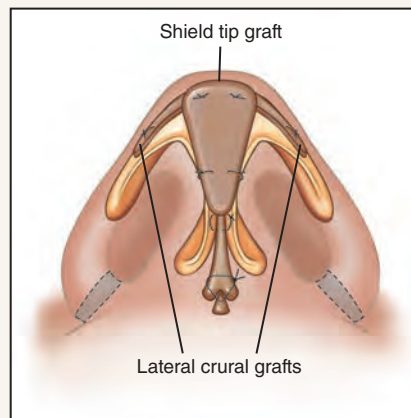
Lower lateral cartilage



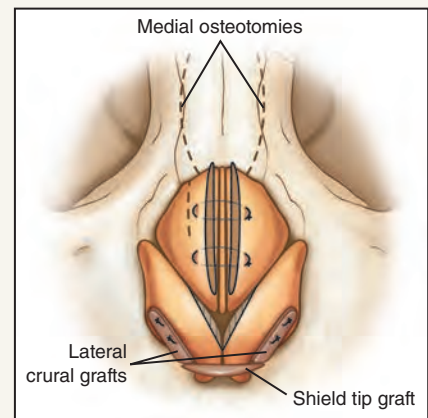
Septum



Lateral



Lower lateral cartilage



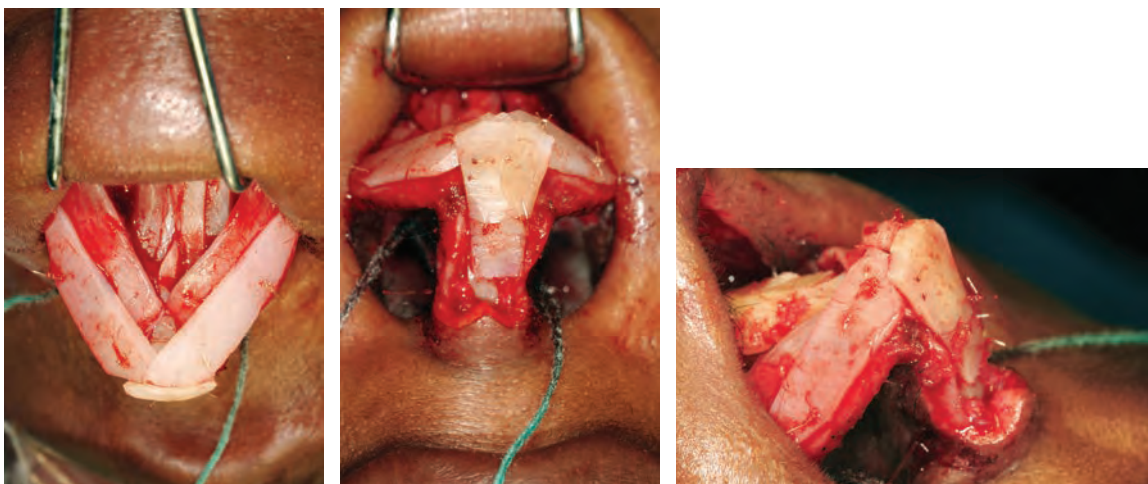
Upper and lower lateral cartilages

Surgical Steps

Submental incision and placement of a medium silicone extended chin implant
 Right inframammary fold incision and sixth rib harvest
 Inverted-V midcolumellar incision connected to bilateral marginal incisions
 Open septoplasty and septal cartilage harvest
 Dorsal hump reduction and rasping
 Bilateral lateral osteotomies
 Bilateral spreader graft placement
 Bilateral cephalic trim of lateral crura



Costal cartilage–extended columellar strut



Shield tip graft and bilateral lateral crural grafts covered with perichondrium
 Costal cartilage supratip graft
 Full-thickness alar base reductions



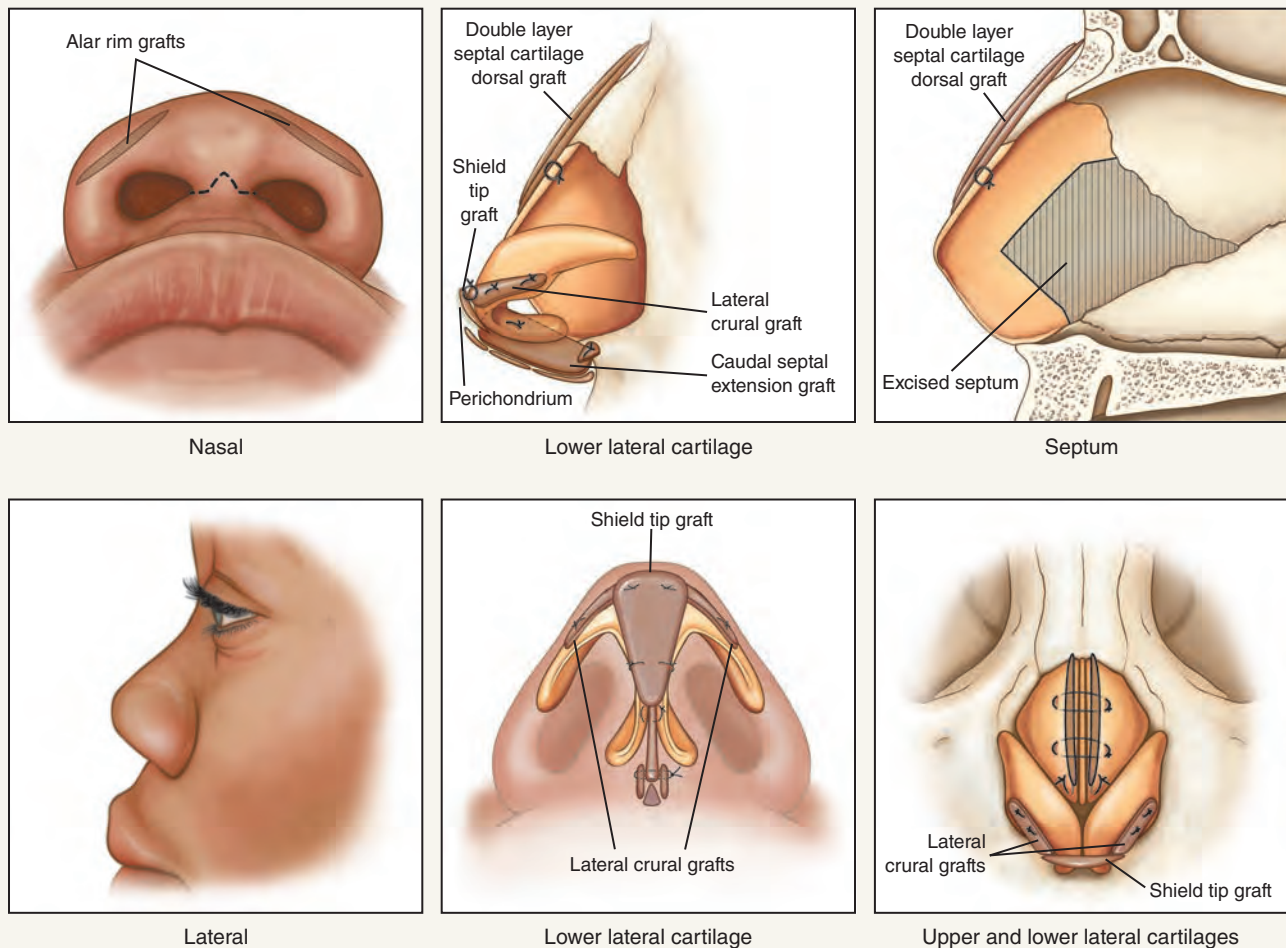
Twenty months postoperatively, the patient has a narrower middle vault, nasal base, and tip. On lateral view, she has a higher, smooth dorsum, increased tip projection and rotation, and increased chin projection. The basal view shows a narrower tip and nasal base.



This 23-year-old woman requested rhinoplasty. On frontal view, she had a very wide nose, ill-defined tip, and hanging alae. On lateral view, she had a low radix, low dorsum, an underprojected tip, and a retracted columella. The basal view revealed a very wide base and underprojected tip.

Surgical Plan

The surgical plan was to narrow the patient's nose by increasing the dorsal height with a dorsal on-lay graft. The abnormal, inverse alar-columellar relationship caused by the retracted columella and hanging ala required a large caudal septal extension graft to lengthen the columella. The lateral crura were not repositioned to avoid bringing down the alae. The shape of the lateral crura did not influence her nasal tip shape, so cephalic trimming was unnecessary. A shield tip graft was used to increase nasal tip projection and refine the tip. Alar base reduction was used to improve the width of the nasal base and nostrils. Her rhinoplasty worksheet illustrates the maneuvers performed during the surgery.



Surgical Steps

- Right inframammary fold incision and sixth rib harvest
- Inverted-V midcolumellar incision connected to bilateral marginal incisions
- Open septoplasty and septal cartilage harvest
- Bilateral costal cartilage spreader grafts



Costal cartilage caudal septal extension graft sutured to nasal spine and spreader grafts

Splinting grafts to stabilize caudal septal extension graft to nasal spine

Bilateral dome sutures, tip graft, and lateral crural grafts covered in perichondrium

Bilateral alar rim grafts



Double-layer septal cartilage dorsal graft covered on margins with perichondrium



Full-thickness alar base reductions



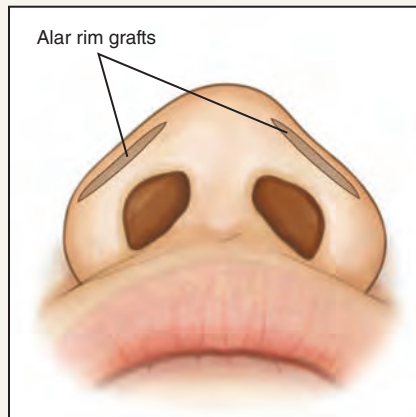
Six months postoperatively, the patient has a narrower dorsum and tip and increased tip definition. Her columella is lower and presents a more aesthetic alar-columellar relationship. On lateral view, she has a higher radix and dorsum, increased tip projection, and increased columellar show. The basal view reveals a narrower and more projecting tip.



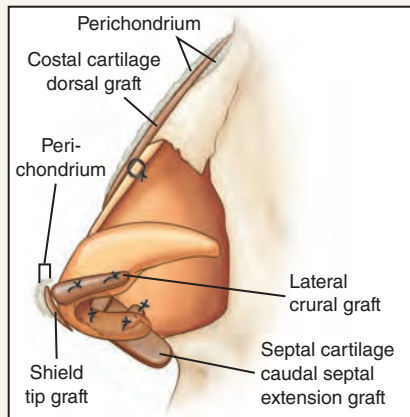
The 28-year-old woman requested rhinoplasty. On frontal view, she had an amorphous tip. On lateral view, she had a low dorsum and an underprojected tip. Intranasal examination revealed a right septal spur.

Surgical Plan

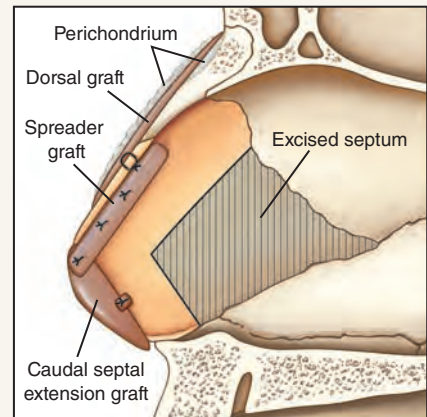
The plan for this patient was to perform an augmentation rhinoplasty. She had a low, wide dorsum that is typical in the Asian patient. Costal cartilage was harvested to obtain material for dorsal augmentation. An alloplastic implant could have been used to avoid harvesting costal cartilage, but this patient did not want artificial material used in her nose. The dorsal graft was used to raise her dorsum and produce a narrowing effect on frontal view. A caudal septal extension graft stabilized the nasal base. A shield tip graft was used to project and narrow the tip. Her rhinoplasty worksheet illustrates the steps performed during the surgery.



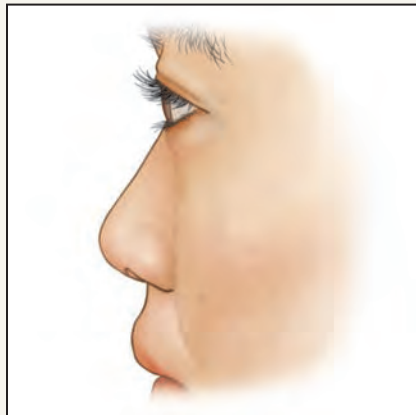
Nasal



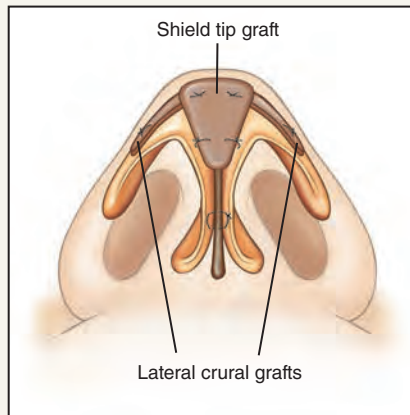
Lower lateral cartilage



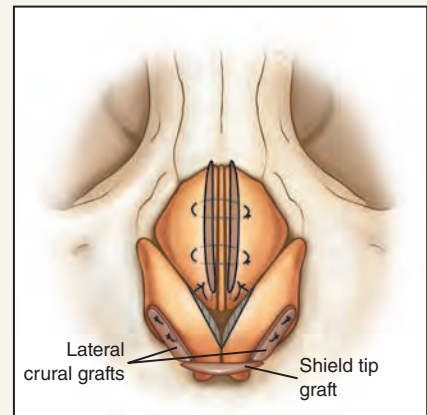
Septum



Lateral



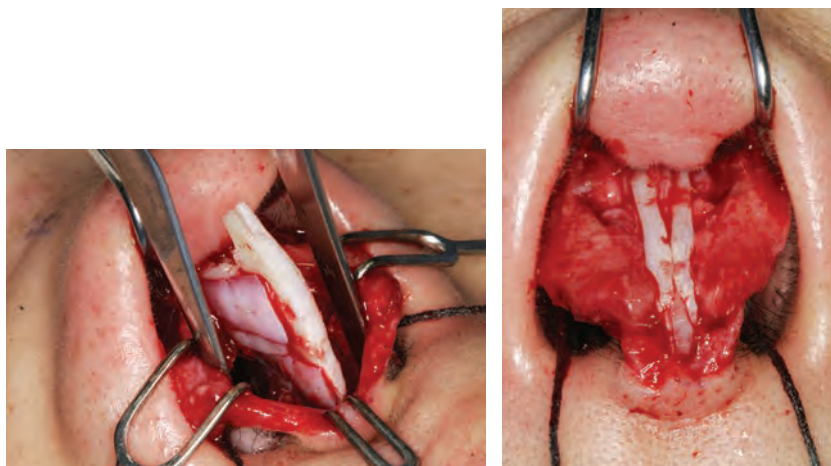
Lower lateral cartilage



Upper and lower lateral cartilages

Surgical Steps

- Right inframammary fold incision and sixth rib harvest
- Inverted-V midcolumellar incision connected to bilateral marginal incisions
- Open septoplasty and septal cartilage harvest
- Costal cartilage spreader grafts



Caudal septal extension graft placed end-to-end and secured with extended spreader grafts and bilateral splinting grafts



- Costal cartilage tip graft and lateral crural grafts covered in perichondrium
- Bilateral alar rim grafts
- Costal cartilage dorsal graft covered with perichondrium and crushed cartilage
- Supratip graft
- Bilateral alar batten grafts
- Bilateral alar base reductions



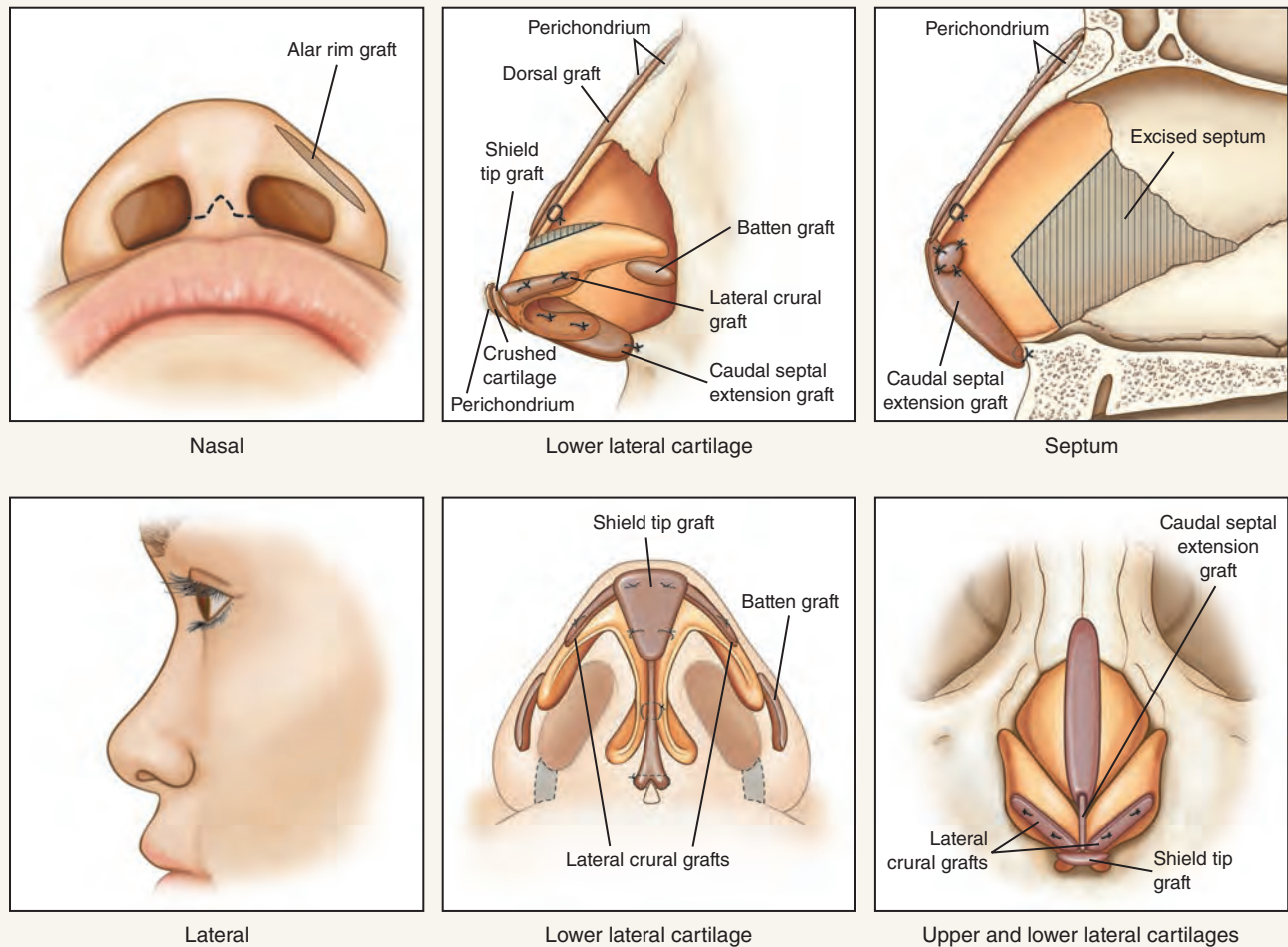
One year postoperatively, she has a narrower dorsum and a narrower and more refined tip. The lateral view reveals increased dorsal height and tip projection. Her nasal starting point is close to her midpupillary line. The basal view shows increased projection and a more refined tip.



This 28-year-old woman requested correction of her nasal deformity. She had no nasal obstruction. On frontal view, she had a wide dorsum, tip, and nasal base. On lateral view, she had a low radix, a very low dorsum, and an underprojected tip. The basal view revealed a wide, underprojected tip.

Surgical Plan

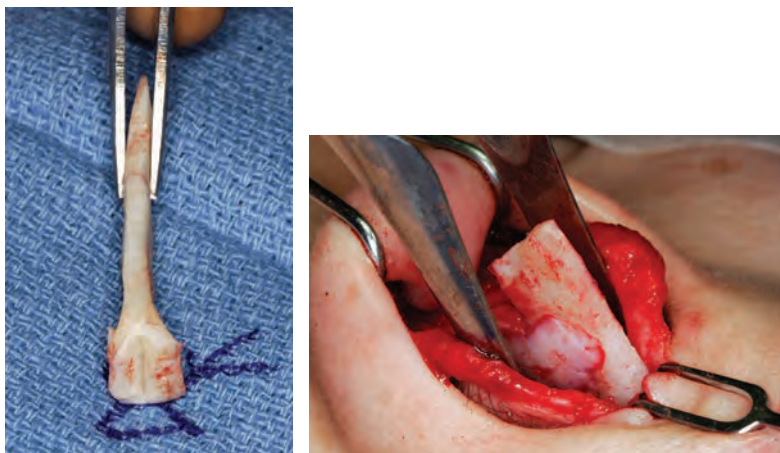
The plan for this patient was to perform an augmentation rhinoplasty. She did not want an alloplastic implant, so costal cartilage was harvested. An extended columellar strut was used to stabilize the nasal base. A notch carved in the strut's base was integrated with the nasal spine to prevent movement. The strut was further stabilized with thin splinting grafts overlapping the caudal septum. To keep the dorsal graft midline, it was notched and integrated with the columellar strut. This maneuver is frequently unnecessary, because the dorsal graft can be sutured to the upper lateral cartilages. A shield tip graft and lateral crural grafts were used to provide tip projection and contour. Her rhinoplasty worksheet illustrates the surgical steps performed.



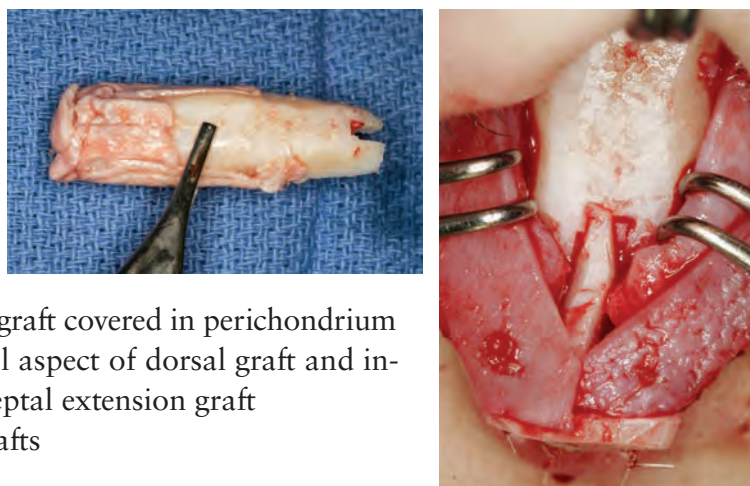
Surgical Steps

Two ribs were needed in this patient. A very large dorsal graft was used to augment her flat dorsum. The other rib graft was used for the septal extension graft and tip grafts.

Right inframammary incision and harvesting of the sixth and seventh ribs
 Inverted-V midcolumellar incision connected to bilateral marginal incisions
 Septoplasty and septal cartilage harvest



Caudal septal extension graft sutured to nasal spine
 Hole drilled in nasal spine with a 16-gauge needle
 Caudal septal extension graft secured to caudal septum with bilateral splinting grafts



Costal cartilage dorsal graft covered in perichondrium
 Notch carved in caudal aspect of dorsal graft and integrated with caudal septal extension graft
 Bilateral alar batten grafts



Shield tip graft and lateral crural grafts
 Crushed cartilage and perichondrium placed over tip graft
 Supratip graft placed



Six months postoperatively, she has a narrower dorsum and tip. On lateral view, she has increased dorsal height and tip projection. The basal view reveals her increased tip projection.

Concluding Thoughts

Ethnic patients requesting rhinoplasty frequently require increasing nasal tip projection or augmenting the nasal dorsum. They tend to have weak lower lateral cartilages and lack nasal tip support. Reductive methods may further decrease nasal tip support and leave the patient with inadequate refinement. Structural grafting can improve tip support and tip definition. Increasing the dorsal height can improve nasal dorsal definition and create a narrowing effect. Structural grafting may require harvesting ear cartilage or costal cartilage. Most ethnic patients have inadequate septal cartilage for grafting purposes. Costal cartilage will provide more than enough material for grafting but does require more advanced techniques. Management of the ethnic patient requires clear communication to ensure the patient and physician agree on the intended aesthetic changes.

Clinical Caveats

Requests for cosmetic procedures are increasing in ethnic patients; rhinoplasty is the most commonly requested.

Clear operative goals are necessary for patient satisfaction.

Careful planning of the chest incision minimizes morbidity.

Early and sequential costal cartilage carving allows warping tendencies to manifest intraoperatively.

Knowledge of cartilage curvatures is essential for proper graft selection and usage.

Stable dorsal graft placement prevents postoperative graft migration.

Base reduction is frequently necessary in ethnic patients.

Close postoperative follow-up is necessary for optimal results.

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Credits



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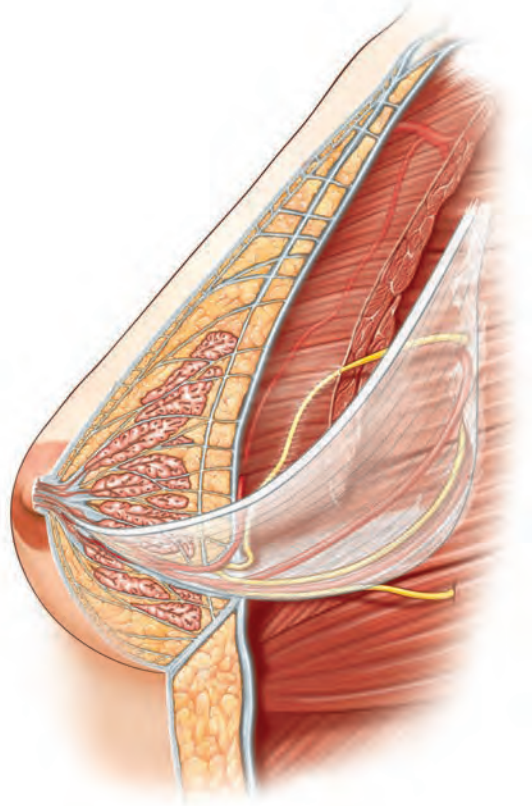
PART XI

BREAST SURGERY



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CHAPTER 59



Applied Anatomy of the Breast

KRISTIN A. BOEHM, FOAD NAHAI

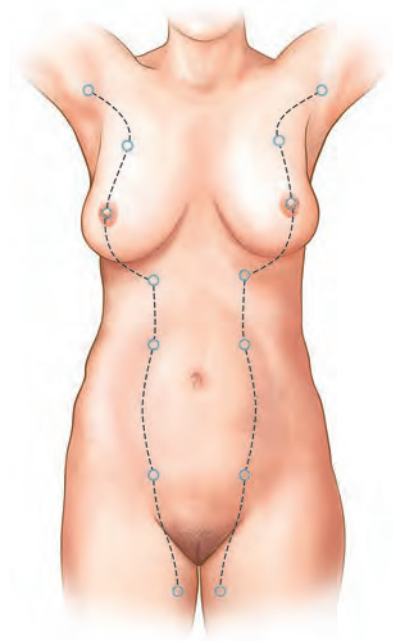
As in every medical discipline, plastic surgery is continuously evolving. Over the years we have seen the development of more-complex techniques by less-invasive means with the goals of ever-improved results and longevity. But most of these refinements, published in the literature and touted at national meetings, focus on the surgical techniques themselves. Articles and texts are replete with procedural descriptions of new microvascular flaps for breast reconstruction or an individual author's stepwise instructions for fat grafting that maximizes survivability. Although most surgeons would agree that a fundamental knowledge of anatomy is a critical foundation to understanding and performing these new surgeries, the likely consensus is that the anatomic principles are more static than the procedures being developed from them.

Nevertheless, advances are being made in the field of breast anatomy as well. Improved techniques for study have led to the discovery of previously unknown structures, enhanced microscopic details, and even better understanding of anatomic variants. These new concepts can have clinical applications that may ultimately offer advantages to patients. In breast surgery, for example, the enhanced ability to localize the vascular and nerve supply to the nipple-areola complex has led to techniques that more reliably preserve these structures and minimize the risk of complications in this area.

So while we often use the term *basic anatomy*, the human form is extremely intricate, and our knowledge of it and its structures is ever evolving. Staying in the forefront of knowledge of anatomy is as important as embracing new surgical techniques in an effort to enhance patient care and deliver superior results.

Embryology

Any discussion of breast anatomy naturally begins with the development of the breast in utero. At the fifth or sixth week of development, mammalian breasts develop along the ventral side of the embryo in longitudinal bands of thickened ectoderm called *milk lines*. These milk lines extend from the axilla to the inguinal region. Most animals develop multiple pairs of breasts along the thorax and abdomen. Humans are distinct in that they develop only a single pair of glands on the thoracic portion of the milk line. This becomes evident at around 9 weeks' gestation, at which time the milk line regresses except for a small span in the pectoral region, where breast development will ultimately occur. Failure of this regression gives rise to polymastia, characterized by accessory mammary glands, and polythelia,



in which supernumerary nipples are present. The axilla is the most common location of extraglandular breast tissue, whereas additional nipples are most often found on the chest wall below the breast. Amastia, or the absence of a breast, is a rare congenital anomaly; it occurs as a result of an arrested mammary ridge at about the sixth week of fetal development.

The mammary gland develops as an invagination of ectoderm. Squamous epithelium essentially invaginates to form a primary bud, which in turn stimulates the development of 15 to 20 secondary buds. These epithelial extensions continue to grow and extend into the connective tissue of the chest wall. By 20 to 24 weeks' gestation, these invaginated epithelial cords develop lumina and will eventually form the lactiferous ducts. The surrounding mesenchyme will become the supporting structures of the breast.

At birth, the individual branched ducts drain into more major ducts, which then coalesce into shallow epithelial pits. These pits become elevated and transformed into the nipple. Failure to do so results in a congenitally inverted nipple; this occurs in 2% to 4% of individuals. During infancy and childhood, the supporting tissues of the breast and the ducts will grow along with the increase in body size. At puberty, hormonal stimulation will cause proliferation of glandular tissue.

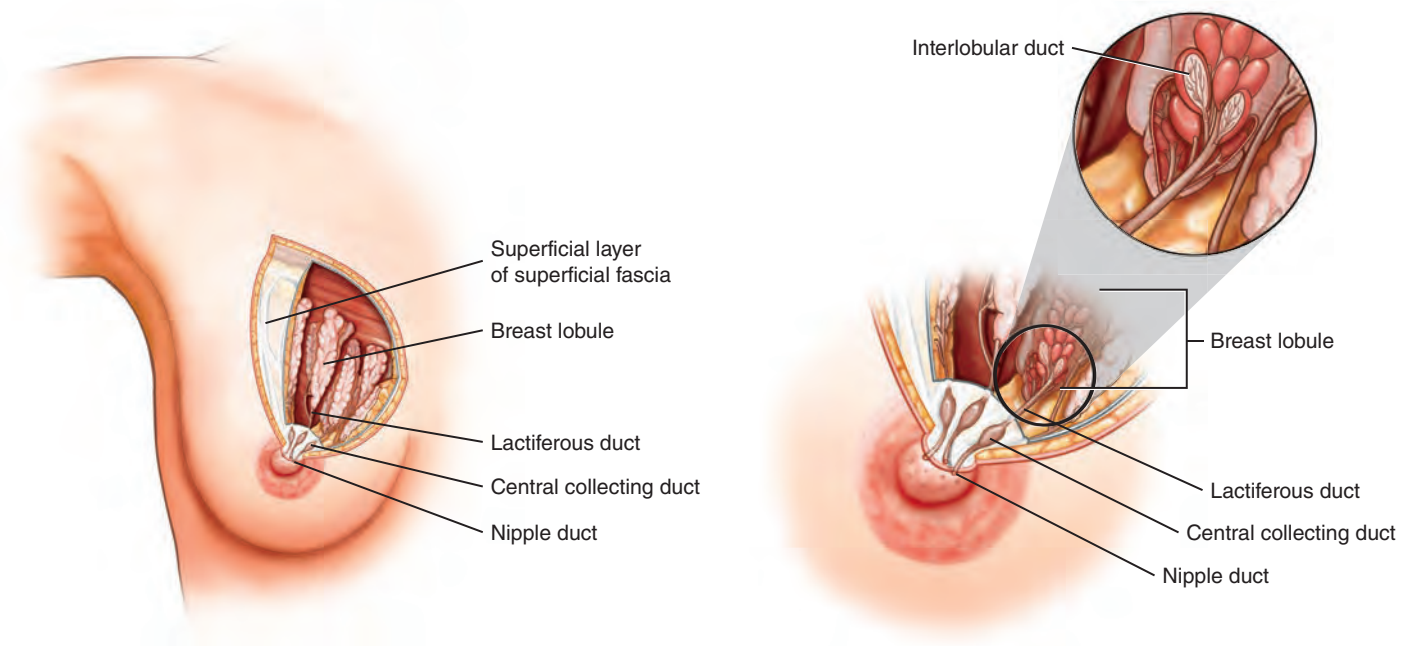
Surface Anatomy

There is tremendous variation in the size and configuration of the mature female breast. The gland typically extends from the second or third rib down to the sixth or seventh rib, where the inframammary fold is defined. It extends medially from the sternocostal junction across to the anterior or midaxillary line. The superolateral part of the mammary gland extends toward the axilla, forming the axillary tail of Spence. Along its deep surface, the breast mound sits atop the fascia of the pectoralis major, serratus anterior, external oblique, and upper rectus muscles. The deep layer of the superficial pectoral fascia lies on the posterior surface of the breast. Between this and the deep pectoral fascia is a potential space called the *retromammary bursa*. This space is identifiable during mastectomy and allows a bloodless plane of dissection.

The breast assumes a conical form with a base usually measuring 10 to 12 cm and a thickness of 5 to 7 cm. Fat lobules confer a rounded contour to the breast; the deposition of fat and branching of the lactiferous ducts that occur at puberty lead to breast enlargement. By contrast, the decrease in adipose and glandular tissue that accompanies aging can give a flaccid, pendulous configuration to the breasts of elderly women.

The nipple-areola complex consists of pigmented, stratified squamous epithelium. The complex typically measures 2 to 3 cm in diameter, and although its position is variable, ideally it is located in the center of the breast mound. The areola contains sebaceous glands, sweat glands, and visibly elevated accessory glands called *Montgomery's tubercles*, which provide lubrication during lactation. Beneath the skin of the areola, smooth muscle fibers are arranged radially and circumferentially as well as longitudinally along the lactiferous ducts up to the nipple. These muscles respond to tactile as well as autonomic sympathetic stimulation and are responsible for nipple erection and areolar constriction. The entire complex, particularly the nipple, has a rich sensory innervation that is important during lactation and milk letdown.

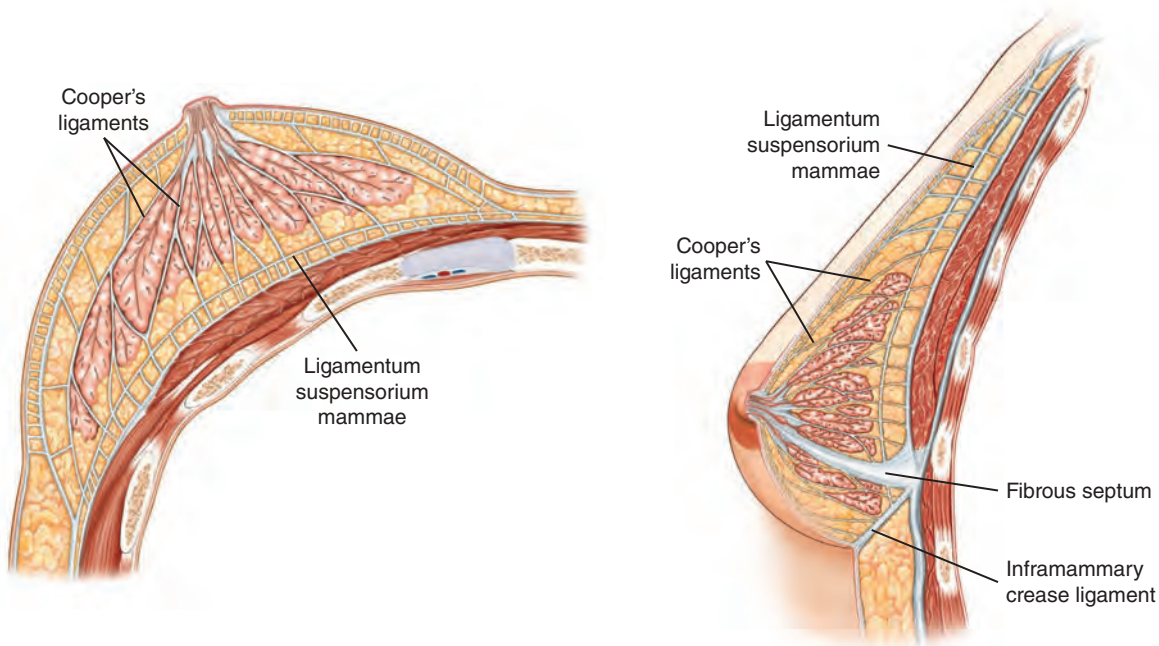
Glandular Anatomy



The 15 to 20 lactiferous ducts extend from deep within the breast lobules and terminate as openings in the nipple. These ducts define the lobes of the breast, each of which consists of all the lobules and alveoli that drain into a single excretory duct. In the subareolar tissue, each lactiferous duct dilates to form a lactiferous sinus. The ducts are lined with stratified squamous epithelium and gradually transition to a double layer, then a single layer of cuboidal cells toward the nipple.

Each duct drains 15 to 20 breast lobules. The lobule is the functional unit of the breast. Each lobule drains from 10 to 100 alveoli. The walls of the alveolar ducts consist of an inner layer of columnar glandular cells overlying a stratum of myoep-

ithelial cells. Connective tissue surrounds the lobules, but there is no distinct fascia separating the lobules. The stroma surrounding the lobules contains lymphatic vessels that bring lymph to the collecting ducts. Adipose tissue around the lobules accounts for most of the mass of the breast. There is a defined subcutaneous layer between breast tissue and the overlying skin, and this is often used as a plane of dissection in mastectomies. Most of the glandular tissue is found in the central and upper portions of the breast mound, particularly the upper-outer quadrant. This probably accounts for the higher incidence of breast cancer in this region.



The breast is enveloped by skin and subcutaneous tissue, but no true fascial layer. There are fibrous thickenings scattered between breast lobules and extending from the pectoral fascia to the overlying skin. These structures, known as the *suspensory ligaments of Cooper*, provide some structural framework to the breast parenchyma. These ligaments have a degree of laxity and stretch to them that allows breast mobility while maintaining structural integrity. Such factors as weight fluctuation, pregnancy, and aging can attenuate these ligaments and lead to mammary ptosis. On the other hand, breast malignancies can surround and shorten these ligaments, causing the dimpling of the skin known as *peau d'orange*.

Although Sir Astley Cooper was probably one of the first anatomists to delineate the internal support structures of the mammary gland, others have described additional ligaments that aid in breast suspension. Biesenberger described the *ligamentum suspensorium mammae*, which starts at the clavicle and reaches to the upper border of the breast and the retromammary space. His work, as well as more recent anatomic study, confirms the great variety in the development of this ligament: it is

a rather robust and well-defined structure in some individuals, yet almost indistinct in others. This may well correlate to the individual development of ptosis in some women but not in others.

Intraoperative experience, particularly with implant insertion, has demonstrated a fibrous bridge between the pectoralis muscle and the skin of the inframammary crease. This inframammary crease ligament gives rise to the inframammary fold and acts as a sling for the breast parenchyma. Cadaver studies have elucidated the relationship of the inframammary crease ligament to the underlying bony framework. The ligamentous structure was found to be continuous with the fifth rib medially and the fascia between the fifth and sixth ribs laterally. Histologic sections show the presence of fibrous tissue abutting rib perichondrium. Medially this structure seems to be a condensation of the rectus abdominis fascia and laterally the fascia of the serratus anterior and external oblique muscles. The firm and fixed nature of this structure, particularly in comparison to Cooper's ligaments, has clinical relevancy. During an augmentation mammoplasty, release of the pectoralis muscle with preservation of the ligament to the bony framework will minimize the risk of the breast's bottoming out. In reconstructive surgery, maintaining the integrity of this structure helps to create a more natural breast and maximize symmetry with the contralateral breast.

Further investigation has demonstrated a horizontal septum at the level of the fifth rib that traverses the glandular tissue. This septum thickens along the medial and lateral edges and curves upward into vertically oriented ligaments that attach the breast to the thoracic wall. These ligaments appear to have a superficial and a deep component; medially they connect to the inframammary crease ligament and laterally to the axillary fascia. Tension on these structures acts as an internal brassiere that lifts the breast superiorly. By corollary, decreased elastin in these ligaments or their stretching over time probably contributes to loss of shape and firmness. Thus knowledge of these ligament locations and variations is important as we continually look to newer and longer-lasting techniques to address mammary ptosis.

Microscopic Anatomy

In response to the hormonal stimulus of puberty, the layers lining the ducts and alveoli increase in number and form additional buds. The mature female breast has three cell types lining the ducts: superficial A cells, basal B cells, and myoepithelial cells. The A cells contribute to milk production. They are rich in cytoplasmic RNA and ribosomes within the cytoplasm. B cells, also known as *chief cells*, are abundant and provide energy for the luminal secretory cells. Myoepithelial cells contain myofila-

ments and perform a contractile function. They surround the alveoli of the milk duct and contract in response to sex steroids and prolactin. This provides the mechanism whereby a milk-filled alveolus can empty into the milk ducts and ultimately up toward the lactiferous sinuses.

Hormonal Regulation

Breast growth, development, and function occur in response to a variety of hormones and growth factors. Intracellular receptors and cell membrane receptors allow binding of these substances, which in turn triggers physiologic responses in the tissues.

Estrogen is the principal hormone responsible for breast growth and maintenance. Because it is lipid soluble, estrogen can diffuse through the cell membrane of both normal and malignant breast cells, where it binds with estrogen receptors. This complex initiates messenger RNA (mRNA) transcription and subsequently protein translation. This mechanism mediates ductal maturation, metabolism, and new receptor development. The result is proliferation of ductal epithelium, myoepithelial cells, and surrounding stroma. The drug tamoxifen prevents the binding of hormones to target receptors, thereby inhibiting the growth of estrogen receptor-positive mammary tumors.

Released from the ovaries, progesterone contributes to lobular development. It initiates the formation of the secretory components of the mammary epithelium, located at the terminal aspects of the ductules. Both progesterone and estrogen can increase connective tissue and fat in the breast, thereby leading to the rounded form of the fully developed breast. Gonadotropic-releasing hormone from the hypothalamus stimulates the release of leuteinizing hormone (LH) and follicle-stimulating hormone (FSH) from the anterior pituitary. LH and FSH are responsible for ovarian synthesis and release of progesterone and estrogen, respectively.

Prolactin acts synergistically with estrogen in ductal development and with progesterone in lobuloalveolar development. It is the hormone responsible for lactogenesis in the postpartum period. Cortisol and insulin are required along with prolactin to differentiate alveolar cells into milk-secreting cells. Prolactin is secreted by the acidophilic cells of the anterior pituitary at parturition.

The menstrual cycle is characterized by alternating levels of hormones. In the premenstrual phase, rising levels of LH and FSH contribute to a rise in estrogen. After ovulation, estrogen levels continue to increase and progesterone rises. These elevated hormones cause an increase in breast volume from water retention, increased base-

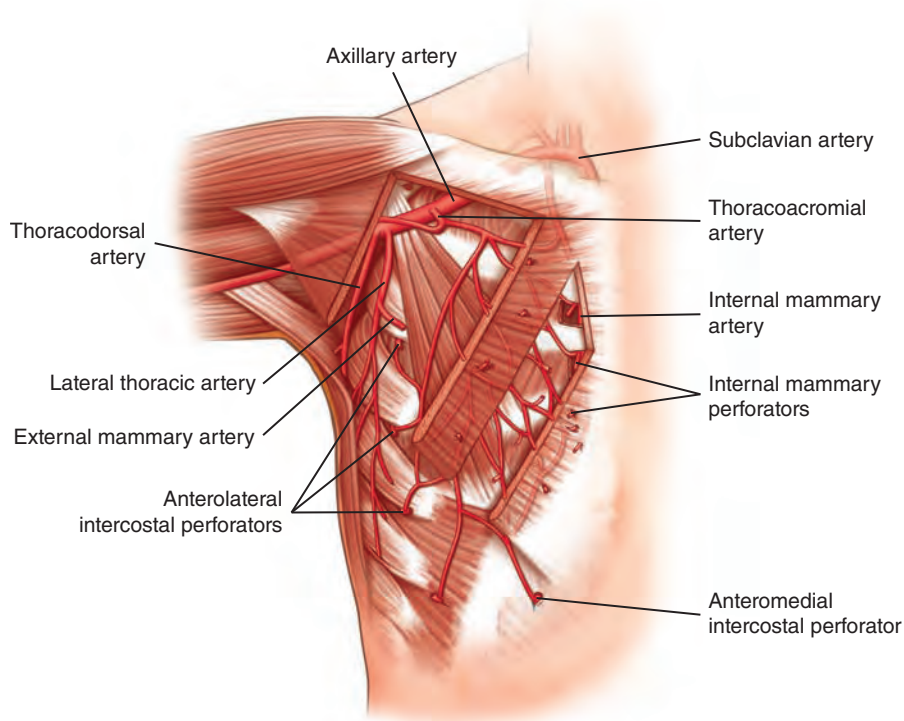
ment membrane thickness, ductal dilation, widened alveolar diameter, and increased intraalveolar secretions. After the onset of menses and withdrawal of sex steroids, the breast volume decreases in response to edema regression, reduction in glandular and alveolar cell size, and diminished secretions.

With pregnancy, high levels of estrogen and progesterone are maintained, initially by the corpus luteum, and, after the twelfth week of gestation, the placenta. In the first trimester, estrogen causes the ducts and lobules to proliferate. Glandular epithelium replaces fatty tissue. The latter part of the first trimester is characterized by breast enlargement, venous dilation, and increased pigmentation of the nipple-areola complex. In the second trimester, the secretory epithelium becomes active in response to progesterone. By the third trimester, colostrum fills the alveolar and ductal spaces, accompanied by increased blood flow and enlargement of myoepithelial cells. Toward the end of pregnancy, prolactin circulates and initiates synthesis of milk fat and proteins.

Following delivery, the placentally induced sex steroids cease and the breast is influenced by prolactin. The milk released in the first few days after parturition, called *colostrum*, has a low lipid content but is rich in antibodies; 4 to 5 days after parturition, the milk becomes laden with lipids, protein, carbohydrates, and immunoglobulins. The ongoing secretion of prolactin by the anterior pituitary is necessary to sustain milk production and secretion. A nursing infant's tactile stimulation of the nipple-areola complex maintains this and will also initiate release of oxytocin from the posterior pituitary. Oxytocin causes myoepithelial cells to contract, which pushes milk from the lobules into the lactiferous ducts. The presence of milk in the ductal system provides an ideal culture medium for bacterial overgrowth. Obstruction to flow along the ducts, usually from areolar inflammation, leads to suppurative mastitis. With cessation of nursing there is regression of the extralobular stroma and atrophy of the formerly proliferative glandular and ductal elements. The breast usually returns to its prepartum state over the next 3 months.

During menopause, the body no longer produces sex steroids as a consequence of diminished ovarian function, and there is actual loss of glandular tissue. Adipose tissue can replace lobular elements, although there is usually a loss in total mass of fat volume in the breast. The result is decreased breast volume, and the breast takes on a flatter, more pendulous shape.

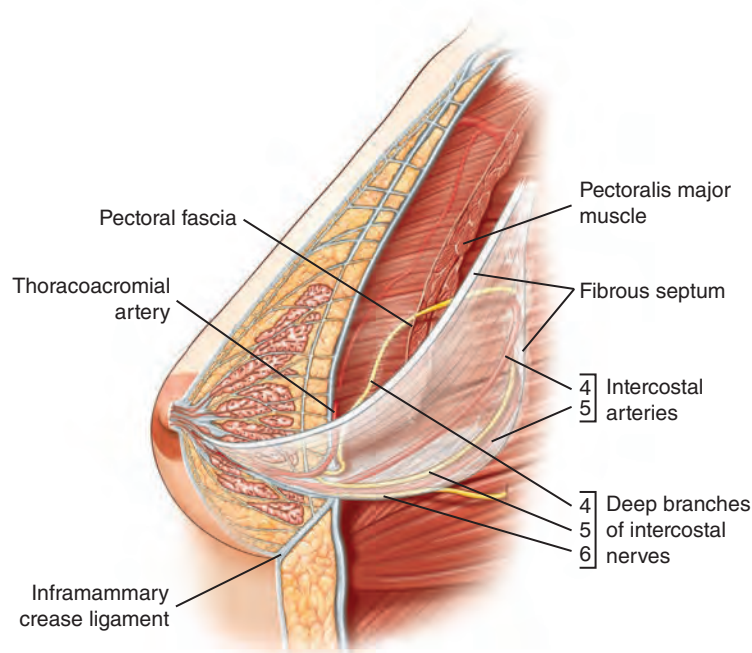
Blood Supply



Most of the breast mass receives its blood supply from the internal mammary artery. Branches of this artery must pass through the intercostal muscles along the second to fifth ribs, a few centimeters lateral to the parasternal border. Once these ventral branches enter the breast, they collateralize with two other major sources of blood supply: the lateral thoracic artery and the cutaneous branches from the posterior intercostal arteries. The lateral thoracic artery originates from the axillary artery and traverses along the lower border of the pectoralis minor muscle. Along its course of the muscle, the lateral thoracic artery gives off the external mammary artery, which will eventually come ventrally through the muscle to supply the upper-outer quadrant of the breast. Branches of the third through fifth posterior intercostal arteries supply the lower outer quadrant of the breast.

The veins parallel the arteries, with primary drainage into the axilla. Significant veins include the perforating branches of the internal thoracic vein, tributaries of the axillary vein, and perforating branches of the posterior intercostal veins. A notable pattern of superomedial and inferior pole drainage appears responsible for the bulk of venous drainage. Although the dominant drainage route appears to be through the third and fourth intercostal spaces, superomedial drainage to the second and third intercostal spaces and lower pole drainage to the fourth and/or fifth intercostal space have been consistently identified and appear to represent anatomic norms.

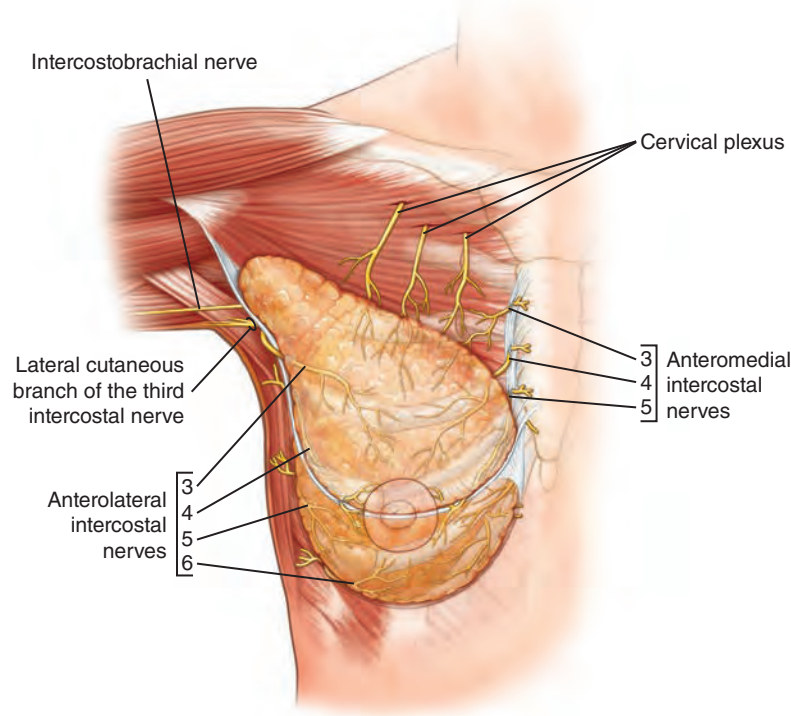
Although venous anatomy is less explored than arterial anatomy, most vascular compromise encountered during breast reduction surgery results from venous compromise. This underscores the importance of maintaining venous architecture in breast surgery to minimize complications. Developments in infrared photography have helped to elaborate the venous architecture of the breast. A subareolar plexus has been identified, with venous radiation from this plexus, probably to the deep venous structures. Preservation of this plexus with deepithelialization techniques should theoretically minimize the risk of venous outflow problems in breast surgery by maintaining a connection between superficial and deep vessels.



Relatively recent cadaver studies have reinforced these well-established vascular patterns, but more closely pinpoint location and demonstrate a consistent anatomic course for the supplying vessels. A horizontal fibrous septum has been shown to arise from the pectoralis fascia at the level of the fifth rib, similar to an intestinal mesentery. This septum lies in between a cranial and caudal vascular network and courses toward the nipple-areola complex. The cranial portion carries inflow from the thoracoacromial artery at the level of the fourth intercostal space and a branch of the lateral thoracic artery. The caudal network is supplied by perforating branches from the fourth and fifth and occasionally sixth intercostal arteries. Along the breast borders, this septum coalesces into medial and lateral ligaments, attaching the breast to the sternum and pectoralis minor, respectively. Medially, the ligament contains perforating branches from the internal thoracic artery, across the second to fourth intercostal spaces. Laterally, branches off the lateral thoracic artery from the second to the fourth intercostal spaces are found.

These vessels within the septum essentially bisect the breast into cranial and caudal parts. This division may well be rooted in embryology, with the formation of cranial and caudal ingrowths of ectoderm separated by a mesenchyme that ultimately forms the vascular network. Histologically, the glandular tissue in these two parts is identical. However, there is clinical significance to this anatomy, particularly as it relates to breast reduction surgery and the goal of maintaining the blood supply to the nipple-areola complex. This has led to the development of the septum-based mammaplasty popularized by Hamdi and colleagues that consists of a two-part glandular resection both above and below the septum. The remaining pedicle maintains the septal attachment of the gland to the thorax. Because this septum contains the vascular perforators, the blood supply to the pedicle and nipple-areola complex is maintained, and the risk of fat necrosis and nipple loss is minimized. Additionally, because this technique maintains a dual blood supply to the pedicle, with inflow both medially and laterally via the septum, more lateral breast resection can be performed, which is often an area of preoperative concern for patients.

Innervation



Sensory innervation to the skin overlying the breast is principally derived from lateral and anterior cutaneous branches of the second through sixth intercostal nerves. A portion of skin along the superior pole is also supplied by branches from the supraclavicular nerve, off of the cervical plexus. The lateral branches of the intercostal

nerves exit through the intercostal spaces to supply the breast. The third through sixth branches are known as *lateral mammary branches*. The lateral branch of the second intercostal nerve is the intercostal brachial nerve and supplies the upper medial aspect of the arm and axilla.

Of utmost importance to plastic surgeons is preservation of the sensitivity of the nipple-areola complex. The fourth lateral cutaneous branch has long been held to be the most important nerve for sensation to the nipple. Its course, however, is somewhat more controversial, largely because of the difficulty in dissecting this small nerve as well as its anatomic variations. Schlenz et al performed a relatively large number of cadaver dissections to confirm the importance of the fourth lateral intercostal nerve, which supplied the nipple in 93% of specimens. They showed that while a superficial course of the nerve exists as a variant, the overwhelming majority of the time the lateral cutaneous nerve takes a subglandular course within the pectoral fascia to approach the nipple from the posterior surface. Resections at the base of the breast are therefore more likely to jeopardize sensation to the nipple-areola complex.

Medial nipple innervation is most commonly derived from anterior cutaneous branches of the third and fourth intercostal nerves. Unlike the lateral counterparts, these nerves take a more superficial approach in the subcutaneous tissue and become more superficial as they reach the medial areola. Incisions around the medial areolar edge are therefore more likely to injure these nerves.

The same septum that carries the vascular network to the nipple-areola complex also guides the main nerves to the nipple. Overwhelmingly, this consists of a deep branch of the lateral cutaneous branch off the fourth intercostal nerve. The nerve consistently runs down the fibrous septum along the retromammary space from lateral to medial, passing through the gland to redirect toward the nipple. Once again, preservation of the septum in breast surgery procedures will maximize the chances of maintaining sensation in the nipple-areola complex.

Lymphatic Drainage

The majority of lymphatic flow from the breast is into the axilla; the remainder of flow is through the internal mammary nodes. This anatomy is reflected in the tendency of breast cancer to involve axillary nodes. Both the axillary nodal groups and the internal mammary nodal group are pathways for the metastatic spread of breast cancer to the systemic circulation.

The lymph nodes within the axilla are divided into three levels based on the location of the nodes relative to the pectoralis minor muscle. Level I nodes are lateral to or below the level of the lower border of the pectoralis minor muscle. This group includes the external mammary, axillary vein, and scapular lymph nodes. Nodes deep to or behind the pectoralis minor muscle are level II lymph nodes and include the central lymph node group and the subclavicular nodes. Nodes above the upper border of the pectoralis minor muscle are level III; the subclavicular and apical node groups contribute to level III.

Lymphatic drainage from the breast can occur by lateral, medial, transpectoral, and retropectoral routes. The lateral route is the most important. The majority of breast and breast skin lymph will drain laterally through the external mammary node group. Lymph that drains medially will drain via the parasternal lymphatics and ultimately into the internal mammary lymph node chain. The lymph that drains medially can originate from all quadrants of the breast and is not limited to the medial aspects of the breast. Transpectoral drainage is via Rotter's nodes, which are located beneath the lateral aspect of the pectoralis major muscle. Rotter's nodes will drain into lymphatics along the thoracoacromial artery to the subclavicular group of level III. The final route of drainage is retropectoral, in which the superior and internal aspects of the breast drain into lymphatic vessels located along the lateral and inferior portions of the pectoralis muscles and eventually terminate in the subclavicular node group in the axilla.

The development of breast lymphatic mapping has assumed greater importance as the sentinel lymph node biopsy in breast cancer has become the standard of care. The vastness of the lymphatic system poses a challenge, and until recently most knowledge of breast lymphatic anatomy was derived from gross clinical studies dating back to antiquity. More modern techniques incorporate injection, cross-sectional analysis, and radiography to elucidate lymphatic structures. These methods verify that lymph-collecting vessels along the anterior torso drain preferentially into the axillary lymph nodes. The previously held dogma relating breast lymphatics to upper torso lymphatics was that the two were connected by a subareolar plexus that ultimately drained into the axilla. Undoubtedly this is the case for some lymph channels located within breast parenchyma. However, it appears that there are also some lymphatics that drain breast tissue without passing through the subareolar plexus and instead drain directly into the axilla. Additionally, there are perforating lymph vessels that course beside the branches of the internal mammary vessels and drain into the ipsilateral internal mammary lymphatics. In some studies, one sentinel node in the axilla drained almost the entire breast. In most, more than one sentinel node is represented.

The prevalence of breast cancer and now-standard performance of sentinel lymph node biopsy raises the question of whether transaxillary breast augmentation interferes with breast lymphatic drainage patterns and ultimately the detection of cancer. Lymphoscintigraphy has been employed to evaluate lymphatic patterns in patients immediately before, immediately after, and in the long term following transaxillary breast augmentation. No statistically significant differences in patterns or time of uptake have been identified among the subjects at the various time intervals. The accepted consensus is that preserved axillary drainage patterns from the breast allow successful sentinel lymph node biopsies in those who later require this procedure after a transaxillary augmentation.

Concluding Thoughts

Performing safe and high-caliber surgery of the breast, aesthetic or reconstructive, requires thorough knowledge of its structures. The study of breast anatomy continues to be of clinical importance as newer techniques for breast surgery evolve.

Clinical Caveats

Continued research and technique refinements have enhanced our knowledge of breast anatomy and the breast's structural framework.

In particular, the concept of an internal breast septal system has been shown to consistently predict neurovascular structures that are important to preserve in all types of breast surgery.

Appreciation of this septal system may help to formulate surgical techniques that reinforce such a structure in attempting to correct mammary ptosis and the bottoming out phenomenon.

Understanding both the established and newer tenets of breast anatomy is important to be able to effectively examine, diagnose, and surgically treat conditions including breast cancer, hypomastia, macromastia, mammary ptosis, and congenital breast deformities.

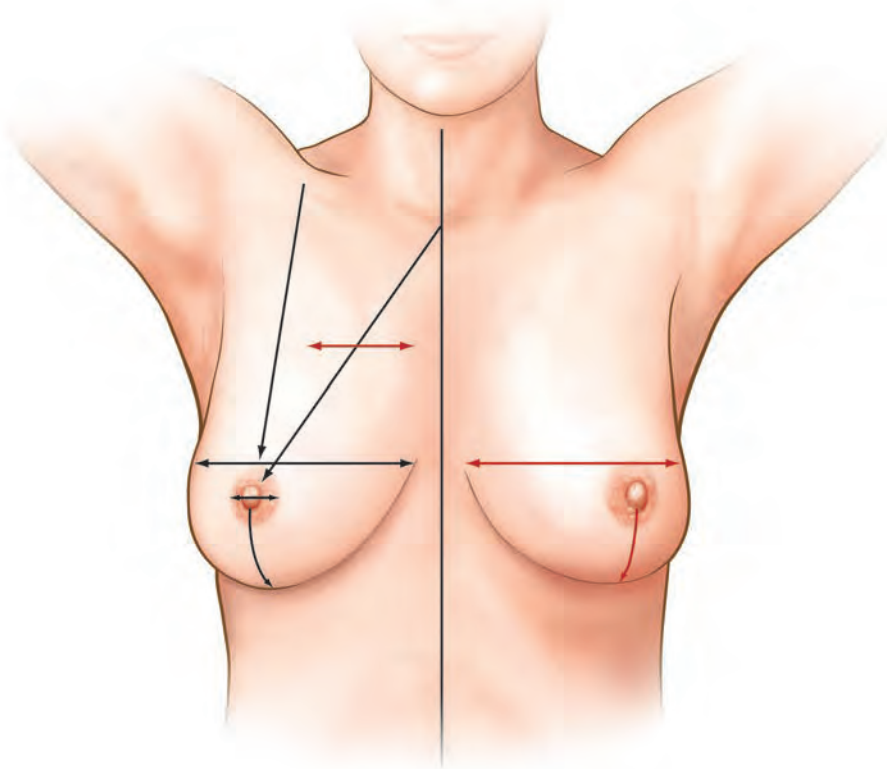
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CHAPTER 60



Clinical Decision-Making in Breast Surgery

FOAD NAHAI

Although only breast reduction actually treats or improves any symptoms, I consider any operation on the female breast to be an aesthetic procedure—not only augmentation and mastopexy, but also reduction and reconstruction. Whether we are restoring body image and self-confidence in a woman who has lost a breast, or enhancing the appearance of a “normal” breast in an effort to boost a woman’s self-confidence, our goals are the same as for any aesthetic procedure.

Principles of Breast Aesthetics

Breast aesthetics consist of the “four S’s”:

Shape

Size

Symmetry

Scars

Shape and Size

Breasts come in all shapes and sizes, some more aesthetic than others. Although the ideal size will vary according to personal and cultural preferences, there is more consensus on what constitutes the ideal shape. I believe shape to be of the utmost importance. The ideal aesthetic breast is projecting, with adequate volume above and below the nipple-areola complex, more below than above. The nipple-areola complex should be located at the point of maximal breast projection. Although breast size is subject to individual taste and societal preference, and is too often influenced by media images, it is also true that disproportionately large or small breasts do not complement a woman’s figure. They may also have physical ramifications. Careful counseling is required when a thin, 5 feet 4 inch, 100-pound woman requests a D cup breast size. Conversely, a well-proportioned teenager whose body development is advanced beyond that of her peers may seek breast reduction to avoid what she feels is unwanted attention.

Symmetry

Ideally, a woman’s breasts are uniform in color and symmetrical in size, shape, and nipple-areolar position. Although minor asymmetry is the rule rather than the exception, gross asymmetry is not only distracting but of practical importance to a woman in terms of bra cup size and appearance in clothing. When a surgeon is counseling a woman seeking breast surgery, minor asymmetries of her breasts must be pointed out. Most women are very accepting of these asymmetries preoperatively, but this is not the case after aesthetic breast surgery.

BREAST SHAPES AND SIZES

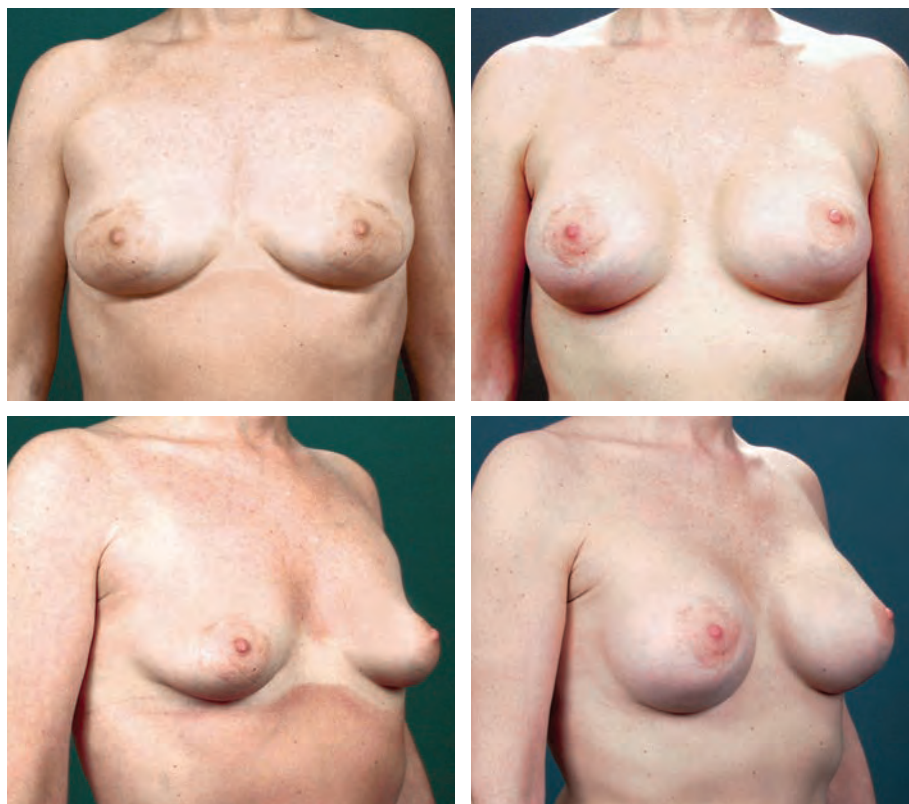


Scars

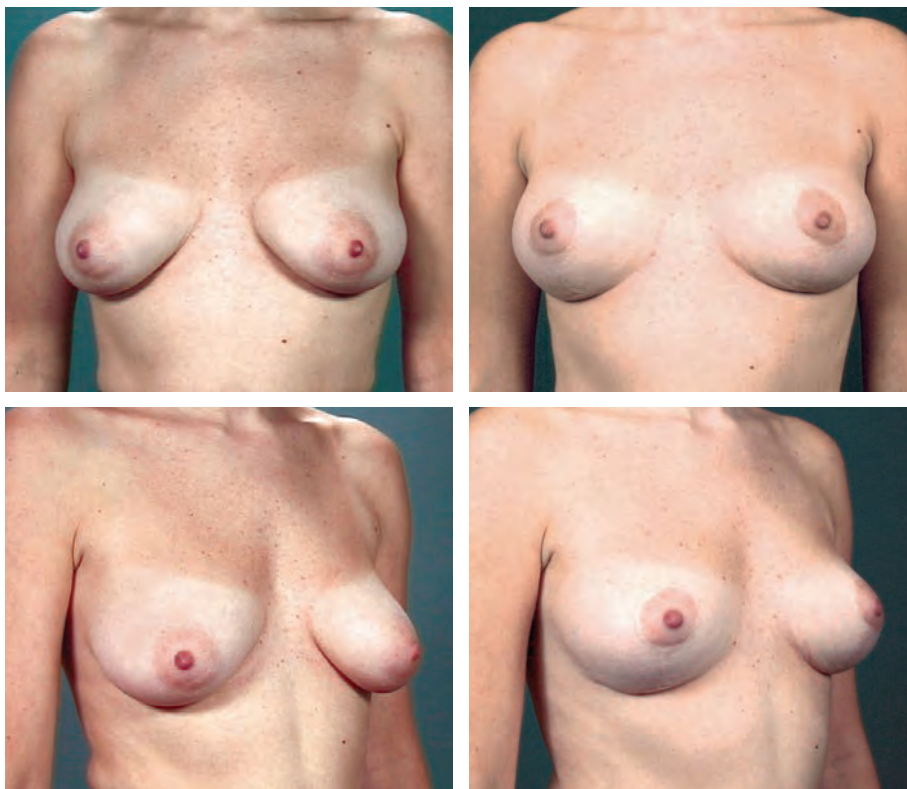
Although many patients' perception is that plastic surgery means no visible scars, in reality that is not possible. Rather, our goals should be to keep the scars minimal in length and as inconspicuous as possible as we enhance the breasts' shape. There is no question that shape is far more important than scars. I believe that shortening of scars and maintenance of optimal shape are mutually attainable goals.

The following three women have had aesthetic breast surgery. They each demonstrate ideal shape, appropriate size to match their bodies, and inconspicuous scars.

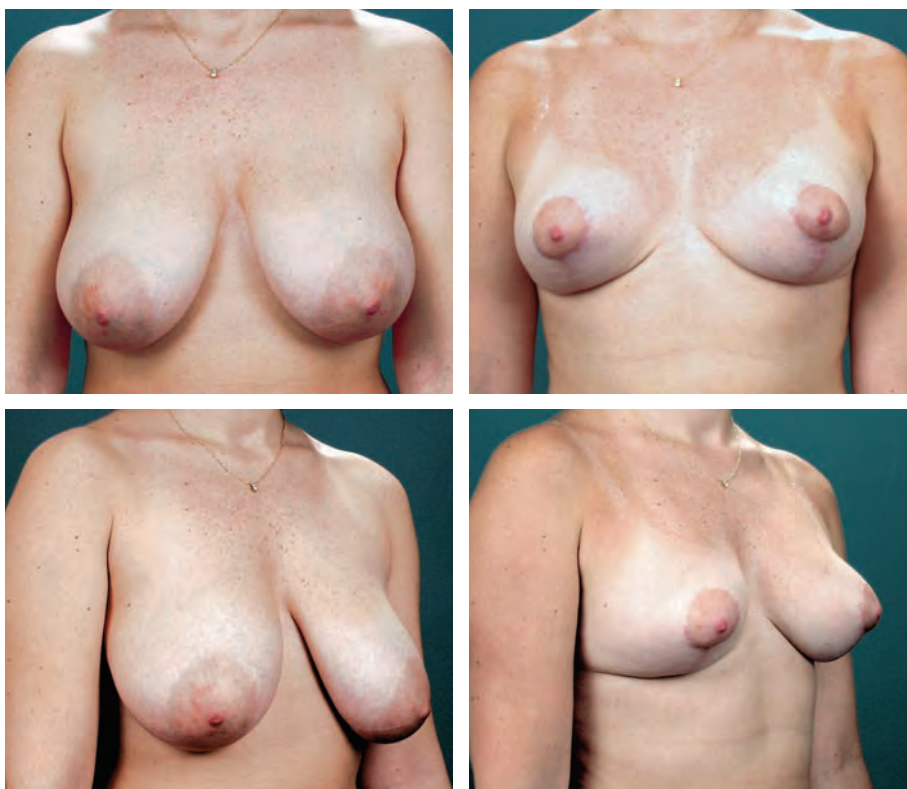
AUGMENTATION



MASTOPEXY



REDUCTION



How do we control shape, symmetry, size, and scars? Symmetry and size are related more to the surgeon’s judgment, artistic sense, and surgical skill than to operative technique. When breast implants are placed, the shape of the breasts is largely dependent on the dimensions, volume, and shape of the implant. Shape and scars, on the other hand, are very much dependent on operative technique. Optimal breast shape and minimal scars are possible through a variety of techniques.

Safety: The Fifth S

Breast aesthetics also consists of safety—not only of the patient, but also of the nipple-areola complex. Knowledge of the arterial blood supply and venous drainage of the breast, and specifically of the nipple-areola complex, is essential.

Breast Augmentation

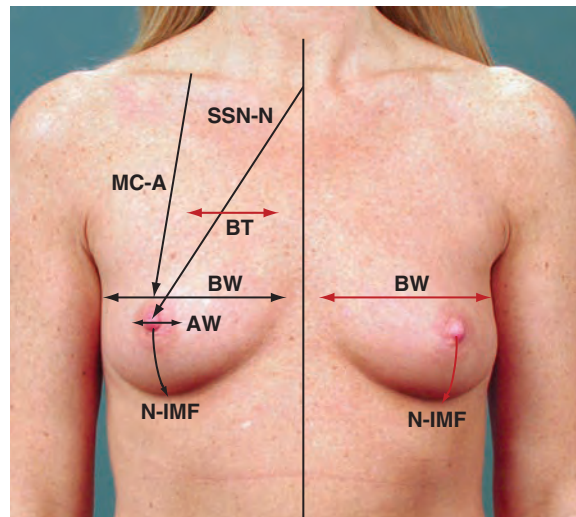
Although the type of breast implants available may vary from one country to another, the principles of implant selection remain the same. The most important determinant of the aesthetic quality of the result is the size of the implant. Inappropriate size selection leads to problems with shape and the need for revision, especially with saline implants.

Patient Evaluation for Breast Surgery

Skin	Width (BW)
– Quality	Thickness (BT)
– Quantity	Suprasternal notch-nipple distance (SSN-N)
Parenchyma	Nipple-inframammary fold distance (N-IMF)
– Fatty	
– Fibrous	
Skin-parenchyma relationship	
– Tightly adherent	
– Moderately adherent	
– Loose	

Detailed patient examination and careful physical measurements will guide the surgeon in selecting the appropriate implant to optimize results and minimize the need for revisions. We must weigh the patient’s anatomic features and her desires for breast size in selecting implants, taking into consideration available implant sizes and dimensions in light of our own experience and judgment.

The examination of the patient includes breast measurements and an assessment of the breast parenchyma and skin, including the relationship of the skin to the underlying breast tissue. All of these anatomic features will influence implant selection as well as the choice of surgical approach and implant placement.

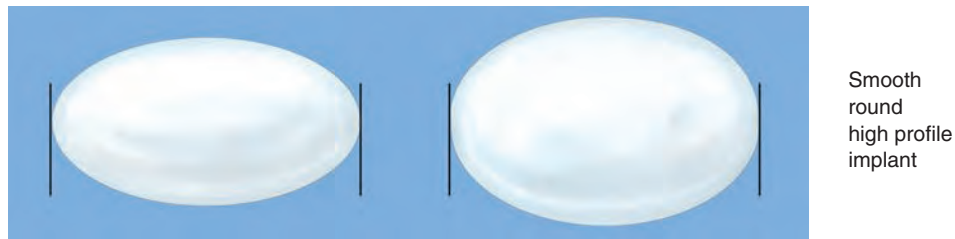


I prefer a dimensional approach to implant selection rather than the volume approach, where the surgeon, through judgment or a desire to please the patient, selects an arbitrary volume for the implant. The most important measurements in selecting the implant are the breast width (*BW*) and breast thickness (*BT*). *BT* should be measured in the upper pole. My preference is to measure it along the *SSN-N* line. (Other measurements shown include *AW*, areolar width; *MC-A*, midclavicular to areola; *N-IMF*, nipple to inframammary fold; and *SSN-N*, suprasternal notch to nipple.) *BW* minus *BT* will indicate the maximum implant width for that breast. Charts are available from all implant manufacturers clearly depicting the diameter, projection, and volume of their implants. Once the base diameter of the implant has been decided on, projection and volume can be selected based on that diameter. If a moderate profile implant would not accommodate the volume or projection desired for the patient, a high profile implant may be selected that will allow more volume and projection with the same diameter. This dimensional approach to implant selection allows maximal projection without exceeding the height and width limits of the breast.

Anatomical or shaped implants demand more precise and detailed measurements to ensure that the appropriate shape, height, and projection are selected.



A moderate profile implant is shown. With increasing volume, the implant extends beyond the width of the breast without increasing projection.



In contrast, a high profile implant increases projection with increasing volume without extending beyond the width of the breast.

Implant Options

Implant options include the following:

- Size
- Shape
- Shell
- Filler

Breast implants are offered in a variety of sizes, shapes, shell surfaces, and filler materials. Size options include dimensions, width, height, and projection as well as fill volume. Prefilled implants do not offer the flexibility of on-table volume adjustments; however, most saline implants and double-lumen implants do offer this option.

The majority of available implants are round, with variations in projection. Standard or moderate profile implants project less than high profile ones. Anatomic-shaped implants are gaining popularity for primary breast augmentation, especially with the cohesive gel implants that are now available. Although currently most anatomic implants are for breast reconstruction and round implants are for augmentation, anatomic implants may well become surgeons' first choice for breast augmentation, especially in thin women. Although the movement of round implants within the pocket does not pose any risk of breast shape change, anatomic implants must be positioned precisely, and any movement will lead to distortion of breast shape. Most if not all currently available anatomic implants are textured to reduce this risk.

The surface of the implant may be smooth or textured. At one time, polyurethane-covered implants were very popular in the United States, and in fact, led to the development and popularity of the textured-surface implants. Polyurethane-covered implants are currently available in some European and South American countries. Although the polyurethane covering of the implants is textured in appearance, this covering is biologically active, becoming incorporated into the surrounding capsule, unlike the standard textured silicone surface. My preference with saline implants is a smooth surface rather than textured, because I have found less visible and palpable rippling as well as a lower implant failure rate with a smooth-surface implant.

Our current options for implant fillers are limited to saline and silicone gel. Other materials have been investigated but have not proved to have any advantage over gel or saline. Some, such as the soybean oil implants, have been withdrawn from the market. Although the saline implant remains a popular option for breast augmentation in the United States, gel-filled implants are preferred in most of the rest of the world. A variety of cohesive gel-filled implants are available and under development, and I believe gel-filled implants will become the filler of choice in the very near future. The advantage of cohesive gel is that in the event of implant failure, the gel will not migrate. The cohesive property also enhances the maintenance of shape in the anatomic implant.

Although saline as a filler is completely biocompatible without any side effects in the event of leakage, it falls far short of the ideal filler in terms of feel, consistency, and pliability. It also appears to have a more deleterious effect on surrounding tissues in terms of thinning and stretching of the skin envelope than its gel-filled counterparts.

Implant Specifications and Location Options

Implant Options	Implant Location			
	Submuscular (total)	Submuscular (partial)	Retromammary	Retromammary Subfascial
Shell				
Smooth	++++	++++	++	+++
Textured	++++	++++	++++	++++
Filler				
Saline	++++	++++	++	+++
Silicone gel	++++	++++	++++	++++
Shape				
Round	++++	++++	++++	++++
Anatomic	++++	++++	++++	++++

Degree of effectiveness indicated by number of pluses.

Implant Placement

Incisions

Several incision sites are available to the surgeon, depending on the procedure and patient characteristics:

- Axillary
- Periareolar
- Transareolar
- Inframammary
- Umbilical

My preferred incision in a patient with an established fold is the inframammary incision, which I will place below the preexisting crease; the distance below depends on the dimensions of the selected implant. In a patient with no fold, I prefer the axillary approach and will place the incision within the distalmost axillary crease. I make the periareolar incision only in combination with mastopexy. I have no personal experience with the umbilical or transareolar approaches bisecting the nipple. In general, I prefer not to involve the breast tissues, specifically the ducts, in performing breast augmentation.

Choosing the Best Option: Breast Augmentation Approaches					
Breast Characteristics	Incision				
	Axillary	Periareolar	Transareolar	Inframammary	Umbilical
Mammary Fold					
Well-defined					
Undefined					
Areola					
Size					
Wide					
Narrow					
Color					
Dark					
Light					
Patient Preference					

Location

The options for implant placement include retromammary, retromammary subfas-
sial, partial subpectoral, and complete submuscular. I reserve complete submuscu-
lar implant coverage for breast reconstruction with implants. For breast augmenta-

tion, I choose between the retromammary and partial subpectoral position based on the shape and thickness of the breast. However, the relationship of the skin to the underlying parenchyma also plays a role in this decision, as would minimal ptosis. In patients with minimal ptosis whose breasts are amenable to correction through implant placement, I will opt for retromammary placement, provided the tissues are thick enough. If they are not thick enough, I choose submuscular placement with the dual plane approach.

All things being equal, I prefer retromammary placement of the implant above or below the pectoral fascia. In this position the breasts have a more natural appearance, and the distortion seen with pectoral contractions is eliminated. The main advantage to retromuscular placement is the extra thickness afforded by the pectoralis muscle, which in thinner women will provide more adequate implant coverage, lessening the potential for visible, palpable rippling, particularly with saline implants. In women with less than 2 cm of breast thickness, especially superiorly and medially, I prefer partial submuscular placement of the implant, whether saline or silicone gel. I will only place saline-filled implants over the muscle if the breast thickness is 3 cm or more.

Recently several reports have shown the benefits of subfascial placement of breast implants. The pocket is made deep to the breast tissue, over the pectoralis major muscle, but including the pectoral fascia. Proponents believe that inclusion of this thin fascial layer will add further protection or tissue volume around the implant. However, this fascia can be very thin, adding very little volume. It would be far better to include the entire 5 to 10 mm thickness of the pectoralis major muscle if deemed necessary rather than the fascia.

Tissue Characteristics and Implant Location Options

Tissue Characteristics	Implant Location			
	Submuscular (total)	Submuscular (partial)	Retromammary	Retromammary Subfascial
Skin				
Normal elasticity				
Nonelastic stretched				
Breast Tissue Thickness				
<2 cm				
>2 cm				
Ptosis				
Ptotic				
Nonptotic				

Conclusion

I always counsel any woman seeking breast augmentation that implants are not permanent, will eventually leak, and will have to be changed; that breast augmentation is not maintenance free; that regular follow-up examinations are mandatory; and that her first pair of implants will not be the last. In terms of size, I find that most patients come in after having talked to friends, researched on the Internet, and made up their minds as to their desired implant volume or bra size. It takes a lot of patience and skill to discuss these issues with patients and to reconcile their desires with the reality of their chest dimensions and tissue characteristics. I emphasize that inappropriately large implants, especially those filled with saline, will lead to serious long-term complications. I explain to them that a dimension-based implant selection will match their breast size to the most appropriate implant, and the choice of access incision and implant placement, subpectoral or retromammary, is also made to match their physique and tissue characteristics.

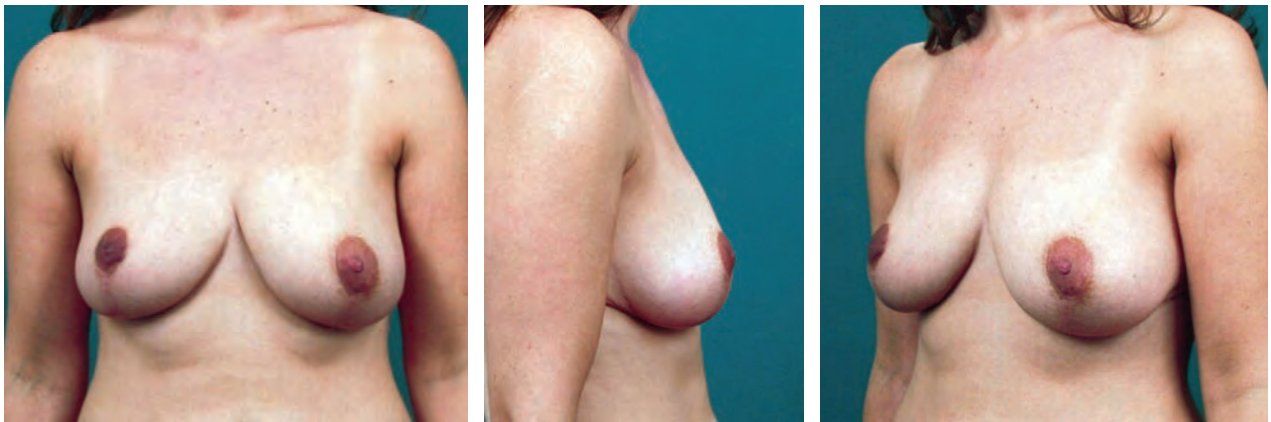
Breast Reduction

The goals of breast reduction are twofold: aesthetic and functional. Most women seeking breast reduction have symptoms related to the large size of the breast and the impact that breast weight has on their lifestyle, and on their ability to work and exercise. Symptoms include pain and discomfort in the neck, back, and shoulders; shoulder grooving, excessive sweating, or frank intertrigo in the inframammary fold. The ideal procedure should not only enhance the form of the breast but also relieve the patient of these symptoms. A sufficient volume of breast tissue must be resected to achieve these ends. Postoperative dissatisfaction with breast reduction is not limited to scars and shape—far too often the patient complains that her breasts were not sufficiently reduced in weight or volume to relieve the symptoms. Although our priority is the aesthetic result of the reduction, surgeons must not lose sight of the patient's goal: relief of symptoms as well as aesthetic improvement.

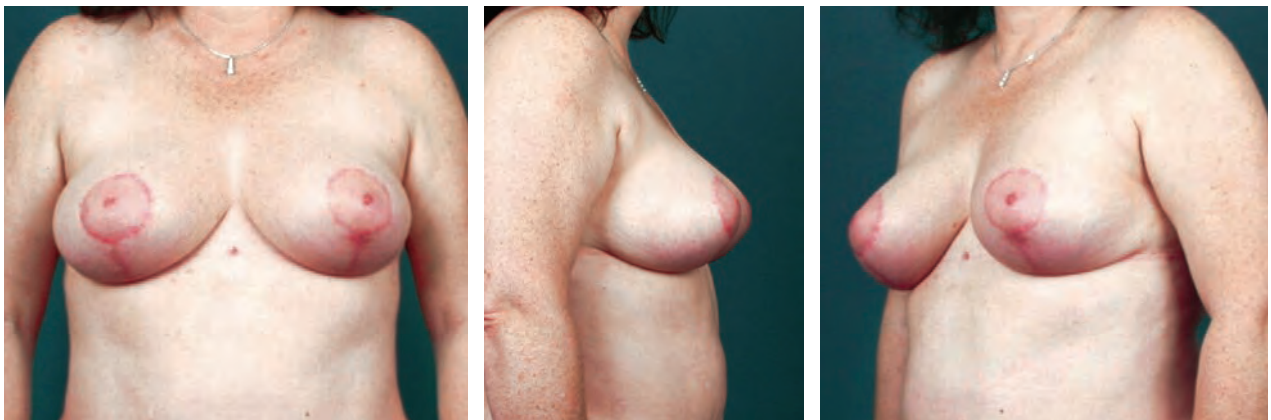
Aesthetic goals are to reduce and reshape the breast with the nipple-areola complex in the appropriate position through minimal scars and with minimal risk of nipple-areolar loss, delayed healing, or wound disruption. By far the most common cause of dissatisfaction and even litigation after breast reduction is scarring. For years breast reduction procedures, although resulting in volume reduction, resulted in poor breast shape, nonprojecting square or wide breasts, and extensive scarring. More recently, greater emphasis has been placed on improvement and maintenance of shape with minimization of scars.



This young woman, who underwent an inferior pedicle Wise pattern breast reduction elsewhere, was seen for evaluation of scars and shape improvement. She demonstrates wide, nonprojecting breasts that have bottomed out, and extensive inframammary scarring that extends beyond the breast, across the midline, and past the anterior axillary fold.



The typical long-term result is shown after a central pedicle Wise pattern breast reduction. Despite the pleasing appearance of the breasts, projection is moderate and bottoming out is noted, especially on the left side.



The typical result after breast reduction using the superior pedicle vertical technique demonstrates projecting breasts.



Side-by-side comparison emphasizes the difference in shape and projection.

A number of operative procedures are available for breast reduction with a variety of pedicles to maintain the nipple and areola, a variety of techniques to shape the breast, and varying lengths of incisions. There is a tendency to refer to breast operations by the resulting scar, such as *periareolar*, *vertical*, and *inverted-T*. These terms should refer only to the scar and reflect the pattern of skin excision. Different pedicles and shaping techniques can be performed through each of these incisions. The appropriate way to refer to a particular technique for breast reduction should include the pedicle, the breast-shaping method, and the resultant scar.

All breast reductions—regardless of pedicle selection, scar placement, or scar length—entail four steps:

- Incisions for access
- Parenchymal resection
- Breast reshaping
- Management of excess skin

With the Wise pattern, all steps are performed through the preoperative markings, affording the best exposure and the option for limitless skin excision. On the other hand, the periareolar approach offers very limited exposure and skin excision. The short-scar options fall in between.

The short-scar superior pedicle or medial pedicle options narrow the base of the breast, increase projection, and push the nipple upward, whereas the Wise pattern central or inferior pedicle procedures widen the base, flatten the breast, and displace the nipple downward. It is not the scar or the pedicle that defines the procedure or the result. It is the tissues resected, the location in the breast where they are resected, and how the breast is reshaped that define the result.

Liposuction-Only Breast Reduction

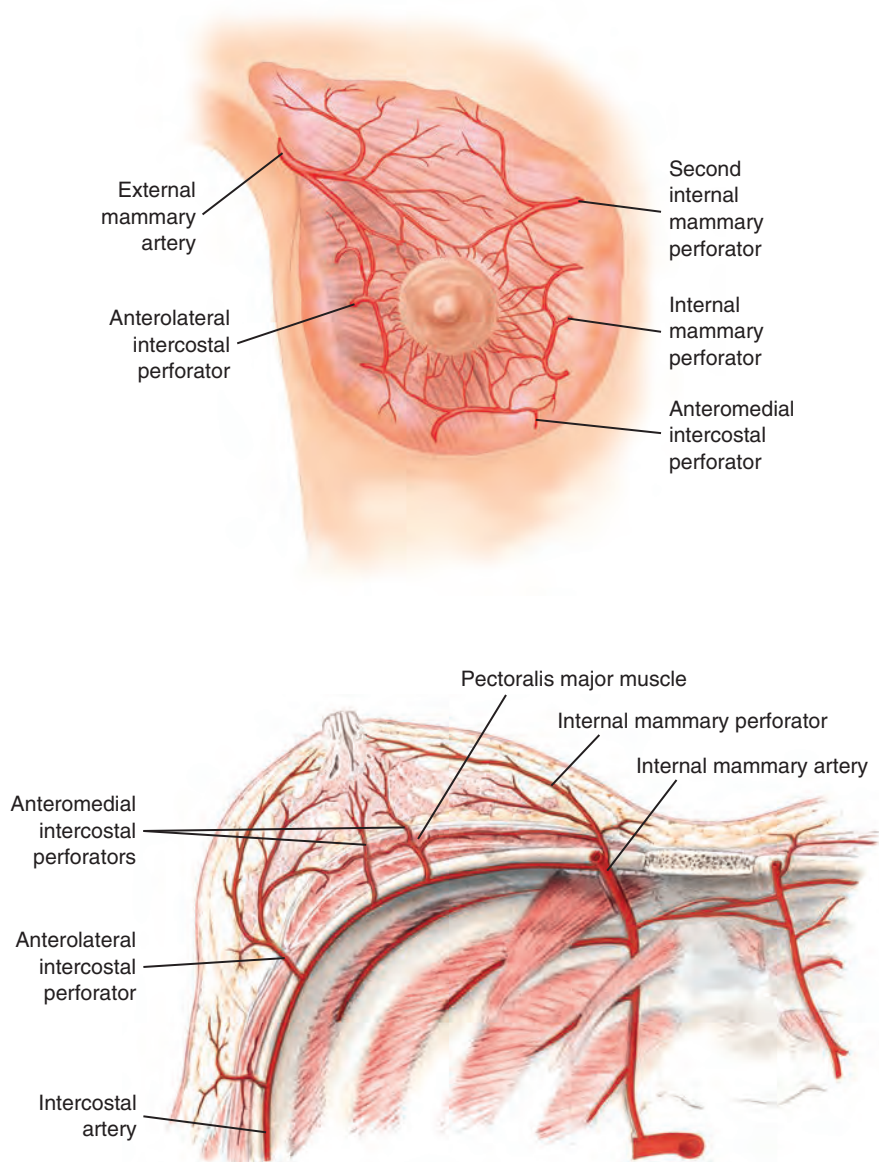
The ultimate short-scar technique, liposuction-only breast reduction, has a role in breast reduction. Both ultrasound-assisted liposuction (UAL) and suction-assisted liposuction (SAL) have been successfully applied to reduce the volume of the breast. Liposuction has also been advocated for correction of ptosis through skin contracture. Although there is no question that liposuction will significantly alter the volume of the breast, it has minimal effects in terms of reshaping and enhancing projection or the appearance of the breast. However, it is relatively simple, fast, and safe with little, if any, risk of nipple-areolar sensory changes or loss. It is best for individuals who may not be able to tolerate a 3-hour breast reduction procedure and are not concerned about improving breast shape. A small number of younger women with large, nonptotic breasts and normal skin elasticity are also good candidates for this technique.

Liposuction perhaps enjoys a wider role as an adjunct to breast reduction, especially in recontouring the lateral part of the breast and the anterior axillary fold area.

SAL has proved safe and efficacious for breast reduction, and fears of tumor dissemination have proved to be unfounded when preoperative mammography has been performed. However, concern regarding the safety of UAL within the female breast is as yet unresolved.

Pedicles

A variety of pedicles have been described for breast reduction. Although all are essentially safe and based on sound anatomic knowledge, some are more popular than others. Each pedicle has its own advantages, disadvantages, and special indications. Each surgeon has his or her preferred pedicle based on training and experience. Pedicle selection is based on the technique and size of the breast. The most devastating local complication of breast reduction is nipple-areolar loss. Familiarity with a pedicle and its limitations will minimize such risks. Compromised circulation, as in a heavy smoker, increases the risk of nipple-areolar loss, regardless of the pedicle chosen.



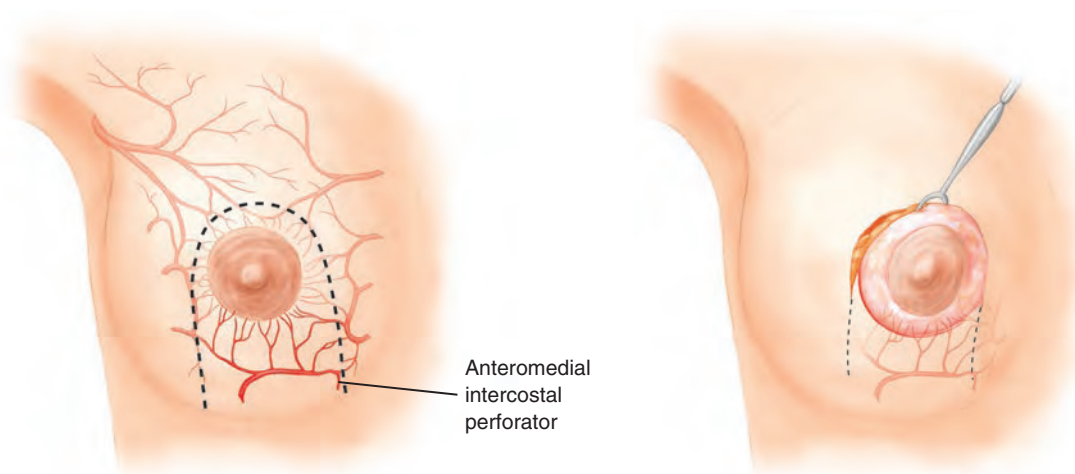
The nipple-areola complex has an extensive blood supply radiating centrally from the periphery. The blood supply is based on the perforators of the internal mammary artery through the pectoralis major muscle, the perforators based on the intercostal vessels, laterally and medially, and the external mammary artery. A variety of pedicles are based on these vessels.

Sensory innervation of the nipple-areola complex after breast reduction depends not only on the pedicle selected but more so on the degree of nipple displacement and the volume of resection. With very large breasts, the incidence of postreduction changes in nipple-areolar sensitivity is high regardless of the pedicle chosen. Breast-feeding after breast reduction is more dependent on pedicle selection.

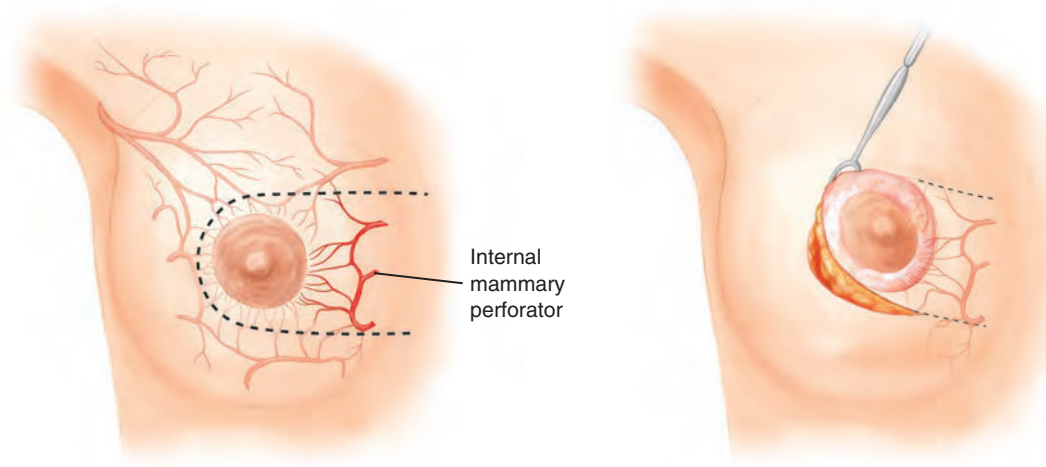
Pedicle Options

Pedicle options include the following:

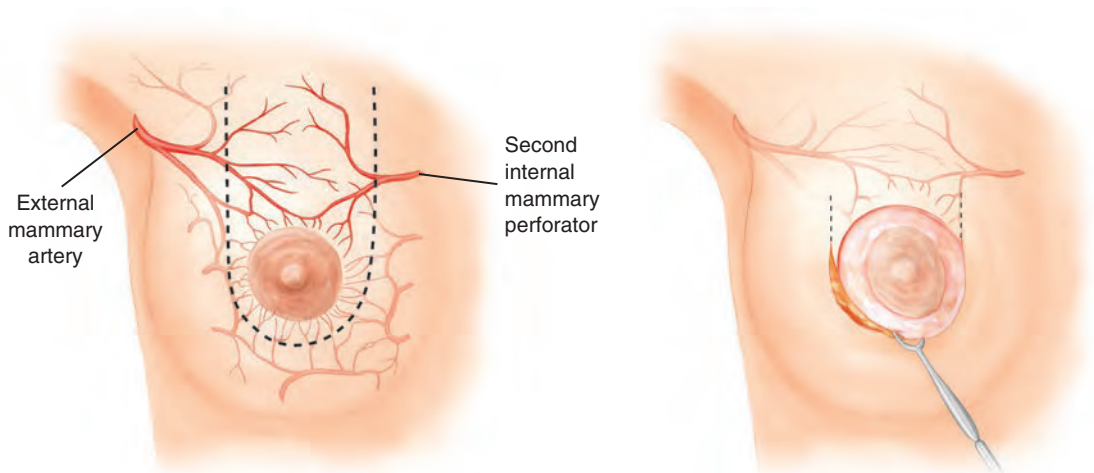
- Inferior
- Central
- Medial
- Superior
- Lateral, including septum-based
- Combinations
- Free nipple graft



The central and inferior pedicles have been the most popular, especially in North America. These pedicles are safe and can be applied equally to minimally, moderately, and massively enlarged breasts. The vascular basis of these pedicles is the musculocutaneous perforating branches of the internal mammary artery through the pectoralis major muscle and intercostal perforating branches through the muscle. These pedicles are reliable; however, the need to preserve and maintain central and lower breast tissue may lead to postoperative bottoming out. Breast-feeding after reduction with the central and inferior pedicles is usually possible, and preservation of nipple-areolar sensitivity with small to moderate reductions is possible.

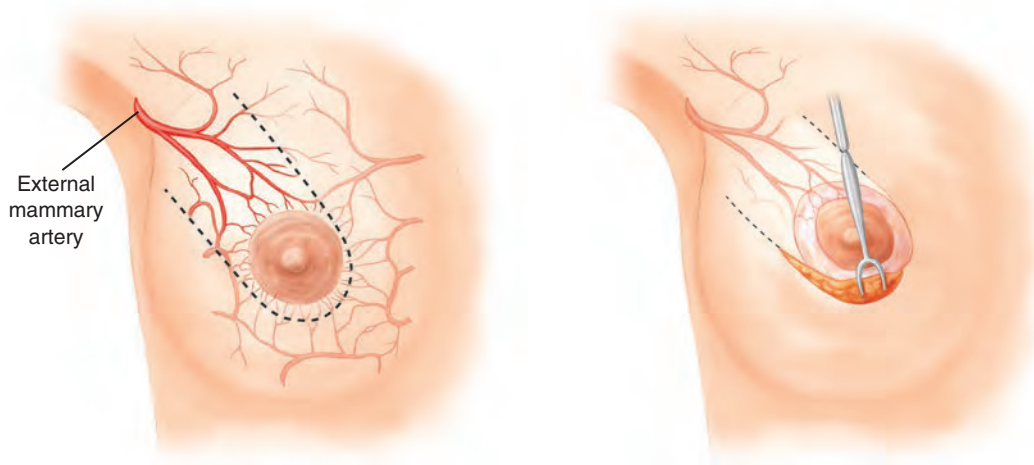


The medial pedicle has gained favor as a safe alternative to the superior pedicle for short-scar vertical reductions. The pedicle is based on medial perforating branches of the internal mammary artery through the pectoralis major muscle and intercostal perforating branches. It is a reliable pedicle for minimally, moderately, and even massively enlarged breasts, allowing easier elevation and inset of the nipple-areola than the superior pedicle. The medial pedicle allows resection of central and lower breast tissue, which contributes to the minimization of bottoming out. Breast-feeding is possible after reduction with the medial pedicle, and preservation of nipple-areolar sensitivity is also possible.



The superior pedicle, popularized with the Lassus and Lejour vertical techniques, is based on superior perforating branches of the internal mammary artery (most notably the second perforating branch) through the pectoralis major muscle, perforating branches of the intercostal arteries, and branches of the external mammary artery. It is a safe and reliable pedicle best suited for minimally and moderately enlarged breasts where nipple-areolar elevation and inset are relatively straightforward. For a

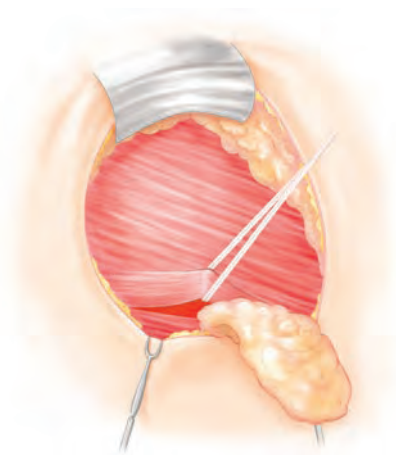
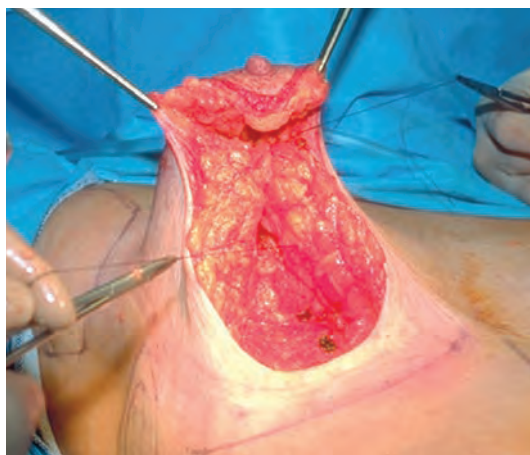
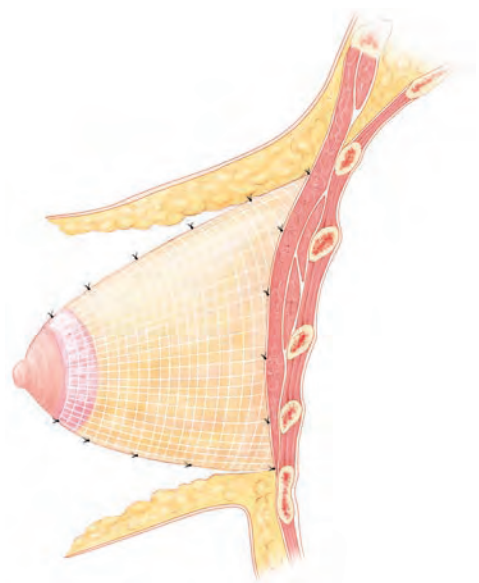
massively enlarged breast, the nipple and areola are carried on a long dermal extension. Nipple-areolar elevation and inset are not always easy and may require careful liposuction of the pedicle base to inset the nipple-areolar complex. The superior pedicle allows resection of the central and lower breast tissue, eliminating lower breast volume, which contributes to bottoming out. It is less likely that the patient will be able to breast-feed after the superior pedicle technique, especially with a dermal extension, than other techniques. Nipple-areolar sensory preservation is possible.



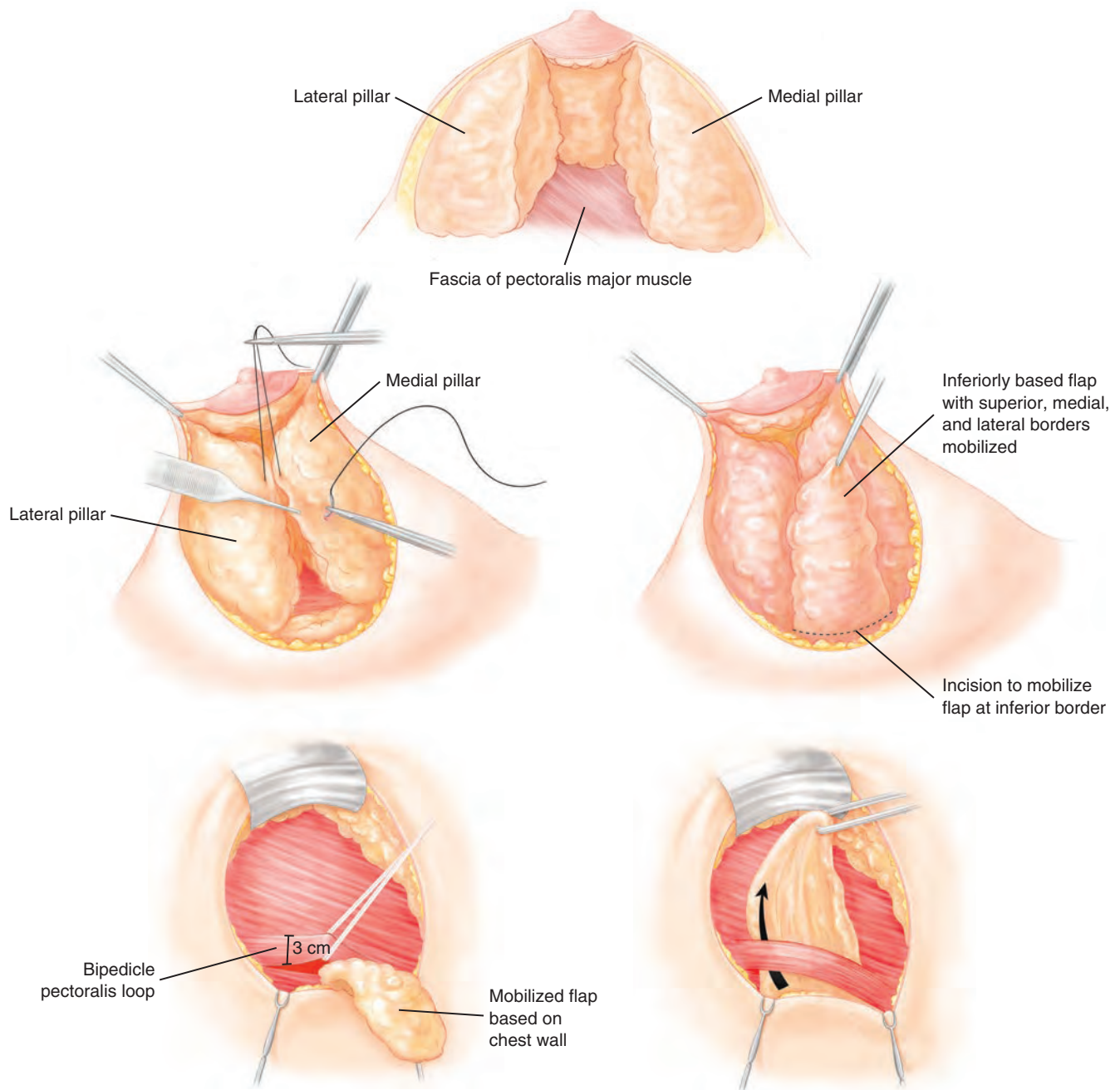
The lateral pedicle based on the external mammary artery enjoys the same advantages as the medial pedicle, but not equal popularity. Occasionally, in an extremely ptotic breast, I will combine a superior central and even inferior pedicle to ensure nipple-areolar safety. For truly gigantic breasts, extremely ptotic breasts, and in women who are heavy smokers, the free nipple graft is a safe alternative. Although hypopigmentation is a common problem, it would be preferable to total nipple-areolar loss. Breast-feeding is possible after the lateral pedicle technique, and nipple-areolar sensation is preserved. Obviously, with the free nipple graft there is little, if any, chance of the ability to breast-feed or preservation of nipple-areolar sensation. The septum-based pedicle is basically a modification of this lateral pedicle.

Breast-Shaping Techniques

The original Wise pattern technique, which was the mainstay of breast reduction for many years, especially in North America, relied on the skin brassiere to maintain shape. This inevitably led to the all too familiar wide, nonprojecting, bottomed out appearance. We no longer rely on a skin brassiere to shape or maintain the shape of the breast. Our priority now is to reduce the breast parenchyma, shape the new breast tissue, and then manage the excess skin. I refer to this as *shape and drape*—that is, shape the breast, drape the skin, and then manage the skin excess. Not only have these recent advances improved breast shape, they have also yielded longer-lasting results.



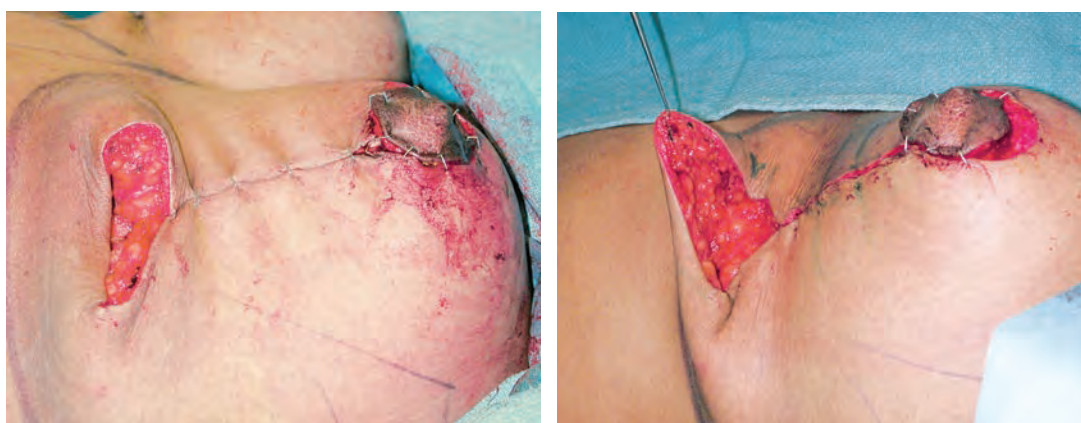
Breast-shaping techniques range from the internal mesh application advocated by Sampaio Góes to a variety of parenchymal incision and suturing techniques, and to the pectoral sling technique of Daniel, as popularized by Graf and Biggs.



My personal preference is the vertical scar superior pedicle technique described by Lassus. Resection of the central and lower breast tissue removes the breast mass, and the breast shaping is performed through suturing of the medial and lateral pillars. This, in fact, is the basis of the breast shaping with the medial and lateral pedicle short-scar techniques. The Daniel technique involves isolation of an inferiorly based dermal-glandular flap of breast tissue, which is mobilized, passed through a pectoralis muscle loop, and sutured onto the chest wall. The loop provides stability for this flap, which improves breast projection. The breast is further shaped through suturing of medial and lateral pillars. The illustrations show the Daniel method, as popularized by Graf and Biggs.

Skin

The most important factor in limiting incision length and scars in breast reduction is not size or even nipple position; I believe it is skin quality and quantity. Short scars and optimal breast shape are compatible and limited only by skin quality, skin quantity, pedicle safety, and surgical experience. The inverted-T is still the standard in the United States, and without question allows maximal skin removal and maximum exposure to the breast parenchyma for shaping procedures. I believe its role should be limited to skin excision only, and not used for breast shaping. The length and placement of the scar in reduction and mastopexy should reflect the surgeon's choice for management of the excess skin. A number of the short-scar techniques, especially those leaving only a periareolar scar, rely heavily on skin contraction as a way of dealing with skin excess.



The ideal approach to breast reduction is to resect the excess volume, then shape the breast, drape the skin, and finally deal with the redundant or excess skin. This concept of shape and drape is best demonstrated in this woman, who underwent a 700 g reduction through a vertical incision with a superior pedicle. The redundant or excess breast skin is clearly shown. Options for dealing with this include excision and closure with a purse-string suture, a short horizontal T, or a J or L excision. Even in such a large reduction, there is no need for a long horizontal component.



As stated previously, size is not the issue; skin redundancy and skin elasticity, mandating skin resection, are the ultimate arbiters of scar length. Although these three women have breasts of differing sizes, they all have normal skin elasticity, a full breast envelope, and skin that is firmly adherent to the underlying breast. It is not possible to pinch the skin away from the breast parenchyma of any of the three women shown above. Therefore they are all good candidates for breast reduction through limited scars. They do not have skin laxity or an excessive amount of skin that cannot be managed through limited scars.



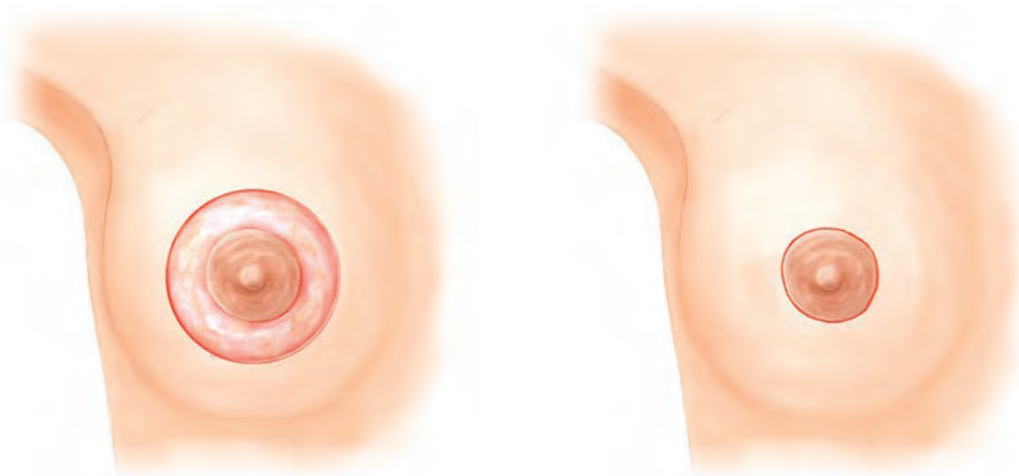
In contrast, these three women, who also have different-sized breasts, are not the best candidates for short-scar techniques because they demonstrate poor skin elasticity, partially filled breast envelopes, and skin that is loosely adherent or nonadherent to the underlying breast tissue. The breast skin of any of these women can easily be pulled away from the parenchyma by gentle pinching. In these women longer scars will be needed, because they have poor-quality skin that will not redrape or contract and must be resected.

The incision options for dealing with excess skin include the following:

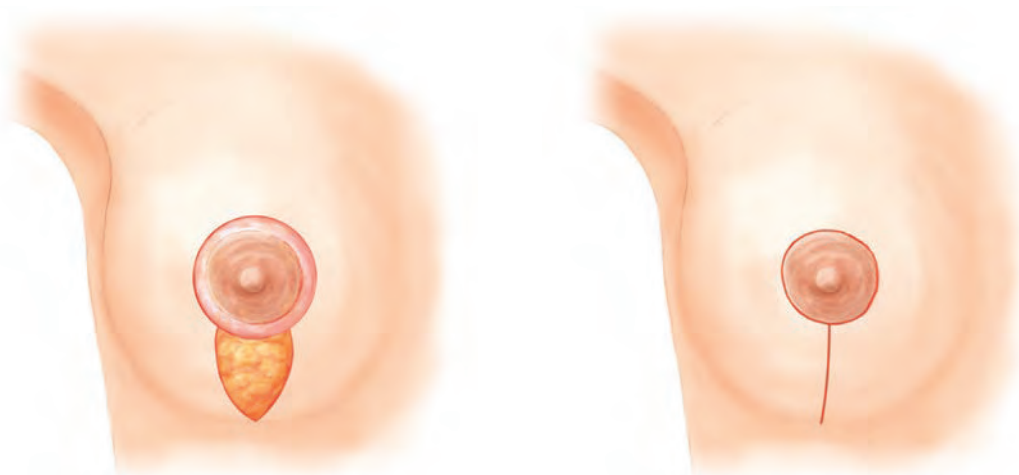
- Periareolar
- Vertical
- Small T
- J or L
- Full-length inverted-T

As we progress down this list, we are able to remove increasingly larger amounts of skin. The higher we remain on the list, the more we rely on skin redraping and contraction, two options not available with stretched, inelastic skin.

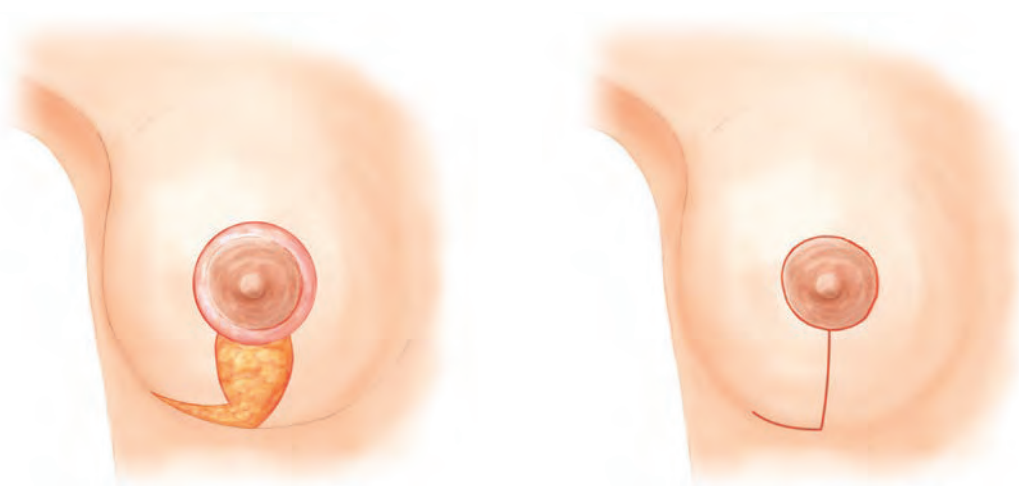
My concept of breast skin excision is three-dimensional: *unidimensional* refers to periareolar skin removal; *bidimensional* includes a periareolar and a vertical component; and *tridimensional* includes a periareolar, vertical, and horizontal component. The horizontal component may include a short T, a J or L, or the long horizontal T.



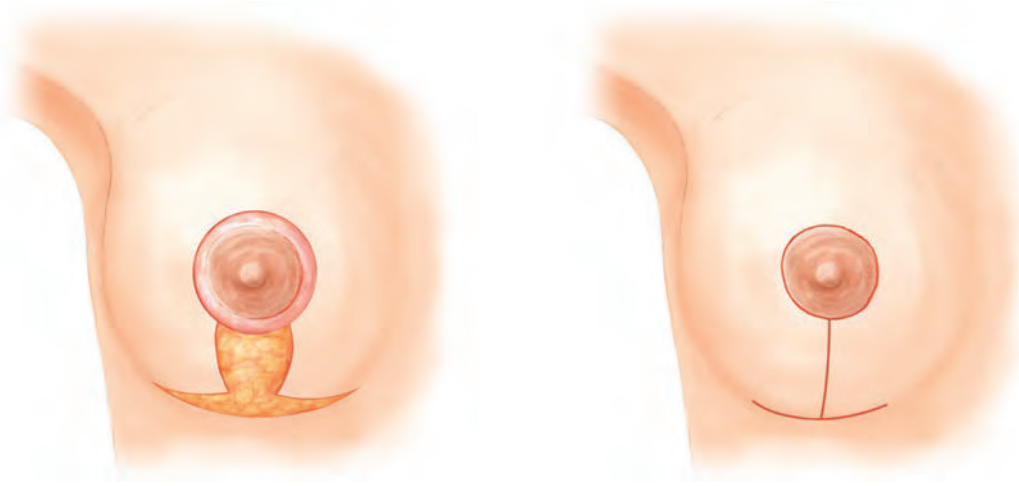
Periareolar scar—unidimensional skin removal to the level of the areola



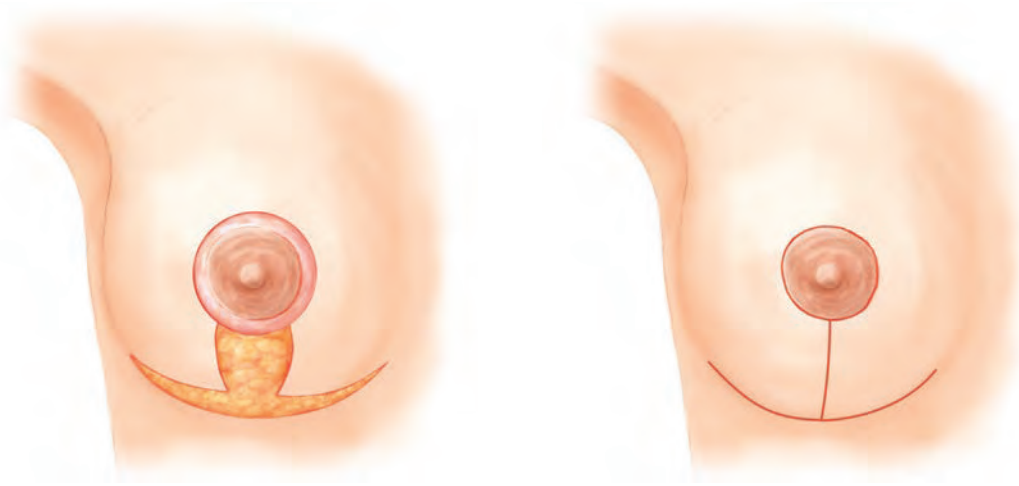
Periareolar and vertical incision; bidimensional skin removal adds vertical skin take-out to the periareolar component, leaving the typical vertical scar



J or L horizontal component added to the vertical and periareolar incision; tridimensional skin removal provides the option of skin excision along the lateral side of the inframammary fold



The short horizontal-T tridimensional skin incision adds a third component of skin excision for a short distance on each side of the meridian of the breast



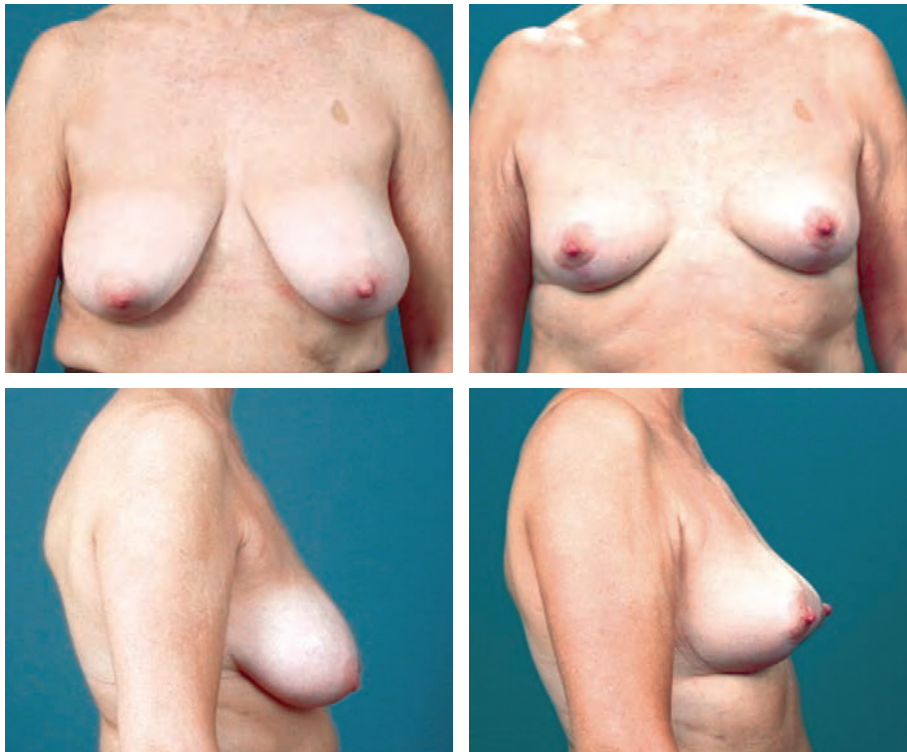
The longer horizontal incision allows maximal skin resection

Conclusion

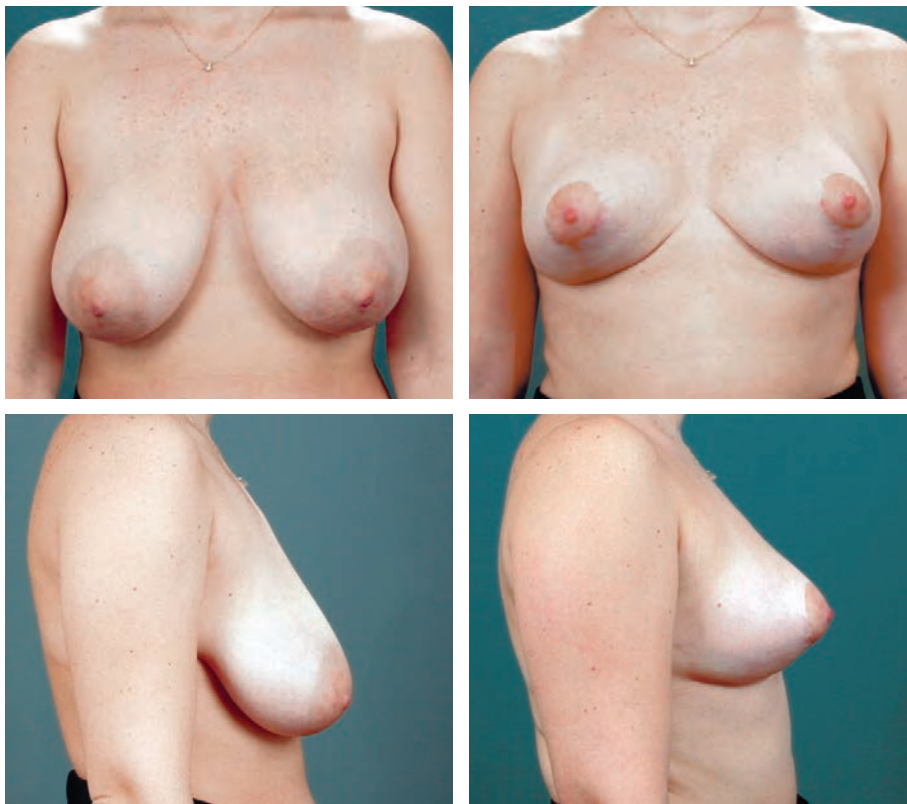
There has been considerable progress in breast reduction over the past two decades. Through the efforts of our colleagues in Europe and South America, short-scar techniques are slowly being accepted and adopted in North America. The concept of reducing and reshaping the breast through minimal scars is sound and here to stay. A variety of reliable pedicles are available to ensure nipple-areolar survival, and a variety of suturing and shaping techniques are available to produce the desired breast shape and projection. Although it is not essential, desirable, or even possible for a surgeon to be intimately familiar with all of these options, it is important that the surgeon be familiar with two or three approaches. In the final analysis, we will each pick the pedicle-shaping technique and incisions with which we are familiar and that in our hands produce consistently good results, with minimal morbidity and minimal scarring acceptable to our patients while meeting their expectations.

The role of the quality and amount of excess skin in defining the length and placement of scars in reduction and mastopexy has been discussed. Not only skin quality and skin excess, but the relationship of the skin envelope to the breast, together with the quality and type of breast tissue (fat versus fibrous tissue), should be taken into account when choosing the procedure. These same parameters also determine the quality and longevity of the result.

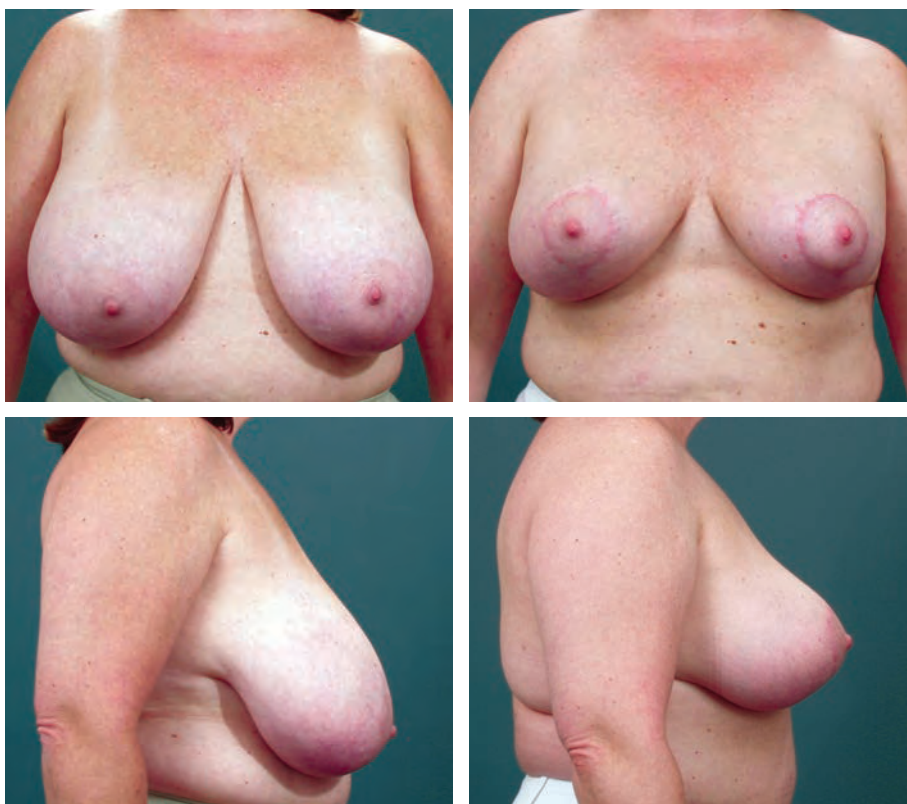
The following three women had breast reductions of varying amounts: 300, 500, and 1000 g per breast. A superior pedicle technique was used with a vertical scar. All demonstrate size reduction, shape enhancement, and minimal scars.



Breast reduction: 300 g per breast



Breast reduction: 500 g per breast



Breast reduction: 1000 g per breast

Choosing the Best Option: Breast Reduction Approaches

Breast Characteristics	Skin Excision Pattern and Final Scar				
	Periareolar	Vertical	Short Horizontal T	J or L	Longer Horizontal T
Size of Reduction					
<500 g					
500-1000 g					
>1000 g					
Skin Elasticity					
Normal					
Inelastic					
Skin Excess					
Minimal					
Moderate					
Massive					
Parenchyma					
Firm and fibrous					
Soft and fatty					
Skin-Parenchyma Relationship					
Firmly adherent					
Loosely adherent					

Mastopexy

Mastopexy is not only one of the most difficult breast procedures, but perhaps one of the more challenging of all aesthetic procedures. Patients have high expectations, yet the quality of their tissues, gravity, and aging all conspire against the patient and surgeon alike. A variety of procedures are available, with or without implants, to lift, reshape, and resize the droopy breast. It is essential to thoroughly evaluate the patient and her breasts before selecting the appropriate technique.

In my practice the quality of the tissues not only guides me in selecting the appropriate procedure for each patient, but also enables me to predict the quality of the result so that I can better explain and demonstrate to the patient the anticipated result and how long it will last.

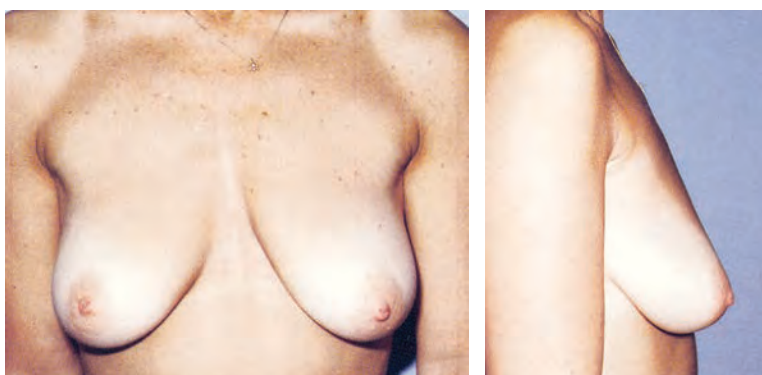
Most patients seeking mastopexy want fuller, perkier, lifted breasts. Before examining the breasts, I try to establish whether the patient is happy with her present breast volume and simply looking for a breast lift or whether she is seeking both volume

enhancement and a lift. If possible, it is best to undertake a mastopexy after the woman has completed her family rather than between children.

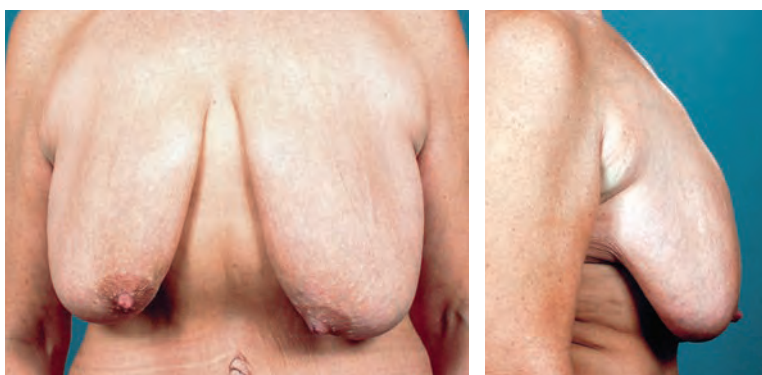
Evaluation of the breasts includes grading of the ptosis. Currently the two classifications available are those of Laldardie and Regnault, glandular or cutaneous. The Laldardie classification includes grades I through IV, based on nipple-areolar position. Regnault's classification, described in 1976, is more complicated but takes more into account. Regnault's classification defines the different degrees of breast ptosis and facilitates evaluating the problem and planning the operation.



Minor ptosis: Nipple at level of inframammary fold



Moderate ptosis: Nipple below inframammary fold but above lower breast contour



Major ptosis: Nipple at lower breast contour; breast below inframammary fold



Glandular ptosis: Nipple above inframammary fold/breast descended below fold



Pseudoptosis: Nipple higher above inframammary fold; gland hypoplastic with some breast descended below fold

Although such classifications are useful, not all women can be classified into each of these categories. In addition, these classifications do not take into account the quality and quantity of excess skin or the relationship of the skin to the underlying gland. My preference is to evaluate the skin envelope and contents, the relationship of the skin to the gland, and finally the nipple position.

Evaluation of the Ptotic Breast

To fully evaluate a patient's ptotic breasts, the surgeon must consider the following:

- Skin
- Gland
- Skin-gland relationship
- Nipple position

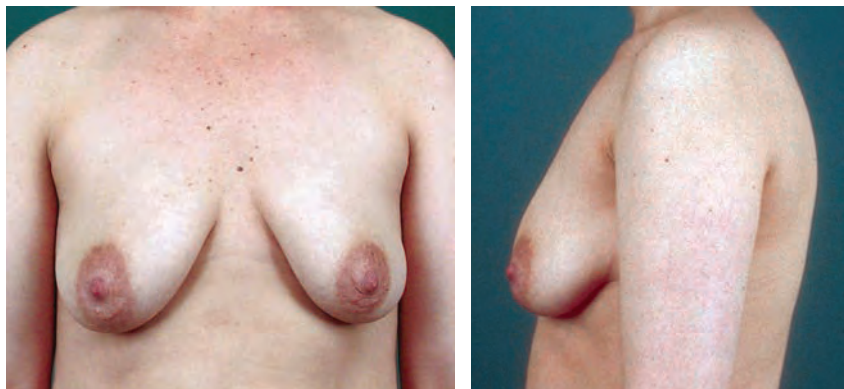
In the skin I look for loss of elasticity, as evidenced by striae, dermal thickness, and skin recoil. I also make a mental note of the excess skin to be resected. The breast tissue is evaluated for shape, volume, and consistency: Is the breast mostly fibrous, fatty, or a combination of the two? In terms of the skin-gland relationship, I assess whether the envelope is full or empty. Is the skin adherent to the underlying tissues,

or hanging loosely around it? Skin quality and the skin-gland relationship are the key factors in determining the appropriate procedure and the quality and longevity of the result. Finally, I assess the displacement of the nipples and the degree of nipple elevation that will be required.

Patient Profiles



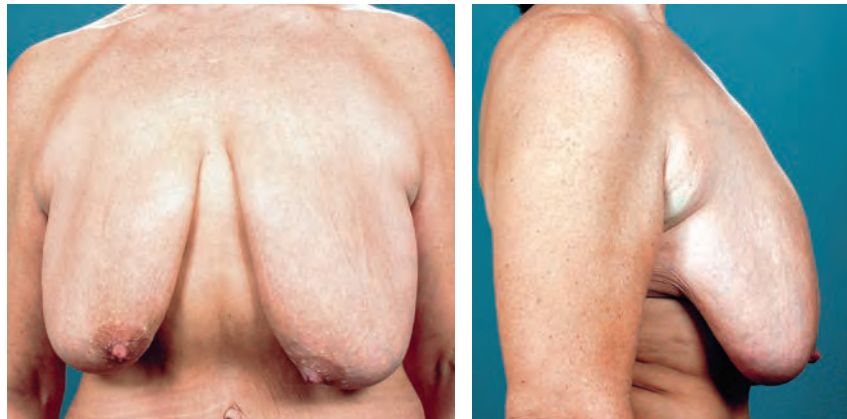
This young woman has full, large breasts. The skin has normal elasticity and recoil, the gland is firm and fibrous, the envelope is full, tight, and firmly adherent to the parenchyma. The skin cannot be pinched away from the breast tissue. Her nipples are displaced moderately. A good result is anticipated in this woman regardless of technique, because all of her tissue characteristics are favorable and she has more than adequate breast volume.



This young woman has partially atrophic breasts; her skin has maintained some elasticity and recoil. Her gland is soft and fibrofatty. Her skin envelope is half-full, loose, and lightly adherent to the parenchyma, and the skin can be pinched away from the breast tissue. Her nipples are moderately displaced. A good result is anticipated, but the degree of projection will depend on the technique. I would certainly consider an implant for this patient.



This middle-aged woman has deflated breasts. The skin has lost most of its elasticity and recoil, the gland is loose and fibrous, and the skin is barely adherent to the parenchyma. The skin can be pinched away for 2 or 3 cm from the breast tissue. Her nipples are moderately displaced. A reasonably good result can be anticipated, but given the quality of her skin, it will not be a long-lasting result, and the patient should be warned about the possible need for early secondary procedures. An implant should also be considered.



This middle-aged woman has deflated, atrophic, and asymmetrical breasts. Skin elasticity and recoil are minimal. The gland is soft and fibrous, and the skin envelope is empty and barely adherent to the underlying parenchyma. The skin can easily be pinched away several centimeters from the breast tissue. An average result may be anticipated; however, the patient should be warned that it will not be a long-lasting result and that a revision may be required sooner rather than later.

Goals of Mastopexy

The goals of mastopexy include the following:

- Restoration of shape
- Restoration of volume
- Restoration of nipple-areolar position

Restoration of Shape

The ideal result after mastopexy is a projecting breast with the nipple and areola at the point of maximal breast projection. There should be breast volume above and below the nipple-areola complex, more below than above. The breast should also be appropriately positioned on the chest wall.

Restoration of Volume

Many women seeking mastopexy have postpartum involution and a deflated appearance. Although they are candidates for volume replacement with an implant, they are surprised when the recommendation is made, because they feel that they have adequate breast volume. During the initial evaluation, I tighten the breast skin with my fingers to bring the nipple-areola complex to the appropriate position; this demonstrates to the patient the anticipated breast volume, without an implant postoperatively. While holding her skin, I ask her to look down at her breast and into a mirror to preview this breast volume. Most patients who thought that they had adequate breast volume in the ptotic stage are surprised that the breasts will look smaller once the ptosis has been corrected. I also explain to patients who require an implant that their results will be better in terms of projection and in all likelihood will last longer with an implant. There is a small group of women whose minor degree of ptosis may be corrected with an implant without any skin envelope adjustment.

Restoration of Nipple-Areolar Position

Restoration of nipple-areolar position is an integral part of the mastopexy, and care should be taken to preserve the blood supply to and venous drainage from the nipple-areola complex, especially if the mastopexy is combined with an implant.

Skin Removal and Mastopexy

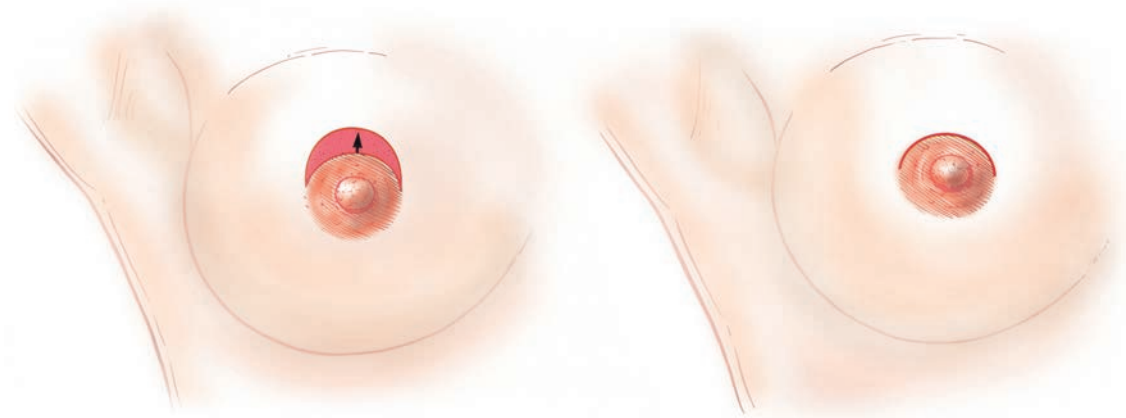
As with a breast reduction, skin excision is planned according to the tridimensional approach: periareolar, vertical, and horizontal planes. The skin incision is designed to allow sufficient access to the breast tissue for reshaping, placement of an implant, and removal of excess skin. It should be noted that inelastic, stretched skin with striae, and a skin envelope that is poorly adherent to the underlying breast parenchyma will not redistribute or contract and must be excised.

Establishing Surgical Priorities

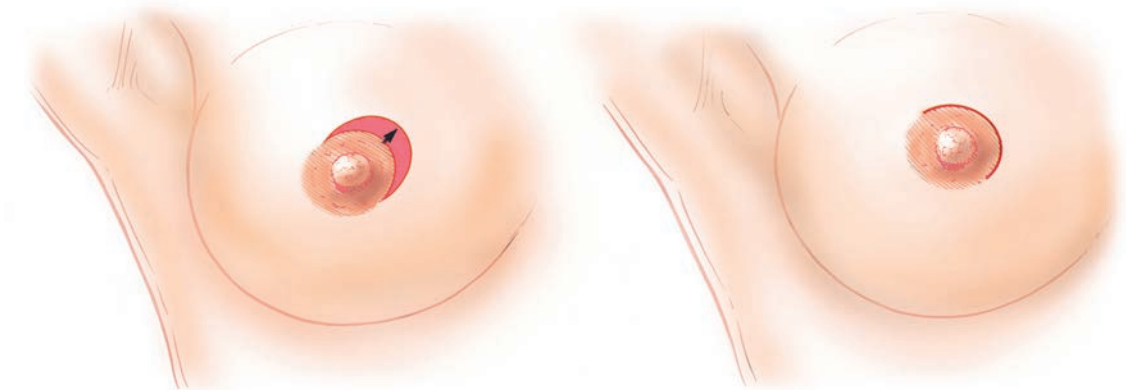
During the patient evaluation, I identify the predominating needs of the breast. If volume deficiency is predominant, volume replacement is performed first and then skin excision. If the predominant factor is skin excess rather than volume, the breast is shaped and the excess skin resected. If volume deficiency and skin excess are equal determining factors, volume adjustment is performed first, followed by skin removal.

Skin Removal and Incision Placement

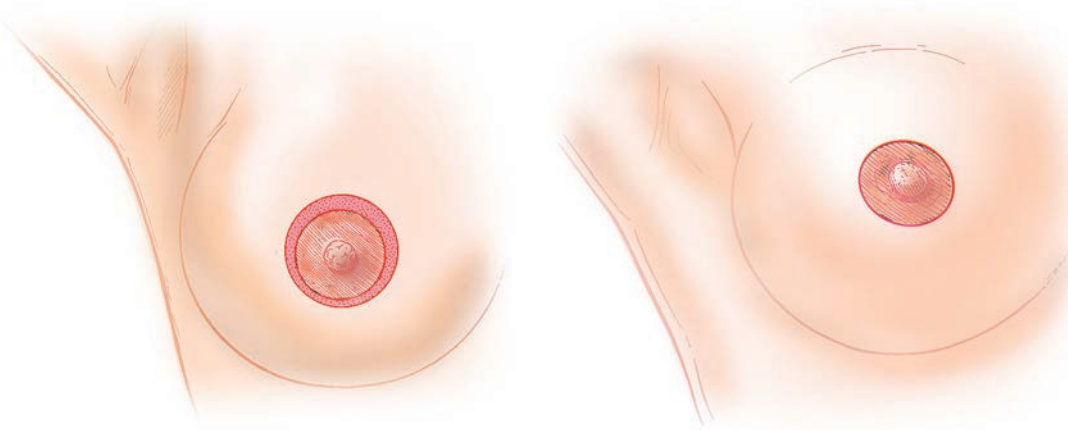
Similar to excisions for reduction mammoplasty, skin removal for mastopexy is planned to permit circumareolar, vertical, and, when necessary, horizontal excisions and remodeling of the breast to a more natural, uplifted, conical shape. This skin removal should also allow repositioning of the nipple and areola and, if ptosis recurs, additional corrections through the initial incisions. The incisions and skin excisions are planned on a continuum from periareolar to circumareolar to vertical scars and then to horizontal scars. With this approach, additional breast tissue can be excised later.



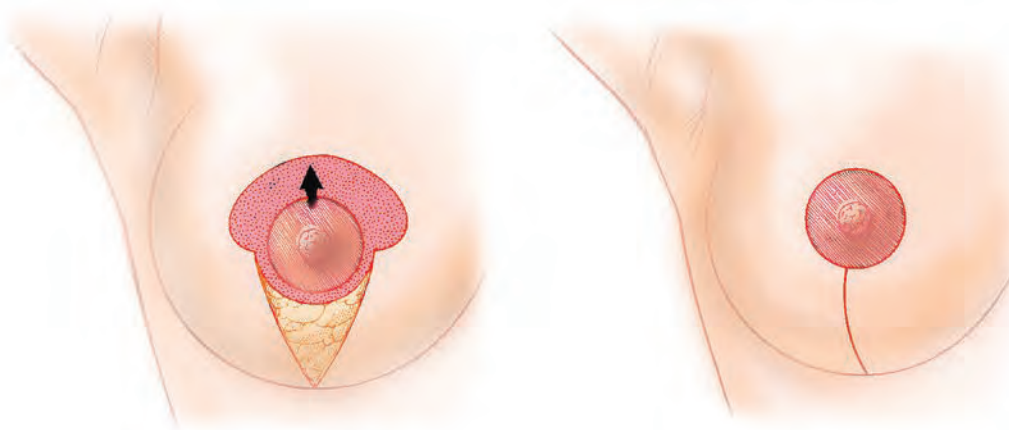
When the nipple-areola complex is low, requiring only a small degree of elevation of 1 to 2 cm, an upper periareolar crescentic ellipse can be excised to elevate it. An augmentation mammoplasty may be done through this incision, if needed, to enhance breast volume to produce an elevated nipple-areolar appearance.



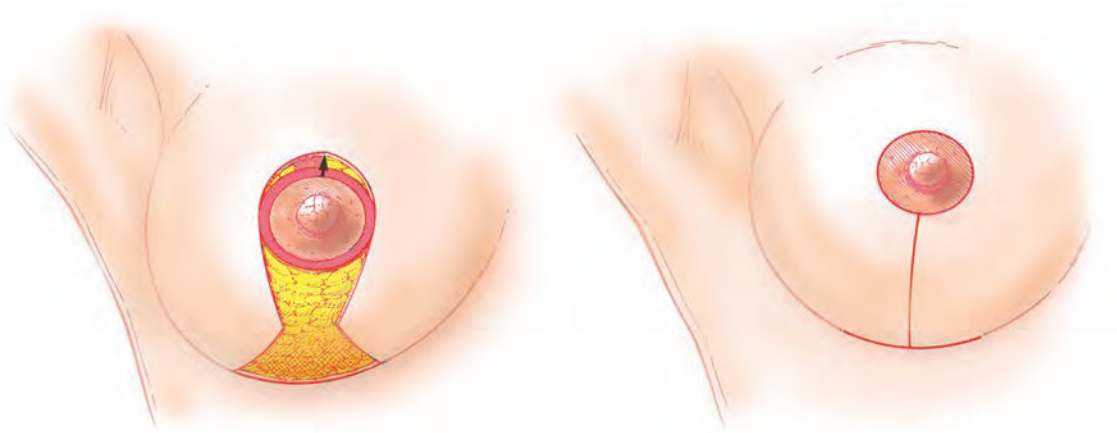
This upper periareolar ellipse can be rotated when specific lateral or medial positioning of the nipple-areola complex is necessary to move it to a more aesthetic position on the breast.



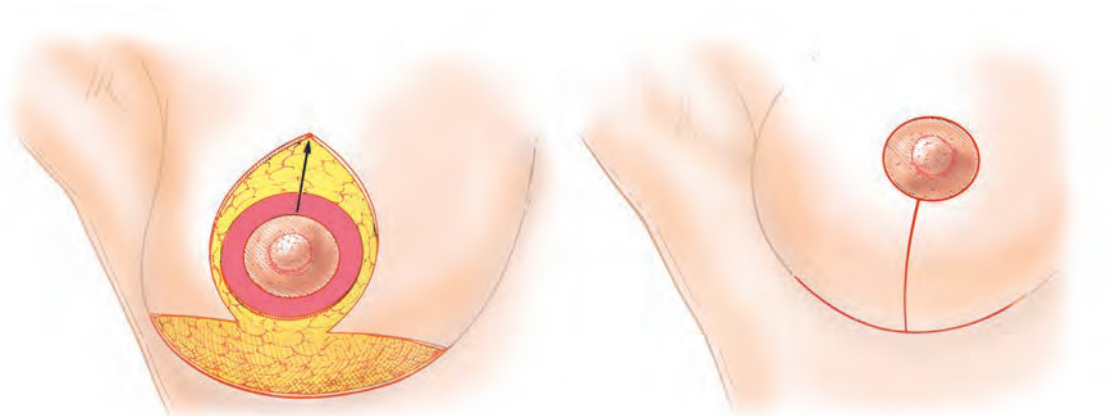
A circumareolar skin excision with periareolar purse-string closure tightens the skin minimally without elevating the areola. It is effective for patients with tubular breasts with protuberant areolae and for patients with very large areolae and pseudoptosis who are to have augmentation mammoplasty. Removal of breast skin leaves only a central circular scar. The scar, however, tends to widen, and the nipple position is minimally elevated. It can also result in unnatural central breast flatness and loss of attractive central projection; however, an implant can minimize this flatness. Alternatively, breast shaping and internal mesh support, as advocated by Sampaio Góes, can enhance shape and projection. A permanent circular suture in the skin periphery, the round block technique, reduces final skin tension and produces a finer scar; this approach extends the application of this technique to some patients with moderate ptosis.



In patients with glandular and minor ptosis, the circumareolar excision with a short vertical ellipse tightens the skin and elevates the nipple-areola complex. Care must be taken to avoid excessive tightness below the areola. This incision can be shortened, because the vertical component contributes primarily to close the defect from the transposed nipple-areola complex. The vertical scar tends to shorten in the post-operative period with scar contraction.



For moderate ptosis the circumareolar excision with a vertical and occasionally a short horizontal ellipse, J or L excision, produces a short inframammary scar and tightens the breast while shortening the inframammary distance. This approach is best only when there is excess skin after vertical mammoplasty that will not redrape, contract, and must be excised. Rather than the short horizontal, J or L excision, I prefer to take up the skin excess through a purse-string suture.



For patients with major ptosis and excessive amounts of inelastic skin, who need maximal breast elevation, a vertical and horizontal excision provides effective breast elevation, even though this approach produces a longer inframammary scar. However, I make every effort to avoid the horizontal component if possible.

Mastopexy Augmentation

Combining mastopexy with augmentation is even more challenging than mastopexy alone. The goals of the two procedures are diametrically opposed. Mastopexy tightens and lifts the breast, whereas an implant stretches and expands the tissues and often displaces the breast downward. Opinions differ as to whether this operation should be staged. My preference has always been a one-stage procedure in which the

implant is placed first, and then the patient is marked for the mastopexy on the table during the operation. As with reduction and mastopexy the quality of the tissues, including the skin, will guide me in selection of technique and the anticipated result.

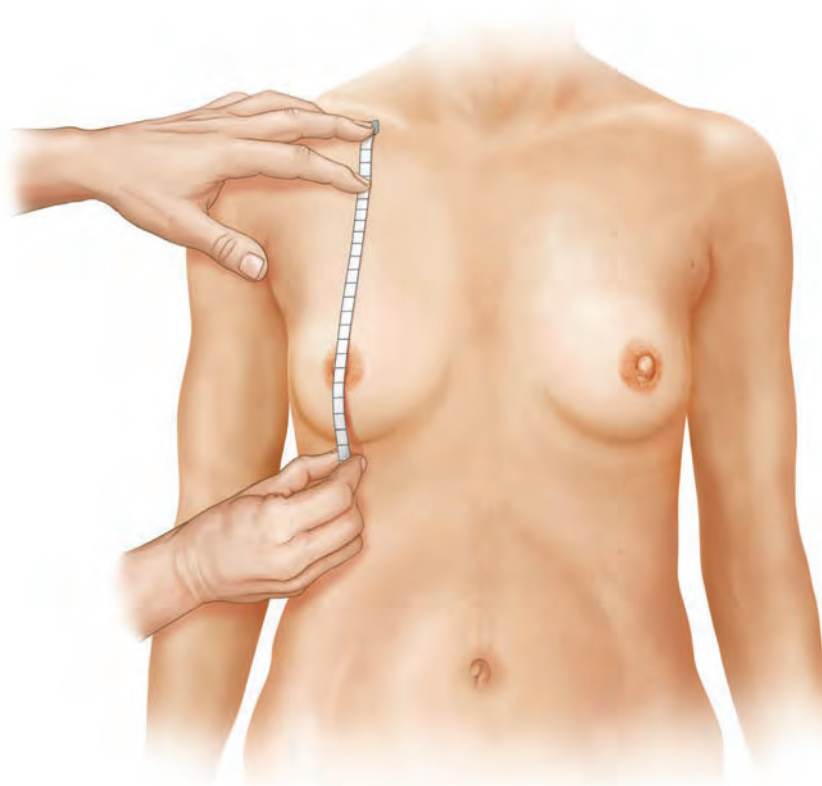
Conclusion

Mastopexy is a challenging procedure; the results are not permanent, and early re-operation may be required to produce the optimal result. A compromise must be struck between the patient’s expectations and the realities of her tissue characteristics. Careful evaluation of the breast volume, skin, and tissue characteristics is an essential prerequisite for operative planning. The patient should be counseled about the limitations and longevity of these procedures. Technique selection and skin excision patterns reflect the same principles as those discussed for breast reduction. If an augmentation is planned, the breast volume should be adjusted first and then the skin envelope.

Choosing the Best Option: Mastopexy Approaches

Breast Characteristics	Skin Excision Pattern and Final Scar					Traditional Full-Length Horizontal T
	Periareolar	Vertical	Short Horizontal T	J or L	Longer Horizontal T	
Nipple Displacement						
Minimal						
Moderate						
Maximum						
Skin Elasticity						
Normal						
Inelastic						
Skin Excess						
Minimal						
Moderate						
Massive						
Parenchyma						
Firm and fibrous						
Soft and fatty						
Skin-Parenchyma Relationship						
Firmly adherent						
Loosely adherent						

CHAPTER 61



Choosing the Right Breast Implant

DENNIS C. HAMMOND

The original design for a breast implant was inspired by the observation that the saline in a half-filled intravenous bag assumed a breastlike shape. From there the first silicone gel breast implant was created, used, and subsequently reported by Cronin and Gerow in 1963. Ever since this original description, attempts have been made to engineer a better implant to improve the performance of these devices. As a result, a wide variety of different types of implants are currently available for use in aesthetic and reconstructive surgery of the breast. Despite the seeming complexity associated with these many different types, there are only three design variables that describe nearly every one of these devices: mandril shape, shell characteristics, and filling material. Understanding how these three variables mix and match allows the surgeon to better understand how these implants interact with the patient's soft tissue to produce the desired breast size and shape.

Construction

Mandril Shape

To understand how the shape of an implant can affect the subsequent shape of the breast, it is helpful to understand how an implant is made.



Courtesy Mentor Corporation

A solid form, or *mandril*, is attached to a dipping rod to determine the three-dimensional shape of the outer shell of the implant. The surface of the mandril is coated with silicone, either by dipping the mandril into a vat of liquid silicone or spraying a fine mist of liquid silicone onto the mandril. Repeated applications or dips of silicone, followed by short drying intervals, ultimately result in a thin layer of silicone rubber coating the mandril.



Courtesy Mentor Corporation

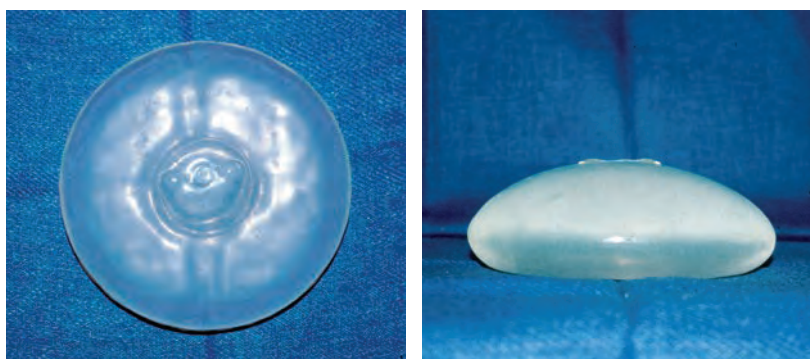
Once the shell has dried completely, the dipping rod is unscrewed from the mandril and a circular cut is made around the dipping rod attachment site. Using this as an entry point, the elastic shell is pulled off by stretching it around the edges of the mandril (*left* and *center*). Thus the basic shape of the shell is determined by the mandril that made the implant. The appearance of the silicone shell is shown immediately after removal from the mandril. The hole in the shell, created by cutting it free from around the dipping rod, has yet to be patched (*right*).

Next, the defect in the shell is patched with a separate sheet of silicone sheeting to finish the process and prepare the implant envelope for subsequent filling with silicone gel.



Courtesy Mentor Corporation

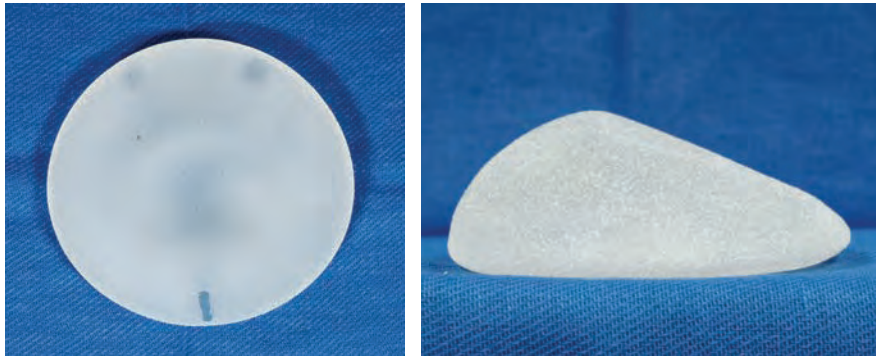
Round Implants



For the first 30 years of implant use, the predominant shape incorporated into the design of a breast implant was classified as round. This description is actually a minor misnomer: a “round” implant actually has a shaped aspect to its design. These

implants are symmetrical in the horizontal and vertical dimensions; however, the projection tends to be less than the width or height of the device. Thus a round implant is asymmetrically constructed and is therefore shaped. This minor nuance becomes important when considering the behavior of breast implants in situ with regard to how the ultimate three-dimensional shape of the breast is created.

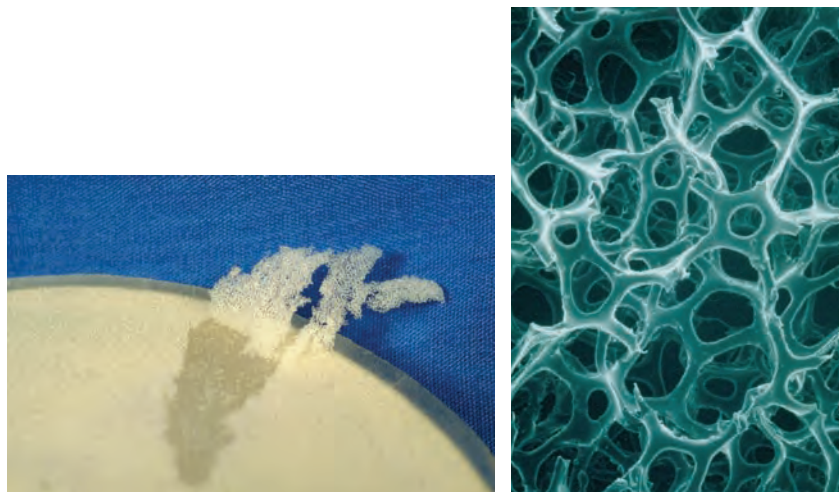
Anatomically Shaped Implants



What has been traditionally called an “anatomically shaped” implant is an implant shell that takes the shaped concept a step further, with the dimensions of the implant being asymmetrically designed in the horizontal, vertical, and sagittal (projection) dimensions. Here, the implant height is typically longer than the width, and the projection of the device gradually increases from the apex of the device down to the lower third of the implant. As a result, these devices demonstrate a teardrop shape designed to mimic the contour of a normal breast in the upright position.

Texture

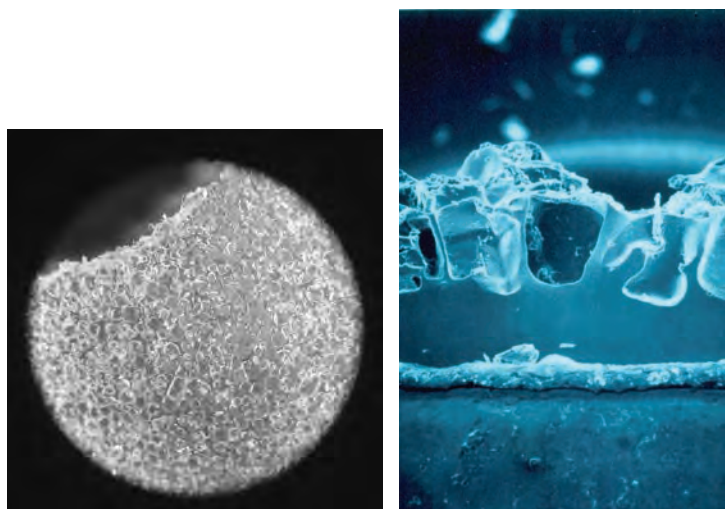
The original silicone gel implants were constructed with a smooth surface. However, in the early 1970s it was discovered that coating an implant with a layer of polyurethane foam resulted in a dramatic reduction in the rate of capsular contracture. This resulted in part from a low-grade inflammatory giant cell response to the polyurethane, creating an ultrathin, pliable, and highly convoluted capsule.



These images depict the polyurethane foam being pulled off a round gel implant, demonstrating the thickness of the foam as well as the porous nature of the material. The scanning electron micrograph image shows the polyurethane foam layer. Note the interconnecting lattice network with the variation in the size of the pores.

Unfortunately, over 10 to 15 years, the foam completely degraded away, resulting in cases of late capsular contracture around the now smooth-walled silicone gel implant. In an attempt to mimic the effect of the polyurethane foam, texturing of the surface of silicone gel implants was developed. To date, two basic textures are used in the vast majority of silicone and saline implants: Biocell and Siltex.

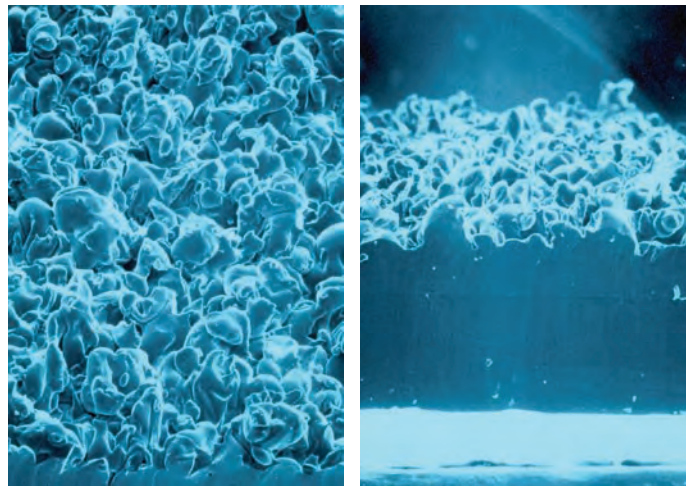
Biocell



The Biocell surface (Allergan) is created by coating a tacky implant shell with salt granules and letting the outer implant shell harden. By subsequently washing away the salt granules, an open pore lattice network is created that leaves an aggressive texture on the surface of the implant. The stereoscopic view (*left*) demonstrates the Biocell textured surface with its variably sized, squarish pores left after dissolution of the salt granules from the surface. The scanning electron micrograph view (*right*) demonstrates the relationship of the pores to the underlying elastomer shell.

This texture can actually interact with the capsule that develops in a favorable manner by causing the collagen fibrils of the capsule to become intertwined with the texture of the shell. Such ingrowth occurs much more commonly with tissue expanders than with implants, because the outward force of the inflated expander tends to drive the textured surface into the capsule. By interlocking the capsule with the textured surface, two events occur. First, the device becomes immobile, a feature that is particularly useful when using anatomically shaped devices that must maintain the proper orientation. Second, many surgeons think that the textured surface reduces the rate of capsular contracture, similar to that with polyurethane foam. This latter finding is somewhat controversial; several studies have failed to note a reduction in the rate of capsular contracture associated with the use of textured implants.

Siltex

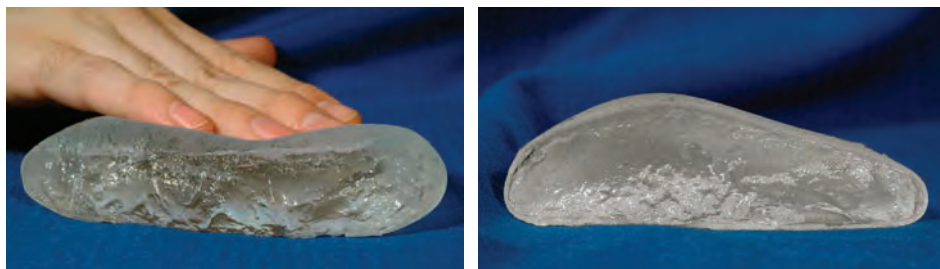


The Siltex surface (Mentor) is created by pressing a thin layer of polyurethane foam into a thin tacky sheet of silicone. The sheet is then allowed to cure, and then is cut and attached to an otherwise smooth implant shell. The scanning electron micrograph of the Siltex textured surface (*left*) demonstrates the imprint of the polyurethane foam sheet left on the shell. A similar view is shown (*right*) that highlights the relationship of the texture to the remainder of the thickness of the shell.

This is a less-aggressive texture that does not demonstrate tissue ingrowth. Despite this finding, rotation of an anatomically shaped Siltex textured implant is very uncommon, primarily because the rough texture exerts a “fingerprint” effect on the surface of the implant, producing enough friction between the device and the capsule to effectively hold the implant in position. As with the Biocell device, many studies have suggested a reduction in the rate of capsular contracture when this texture is used, although again, the point remains somewhat controversial.

Fill

Although several alternative filling materials, such as hydrocolloid gel and peanut oil, have been proposed over the years, the only two that have stood the test of time have been saline and silicone gel. Saline has the obvious advantage of being readily available, entirely physiologic, and inert, which affords a particular advantage when a saline implant ruptures, because the saline is simply absorbed and excreted without sequelae. The surgeon can fill the device during surgery; thus differential implant filling techniques can be employed to manage asymmetries in a very controlled fashion. The disadvantage of saline relates to the feel of the implant that results, because the low cohesivity of saline results in a fluidlike water-balloon effect on the implant that can be seen and/or felt in thin patients.



However, silicone gel has much more inherent cohesivity, producing a softer, more natural feel to the implant. The appearance of the less cohesive memory gel present in standard textured and smooth round silicone gel implants is shown above. The gel is less extensively cross-linked during curing, leading to a looser consistency to the gel (*left*). The gel can also be structurally cross-linked to a greater degree to create a firmer gel that is used to support the shell in anatomically shaped implants. The appearance of the gel from an anatomically shaped cohesive gel device is shown (*right*). Because of a greater degree of cross-linking of the silicone molecules, it has a firmer consistency, which translates to better support for the anatomically constructed shell. However, because these implants come prefilled, the volumes are limited to a defined schedule of choices. If the implant ruptures, the gel remains in the periimplant space, and an operative procedure must be performed to remove the implant material.

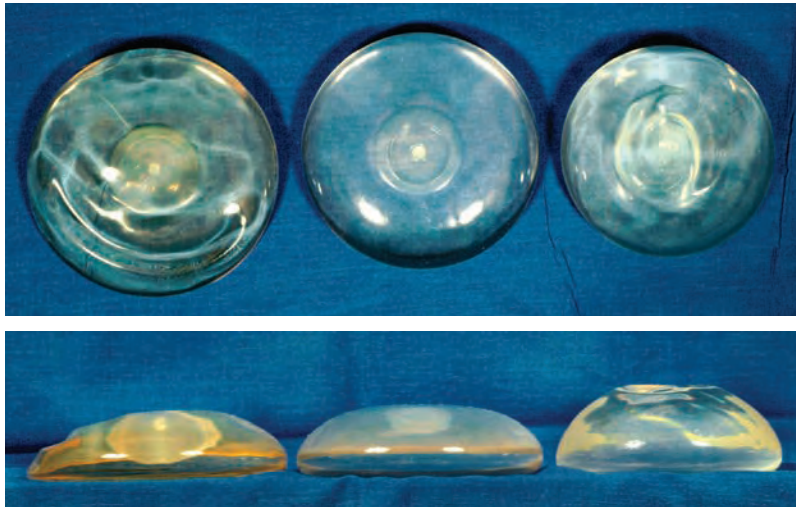
Design

Implant Shape

Taking the three design variables into consideration—mandril shape, shell characteristics, and filling material—it is possible to combine them into a host of possible implant designs. However, the predominant variable is the shape of the device. To this end, two basic groups of implants are commonly used today: round or anatomically shaped.

Round Implants

All round implants have a horizontal and vertical dimension that is symmetrical. However, several different types of round implants are available that differ in projection. Most manufacturers offer round implants with three different projections for a given volume. These are generally named using a system that designates them as having a low, mid, and high projection or profile.



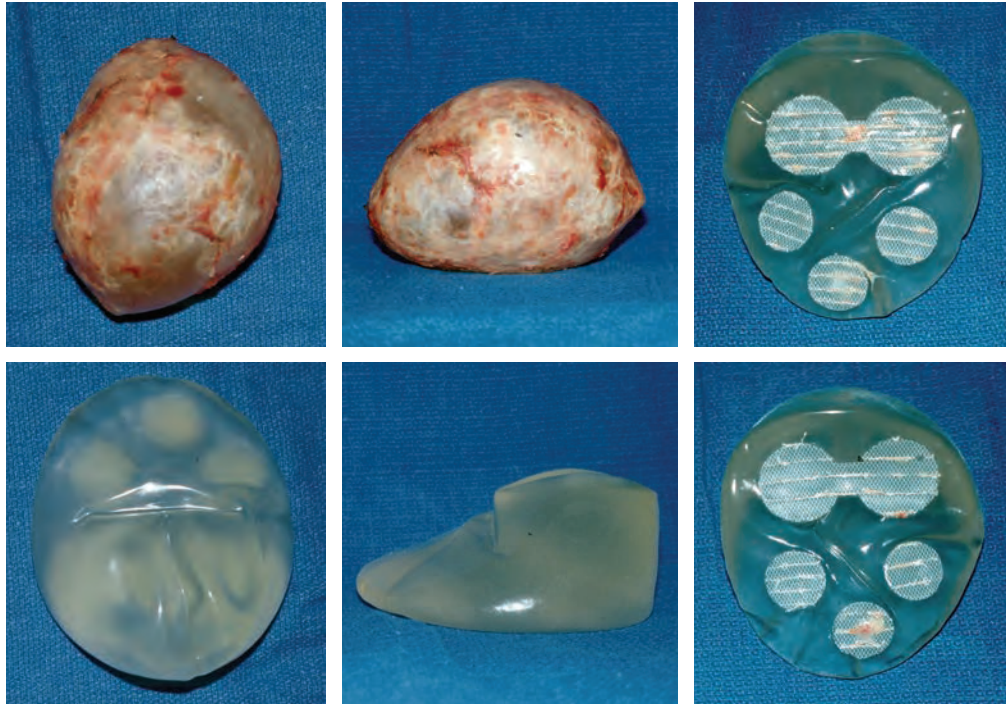
Anteroposterior and lateral views are shown of a series of moderate, moderate plus, and high profile implants, all with a 325 cc fill volume. It is important to realize that for these devices with volume as the fixed variable, as the projection of the implant increases, the base width of the device decreases. This has implications for how these implants are used in specific patients. For instance, a patient with a tight skin envelope and severe macromastia will not be able to tolerate a high projection or high profile implant without creating tension at the apex of the device, resulting in a rounding out of the periphery of the implant and possibly creating a prominent, rounded contour at the breast periphery. In such cases a moderate profile implant is a better option, because it will fit beneath the skin envelope without crowding the space, creating a more comfortable relationship between the implant and the soft tissue and a more aesthetic and natural result. Conversely, in a patient with a very loose skin envelope, a low profile implant could nicely augment the base of the breast but not adequately fill out the apex of the breast mound, creating an odd appearance where the peripheral contours of the breast were filled out, with the apex of the breast actually hanging off the front. In these instances, a high profile implant would be a better choice, because it would more evenly fill out the loose and redundant skin envelope.

Beyond issues related to projection, what the implant is filled with can dramatically affect its performance. Because of their relatively low level of cohesivity, saline-filled implants must be filled to a greater degree than silicone gel implants to perform safely;

an under-filled saline implant cannot support the upper pole of the device when it is placed upright, resulting in collapse of the upper pole and wrinkling of the shell. Such wrinkling results in sharp stress points in the shell that can weaken over time, leading to rupture. For this reason, many surgeons slightly overfill saline implants to prevent wrinkling and lengthen the life of the implant. One disadvantage of this overfill strategy is the more rounded contour of the overfilled round device. In thinner patients, this rounded contour can distort the breast, creating an artificial, augmented appearance. Filling the round implant with silicone gel is more easily tolerated by the round implant shell. Here an underfill strategy can be used, because the wrinkles that form are much softer and place less stress on the implant shell. The wrinkles are also less likely to become visible through the skin envelope. This, together with the overall softer feel of silicone gel-filled implants, makes these the implant preferred by many surgeons.

Anatomic Implants: Design Variations

Shortly after the introduction of the silicone gel implant for breast augmentation, it became clear to early practitioners that an anatomically shaped implant held at least a theoretical advantage in creating a pleasing breast shape.



To this end, a shaped silicone implant was introduced that had five Dacron patches attached to the back that held the implant in position and prevented rotation because they stimulated intense tissue ingrowth into the patches. Anteroposterior and lateral views are shown of the original shaped silicone gel implant from the late 1960s. (Note the five Dacron patches attached to the back of the device.) From an engineering standpoint, this was a sound implant design, and the merging of a shaped

device with a means to hold the implant in the proper anatomic position is a valid concept that applies to the use of anatomically shaped devices even today. However, as can be seen in the example on p. 2213, severe capsular contracture was quite common with this particular early implant design, and the implant fell into disfavor.

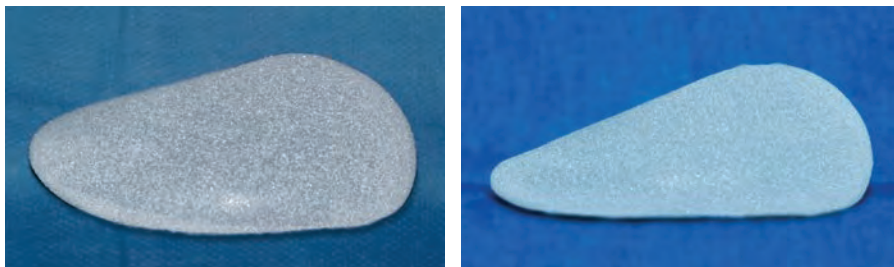


Eventually a polyurethane foam-coated device with an anatomic shape called the Replicon implant, developed by Surgitek, was introduced that again merged a textured surface that stimulated tissue ingrowth with an asymmetrical anatomically shaped implant. This device was considered by many to be one of the most effective breast implants ever designed. The device allowed better control of the shape of the breast and, what is perhaps more important, remained soft over time, leading to one of the lowest rates of capsular contracture ever reported. The biochemical effect of the slow degradation of the polyurethane foam was somehow inhibitory to contracture of the capsule. Unfortunately, the safety of this foam degradation process was called into question in the early 1990s, because the byproducts of polyurethane foam breakdown were thought by some to have carcinogenic potential. These concerns were eventually dismissed as unfounded, but these types of devices were eventually removed from the market and have not yet become available again in the United States.

With the development of textured silicone surfaces, once again there was an opportunity to apply an implant fixation method along with the anatomic concept for breast implants, and over the years several different anatomic designs for both silicone and saline have been introduced, as demonstrated in the lateral views shown next.



The Biocell (363 Allergan; Allergan, Inc., Irvine, CA) (*left*) and Siltex (Spectrum, Mentor) (*right*) textured short height anatomically shaped saline implants were developed for both augmentation and reconstruction.



The Biocell textured full height anatomically shaped saline implant (163 Allergan) (*left*) was thought to be better suited for reconstruction, because it could provide better upper pole fill for the breast after mastectomy. The anatomically shaped Bio-cell textured cohesive silicone gel implant (410 Allergan) (*right*) combined a variable anatomic shape with a textured surface to provide a controlled result in both augmentation and reconstruction.



A lateral view of an anatomically shaped Siltex textured cohesive silicone gel implant (Contour Profile Gel [CPG], Mentor) is shown.



This side-by-side view shows a saline-filled implant placed upright compared with an anatomically shaped cohesive gel CPG implant (Mentor). As a result of the support the cohesive gel provides to the anatomically shaped shell of the CPG, the implant holds its shape when placed upright, whereas the saline device collapses in the upper pole, leading to the possible formation of visible or palpable wrinkles.

Whatever the specific design, the concept remains the same; namely, by building an anatomic teardrop shape into the implant, a better, more aesthetic breast shape can be created through both aesthetic and reconstructive breast surgery.

Combination Implants

In an attempt to combine the advantage of saline volume adjustability with the softer feel of silicone, manufacturers have developed a series of combination devices that incorporate a dual-lumen concept. Generally, the outer lumen is constructed with a silicone gel filler and the inner lumen is filled with saline. A remote valve passes through the outer gel component to allow access to the inner saline portion.



This anatomically shaped dual-chambered device has an inner saline bladder attached to the lower pole. The fill tube enters the inner saline bladder through a valve port built into a patch on the back of the implant.

The remote port is then buried under the skin and is accessed as needed to add volume to the overall implant. This device was introduced as a combination expander-implant, because the external valve portion could be removed and a self-sealing mechanism would maintain the integrity of the device. In reconstructive cases, once the needed volume had been added, the port and tubing could be removed with the patient under local anesthesia, with the device now also functioning as the final implant.

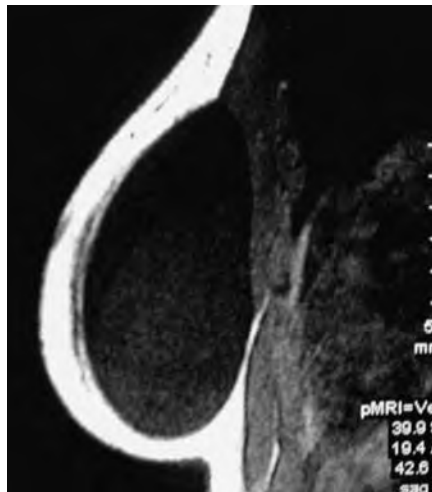
This concept has also been explored for patients undergoing breast augmentation, with volume adjustability allowing the patient to choose the final desired size by adding saline as needed postoperatively, then eventually removing the remote port. Although this is attractive in theory, such devices occupy only a small niche applicability for the vast majority of surgeons performing aesthetic and reconstructive breast surgery.

Rationale for Anatomically Shaped Implants

The rationale for using a shaped implant has been challenged by many in plastic surgery, and the utility of a shaped device has been called into question. The counter-argument is that round implants have worked quite well over the past 40 years, and there is no need to invite the potential for implant rotation or to make a very straightforward operation more complex. This opinion is understandable, given the numerous reports that have documented the excellent aesthetic results achieved with round implants. However, these results must be interpreted in light of how these devices are actually interacting with the surrounding soft tissue to create the final three-dimensional breast shape. It is now clear that an underfilled silicone gel implant will variably fold and wrinkle, depending on the characteristics of the soft tissue cover overlying the device, as well as on the size of the pocket into which the implant is placed. In most instances, these wrinkles are masked by the overlying soft tissue and do not create a contour irregularity unless the soft tissue cover is very thin. However, when these implants are evaluated by imaging studies, the shape assumed by the implant is variably and often markedly anatomic.



325 cc smooth round moderate profile silicone gel implant



310 cc smooth round high profile saline implant filled to 350 cc



280 cc mid height low projection (321) textured cohesive gel anatomic implant

Recent data from an upright MRI scanner regarding implant shape have been obtained to evaluate the shape of the breast and the implant in the upright position. These images have documented the propensity of round implants to wrinkle and demonstrate something other than a round shape under the influence of the overlying soft tissue framework. This propensity for wrinkling can be seen with the lateral view of the 325 cc smooth round moderate profile silicone gel implant (*left*). The shell is wrinkled and the apex of the device of the device comes to a sharp point, creating a smooth takeoff from the chest wall in the upper portion of the breast.

Using upright MRI images, the relationship of the upper pole of the implant to the overlying soft tissue can also be evaluated. When the implant can change shape in the upper pole and become more angulated, deficiencies in the thickness of the soft tissue cover can be tolerated without creating upper pole distortion. It is for this reason that silicone gel implants are more versatile than saline implants, because a fixed yet underfilled round silicone gel implant can more readily fold and assume a more or less anatomic shape than a saline implant, which tends to retain a more rounded configuration when properly filled. The upright MRI scan of a 310 cc smooth round high profile saline implant is shown (p. 2217, *center*); the device has been filled to 350 cc. Note that the shell of the implant is completely filled and there are no wrinkles.

It does not take a significant leap of logic to then ask, if an implant assumes an anatomic shape in situ, why not construct it to have an anatomic shape from the beginning? Not only would the shape of the implant and therefore the breast be better controlled, but also the wrinkling and whatever deleterious effect such wrinkles would have on the shell of the implant, leading to potential weakening and rupture, would be greatly minimized. Because the anatomic implant is constructed to assume a teardrop shape, the in situ distorting forces across the top of the device are minimized and wrinkling is prevented.

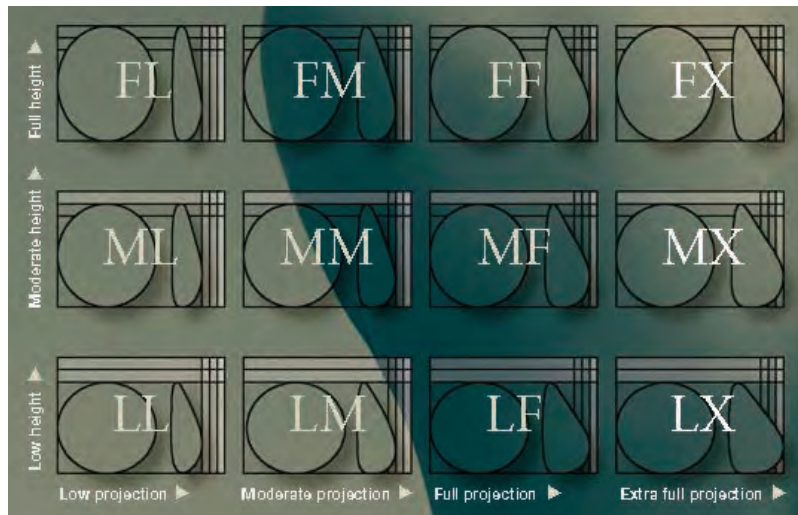
This argument has been confirmed again through upright MRI evaluation of breasts augmented with cohesive gel anatomic implants, where wrinkling in the shell of the device is minimal to none. In the MRI scan of a 280 cc mid height low projection (321) textured cohesive anatomic silicone gel implant in an upright position (p. 2217, *right*), the apex of the device remains contoured to create a smooth takeoff in the upper pole of the breast. Additionally, the anatomic distribution of the gel along with the absence of wrinkling in the outer shell can be seen.

One design feature of these types of devices relates to the consistency of the gel used to fill the implant. If the gel has a greater density and is more cohesive, the magnitude of the distorting forces across the top of the device will be further minimized, and the device will effectively create a teardrop shape without wrinkling. One way to contrast the use of round versus shaped devices relates to this finding. With an underfilled round gel implant that can fold and wrinkle according to the dictates of the overlying soft tissue framework, it is the soft tissue that is shaping the implant to create the final breast contour. This is a very versatile and effective way to use a breast implant. However, with cohesive anatomic gel devices, it is most decidedly the firmer anatomic implant that is shaping the breast. In this instance there is less room for error, and each implant must be carefully measured and matched to each patient to work effectively. This is why all anatomically shaped cohesive gel implants are manufactured using a matrix strategy by which several different implant heights are merged with an equal number of different projections. Within this framework, implants of different dimensions and volumes are available for each cell of the matrix.

Anatomic Implants: Gel

Anatomically shaped cohesive gel implants are manufactured to meet the needs of a wide variety of patients. The important variables are implant height, width, projection, and volume. No matter what the variables are that define each individual implant, all are constructed with a firmer, more cross-linked gel that supports the anatomically shaped shell to better maintain the shape of the implant and resist wrinkling.

410



The first widely used anatomically shaped cohesive silicone gel implant, called the 410, was introduced in the mid-1990s (see p. 2215). Currently this device is manufactured by Allergan using a matrix structure that combines implant height and implant width with projection. The base diameter of the implant is constructed to be proportional to the overall shape of the device. Using this matrix, these devices are then named based on the variables. For example, the full height full projection implant is called the FF; the mid height mid projection implant is called the MM; and so on. Originally nine cells were included in the matrix to meet the needs of individual patients, and within each cell a wide variety of volumes were manufactured to provide versatility in implant choice. Eventually an extension to the matrix was added to provide implants with greater projection; these devices are called X for extra projection. Therefore a full height extra projection device is called an FX.

Because of concerns about the stiffness and firmer feel of these implants, an alternative matrix was developed using a slightly less firm gel, leading to a separate matrix of anatomic implants called the 410 Soft Touch. Expanding on the anatomic concept led to the development of a dual implant design called the 510. With this device, the same cohesive gel is used to fill an anatomically shaped shell, and a small insert of an even more cohesive gel is fastened inside the implant in the lower pole to resist compression and maximize projection.

Contour Profile Gel



An alternative anatomically shaped cohesive gel implant called the Contour Profile Gel (CPG), manufactured by Mentor, was introduced using the same matrix concept (see p. 2215). Here the overall resistance to compression was graded as level 3, with the standard gel of the traditional round implants called level 1, and mildly cohesive gel called level 2. Three different implant heights were offered including low, mid, and full height, labeled 1, 2, and 3, respectively. Three different projections were offered, including low, mid, and high projections again called 1, 2, and 3. The matrix system was then organized using this numbering system. Since all these devices were manufactured with type 3 cohesive gel, this whole matrix could be thought of as the 300 series. With this in mind, a mid height low projection implant is called a 321, with 2 referring to height and 1 to projection. A 323 would be a midheight full projection device. During the development of this matrix, it was realized that several of the boxes in the matrix would create implants that had limited clinical applicability. Therefore to simplify the implant selection process, these outlier boxes were removed, leaving a more refined selection of shape choices that removes the more extreme shapes, leaving behind a more clinically relevant selection of implants.

Anatomic Implants: Saline

The anatomic concept has been likewise applied to saline implants by using an anatomically shaped mandril to create the implant shell, which is then filled with saline. The advantages of this implant design include use of the anatomic concept and the ability to modify the volume of the device within a limited range of fill volumes. However, the use of saline as the fill material remains a significant drawback; as noted with round implants, saline has very limited cohesion and provides little support to the implant shell. As a result, any tendency for the implant to be under-filled results in wrinkling and loss of implant shape.

In practice, the implant actually requires a variable overfill strategy to prevent this shape change with collapse of the upper pole of the implant when it is placed upright. Thus by overfilling the device, some of the anatomic shape of the device—in particular, the contour of the upper pole—is lost, and the variably overfilled implant actually can develop a mild bulge in the upper pole. Therefore, paradoxically, many surgeons have noted that these devices, rather than affording control of the upper pole of the breast, actually resulted in distortion of the upper pole. To some extent this observation was responsible for many surgeons remaining skeptical about the anatomic concept until the introduction of cohesive gel allowed the anatomically shaped shell to be used more effectively.

Problematic upper pole control with anatomically shaped saline implants was more common with full height devices. Shorter height implants were less prone to upper pole distortion simply from a mechanical perspective, since there was less implant to potentially overfill the upper pole of the breast, and many surgeons were able to use these devices to good effect. No matter what the potential disadvantages may be, anatomically shaped saline implants played an important role in the development of the shaped implant concept. During the early 1990s, when there was a moratorium on the use of silicone gel implants imposed by the FDA in the United States, the saline implant was all that was available, and it was this experience that guided the subsequent development of the current generation of anatomically shaped cohesive gel implants.

Implant Selection

The goal in choosing a specific implant for a particular patient is to select a device that will optimally complement the patient's existing anatomy to create the most aesthetic result possible. To a certain extent, this goal can be influenced by the desires of the patient regarding breast size and shape. To this end, a series of measurements can be made preoperatively that directly guide implant selection.

Preoperative Measurements to Guide Implant Selection

Clavicle-to-Nipple Distance



The clavicle-to-nipple measurement provides a gauge to assess the degree of breast ptosis. Although many other variables can influence this measurement, distances of more than 19 to 20 cm indicate a low-riding nipple, and the surgeon may consider a combination mastopexy and augmentation. Perhaps more useful is the observation that this distance can potentially be different from side to side. Such asymmetry can either result from an asymmetrical shoulder cant or clavicle position or from a true asymmetry in nipple position. It is important to point out such asymmetries to the patient ahead of time so she knows that these differences may well still be present after the augmentation, or together with the surgeon she can consider procedures designed to correct the asymmetry.

Sternal Notch-to-Nipple Distance



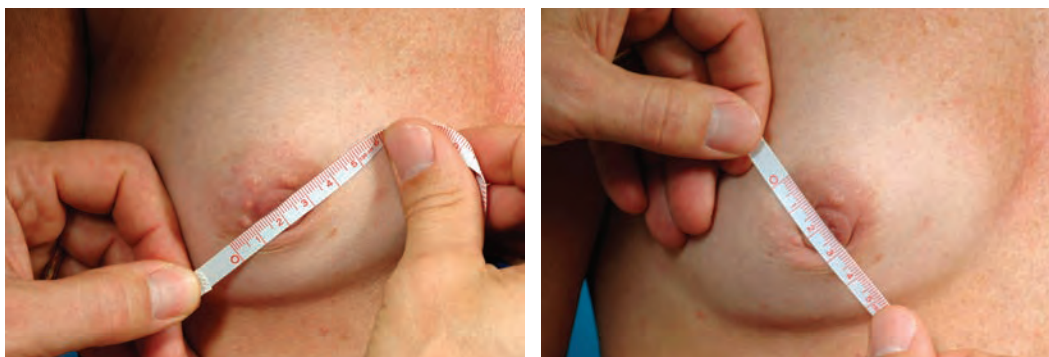
The distance from the sternal notch to the nipple, measured on both sides, is a truer indicator of nipple-areola complex asymmetry, since the variables of shoulder cant and clavicle position are removed.

Intermammary Distance



The intermammary distance is determined by gently translocating the breasts together medially in an attempt to reproduce the contour that will be created by an implant. With this maneuver, some women will develop cleavage to the point where the breasts actually touch. Others will maintain a variable distance between the breasts. This assumes that the pocket dissection will not extend past the internal mammary perforators and onto the thin presternal skin. It is important to discuss this aspect of the breast augmentation result with the patient, because many women will assume that their breasts will touch in the midline after the procedure. If the preoperative anatomy will not allow this, it must be pointed out ahead of time to avoid any patient misconception.

Areolar Diameter



The horizontal width and height of the areola without tension is noted and used as a guide to predict how big the areola could potentially become after an implant is placed. If the size of the areola becomes excessive postoperatively, the quality of the final result can be compromised. In these situations, the potential need for an areolar reducing procedure can be discussed as part of the overall operative plan.

Inframammary Fold-to-Nipple Distance Without Stretch



The distance from the inframammary fold to the nipple serves as an indicator of the amount of skin available to stretch over the implant. When this distance is short (less than 5 cm), it is best to consider using a moderate (low) profile implant that will not require a great deal of skin to wrap around the inferior pole of the device. When this distance is excessive (more than 8 cm), a high profile implant to fill out the redundant skin envelope with or without a mastopexy should be considered. For distances between 5 and 8 cm, a moderate plus (medium) profile implant will usually suffice.

Inframammary Fold-to-Nipple Distance With Maximal Stretch



To assess the elasticity of the lower pole skin envelope, the distance from the inframammary fold to the nipple is measure with the tissue under maximum stretch. As with the static inframammary fold-to-nipple measurement, this information can affect the choice of implant projection. When the lower pole skin stretches only 2 cm or less, there is tight skin envelope and a lower profile implant may be the best choice. When the skin stretches 3 cm or more, a higher profile device will more effectively fill out the lower pole of the breast.

Breast Base Diameter



The base diameter of the chosen implant must fit comfortably within the confines of the patient's preexisting soft tissue framework. A linear caliper is used to estimate the width of the breast that will result after the breast has been augmented. This measurement extends from the medial border of the breast, just lateral to the location of the internal mammary perforators, over to the proposed new lateral border of the breast. This measurement is termed X.

Medial Breast Pinch Thickness



With a pair of skin fold thickness calipers, the horizontal skin fold thickness of the medial breast is measured by pinching the skin together with the forefinger and thumb of the left hand so that a horizontal skin fold is created. By dividing this measurement in half, the thickness of the medial soft tissue layer that covers the medial aspect of the implant can be determined. This measurement is termed Y.

Lateral Breast Pinch Thickness

A similar measurement is made laterally to determine the lateral soft tissue thickness. This measurement is termed Z.



Breast Implant Calculation

The base diameter of the implant that will optimally fit the patient can be selected by subtracting the medial and lateral soft tissue thickness from the proposed breast base diameter, or

$$X - (Y + Z)$$

This measurement simply represents the average base diameter that will comfortably fit within the measured soft tissue framework. It is possible to underselect this measurement by up to 1 cm to meet the needs of a patient who wants only a modest increase in breast size. However, underselecting a base diameter by more than 1 cm risks creating a contour deformity from incomplete filling of the soft tissue envelope of the breast. Conversely, it is also possible to overselect this measurement by up to 2 cm, depending on the patient's wishes. In this circumstance, the position of the inframammary fold will also likely have to be adjusted lower to accommodate the increased dimensions of the device. In other words, there is a certain tolerance to the measurement of the breast base diameter, and this dimension can be manipulated to a certain extent to satisfy a specific goal.

Upper Pole Pinch Thickness



The soft tissue thickness of the upper pole of the breast can be assessed by pinching the skin fold at the level at which the upper border of the implant will be located. If the soft tissue cover measures 2 cm or more (or a 4 cm doubled over skin fold mea-

surement), the subglandular plane can be used for implant placement without risk that the superior implant border will be visible. A measurement of less than 2 cm may result in a visible implant shadow along the upper-inner quadrant of the breast if the subglandular plane is used. Of course, other factors, such as implant shape, volume, fill, and soft tissue elasticity can also have an impact.

Patient Desires

One of the most important elements of the preoperative evaluation process is to assess very clearly what the patient wishes to achieve as far as the size and shape of her breasts postoperatively. In the past, discussions based on cup size using the A, B, C, D, DD sizing system have proved incomplete at best and inaccurate at worst. A better way of communicating this would be based on the patient's preexisting anatomic limitations and how those limitations can affect the final result. To this end, I have found the following classification system to be very useful for ensuring that the result the patient and I have in mind is as similar as possible:

Type 1: A small breast implant is used if the patient does not want the size of her breast to be noticeably increased. Such patients are often simply seeking a modest filling out of an underfilled and ptotic postpregnancy skin envelope. A larger implant could easily be used, but the patient does not want that degree of breast enlargement.

Type 2: The patient's overriding concern is for the breasts to be as large as possible, but not to the point at which the shape begins to appear unnatural. In particular, the slope of the upper pole of the breast must be straight, with no telltale bulging to suggest that an implant has been placed.

Type 3: A larger implant is used to create an overly full upper pole and complete filling of the skin envelope. When the patient wears a bathing suit or a low-cut dress, it may be clear to the casual observer that the results appear augmented.

Type 4: The largest implant that can be inserted under the available soft tissue framework is used, with no regard for the unnatural shape of the breast that results.

Discussing this with the patient and attempting to understand what type of result she desires can provide useful insight into the type of implant that can provide the optimal result. This can minimize the reoperation rate for size change after initial breast augmentation and increase patient satisfaction.

The evaluation parameters described in this section form the basis for the BodyLogic implant selection system. The data sheets, required calipers, and implant selection guides are commercially available from Mentor.

Indications

Round

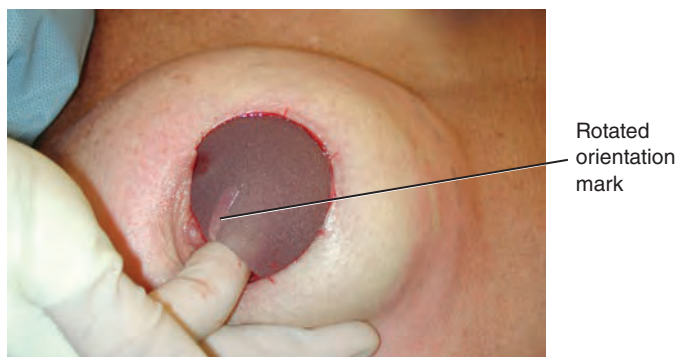
Round implants continue to play a dominant role in breast augmentation, and for good reason—an excellent result can be achieved in the vast majority of patients with round gel or saline implants. Using the measurement parameters described earlier, an appropriate round implant can be chosen to meet the needs of each patient by matching the base diameter, volume, and projection in the best way possible to create the desired result. Certain features concerning round implants bear emphasis, however. When saline implants are used, the volume in the device must be at or even slightly beyond the stated fill volume to prevent wrinkling in the implant shell. Thus these devices tend to create a more rounded contour in the upper pole, and, when this is taken to the extreme, can noticeably distort the breast. Conversely, round gel implants are always variably underfilled and will fold and wrinkle once placed in the pocket. The folds and wrinkles that form tend to be softer, with edges that are less sharp than those that form with saline devices; therefore the wrinkles are better tolerated. These devices also have a softer feel to them. Because of this ability to fold and conform to the overlying soft tissue framework, round gel implants offer a very versatile option for breast augmentation; a full, natural shape is developed with less chance for upper pole contour deformity.

Whether saline or gel, round devices continue to play an important role in the breast augmentation practices of surgeons around the world.

Anatomically Shaped

It would not be an oversimplification to state that every breast augmentation patient is a candidate for the use of an anatomically shaped cohesive gel breast implant. The concept is that powerful, and the results can be that outstanding. The ability to directly control the contour of the breast by using the implant to create the desired shape offers the surgeon control over the operation. With that as the basic premise, one must then step back and evaluate the other variables and balance the potential complications against the results obtained with round implants, sincere there are several potential drawbacks associated with the use of cohesive anatomically shaped gel implants.

Drawbacks to the Use of Anatomically Shaped Cohesive Gel Implants



ROTATION It is self-evident that an anatomically shaped implant must remain in the proper orientation to produce the desired shape. If the implant rotates, control over the shape of the breast is lost, and the breast becomes distorted.

STIFFNESS Although the cohesive gel supports the implant shell and helps create the device's shape, these implants have a stiffer feel than the more traditional round gel implants. Some patients may find this firmer feel objectionable.

COMPLEXITY The implant selection process and the operative technique are more involved with anatomic devices than with round implants; therefore greater emphasis must be placed on accurate measurement of the patient and on more exacting surgical technique. In short, there is less tolerance for inaccuracy when using shaped devices.

COST Anatomically shaped cohesive gel implants are more expensive than comparable round devices.

These variables, in particular the possibility of implant malposition with rotation, must be weighed against the advantages of the shaped design. In general terms, if the results obtained using a round device on one side and a cohesive shaped device on the other were to be indistinguishable, it is a better option to use the round device to avoid these potential complications. With that in mind, however, there are several subsets of patients who are particularly good candidates for anatomically shaped cohesive gel implants.

Suitable Candidates for Anatomically Shaped Cohesive Gel Implants

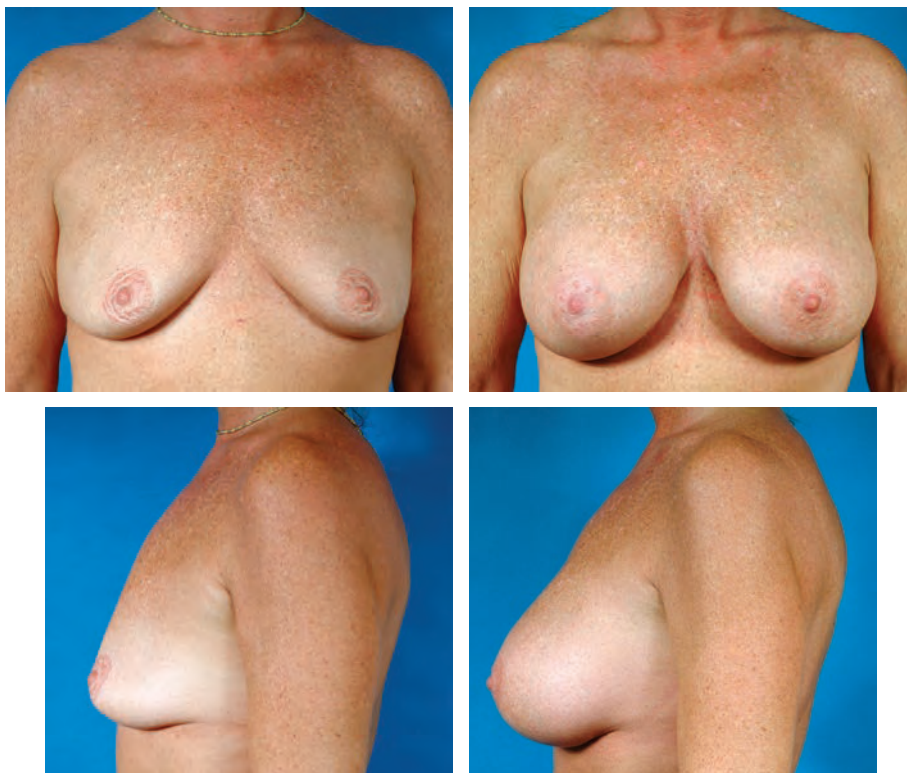
PATIENTS WITH HYPOMASTIA In patients with small breasts in whom the implant would provide 75% or more of the overall final breast volume, an anatomically shaped device will provide better control over breast shape than a round device would. In such patients, the ability to control the upper pole and maximize lower pole projection allows the surgeon to create very aesthetic results, particularly when used in the subpectoral position, where the muscle can be used to soften the pe-

ripheral upper pole contours. In these patients, using a cohesive gel anatomically shaped device can create a more natural result for a given volume than a round implant can. Reconstructive patients who have relatively thin mastectomy flaps and revisionary patients who have undergone multiple procedures with thinning of the soft tissue framework of the breast can benefit from selection of a cohesive gel shaped implant. As with primary hypomastia, the ability to directly shape the breast allows the surgeon to more definitively control the quality of the aesthetic result.



This 32-year-old woman requested breast augmentation. Because of her significant hypomastia, a textured anatomically shaped cohesive silicone gel implant was selected to fill out the breast-skin envelope. She is shown 2 years after placement of 355 cc (321 CPG) mid height low profile textured cohesive anatomic silicone gel implants in the subglandular plane. An overall aesthetic augmentation of the breast has been achieved.

PATIENTS WITH PSEUDOPTOSIS Patients who present with a properly positioned nipple-areola complex but have ptosis of the lower pole with an excess of skin and parenchyma in the lower pole are particularly good candidates for breast augmentation using anatomically shaped cohesive gel implants. Because more of the gel is located in the lower pole of the anatomic implant, a more proportional filling of the lower pole of the breast results from its use and this can provide results superior those obtained with round devices.



This 44-year-old woman requested breast augmentation to correct her pseudoptosis. Textured anatomically shaped cohesive gel implants were chosen to fill out the lower poles of her breasts. She is shown 2 years after placement of 321 CPG mid height low profile textured cohesive anatomic silicone gel implants in the subglandular plane. Aesthetic augmentation of the lower poles of the breast has been achieved without creating any distortion or excessive fullness in the upper poles of the breasts.

Patient Request

The safety profile associated with anatomically shaped cohesive gel breast implants is impressive. Perhaps no other implant has provided such outstanding aesthetic results with fewer complications. For this reason, many patients who are knowledgeable about implant selection often request information about these devices. At this writing, these implants are still available only as part of an FDA-sponsored study. Once they do become available for general use, the popularity of these devices is likely to increase significantly.

Concluding Thoughts

The overriding goal in choosing an implant for use in aesthetic and reconstructive breast surgery is to pick a device that will complement the patient's existing anatomy and provide the best aesthetic result possible. By thoughtfully combining the various choices in shape, fill, and texture, implants appropriate for each patient can be selected that will maximize the quality of the aesthetic result and minimize complications.

Clinical Caveats

The patient's desires should be assessed and discussed preoperatively regarding size to avoid patient dissatisfaction.

A selection system based on the patient's anatomy rather than on cup size is preferable.

A repeatable measuring technique must be developed to enhance consistency.

Base diameter, volume, and projection are combined to optimize implant selection.

When possible, the bigger of two implants should be chosen when both will fit the soft tissue framework.

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This is one of the first reports in the literature on the results obtained using the newer types of anatomically shaped cohesive gel implants.

Suggested Readings

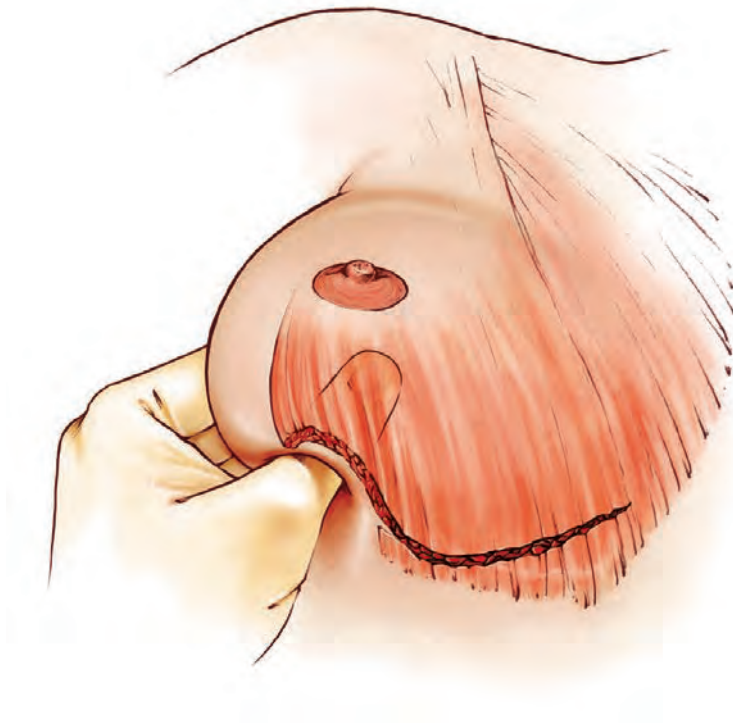
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CHAPTER 62



Breast Augmentation

GLYN JONES

Breast augmentation is one of the most popular aesthetic surgery procedures performed in the United States today. Each year more than 250,000 women elect to have their breasts enlarged, despite unresolved questions about implants and long-term problems such as capsular contracture. Typically performed to enhance the size of normal but small to moderate-sized breasts, this operation can also help to restore balance to asymmetrically sized breasts. Although breast augmentation is a procedure with a high level of patient satisfaction, it is less routine than its description would suggest. Critical decisions concerning the choice of implant, surgical approach, and implant placement are essential to ensuring a satisfactory result. Even with meticulous surgical technique, the operation is dependent on the design and efficacy of the implantable device and the body's reaction to this foreign material. Capsular contracture remains the most persistent and troubling of potential complications associated with these devices. As a result, creating a long-lasting, soft, and natural-appearing augmented breast continues to challenge the surgeon's skill and ingenuity.

Evolution of Technique

The introduction of the silicone breast implant in 1963 marked the beginning of breast augmentation as we know it today. Since its inception, this operation has evolved with the development of new implantable devices with improved shell and filler technology to enhance patient outcomes and to provide surgeons with a range of treatment options. The popularity of this operation declined with the breast implant controversy of the early 1990s, when the FDA restricted access to breast implants filled with silicone gel because of fears about complications and possible links to disease. These fears have largely waned over time as new scientific studies and clinical trials have provided considerable information about the safety and efficacy of these devices. Demand for breast augmentation today is even stronger than it was before the controversy arose. However, restrictions placed on silicone gel implants by the FDA have served to substantially limit implant availability in the United States.

The search for the ideal implantable device has long shaped the evolution of this operation. The quest is for a device that is soft, natural, long-lasting, containing a biodegradable filler, and radiolucent. The filling used is an important factor in obtaining this ideal. Early breast implants were filled with silicone gel. Experience with these implants revealed that capsular contracture was a possible complication, which led surgeons to develop saline-filled implants as a possible alternative. Although saline-filled devices reduced capsular contracture to some extent, the incidence of contracture remained frustratingly high. The quest for alternative fillers continues to

this day. Implants with lipid fillers have been tried but abandoned. Although they were radiolucent and allowed improved visualization during mammography, they were not biodegradable. Furthermore, reports of granulomas and a percutaneous rancid odor made them unacceptable. While surgeons in the United States were dealing with FDA restrictions on implant usage, the search for alternative fillers was ongoing outside the United States. Several companies developed cohesive silicone gel implants for use elsewhere in the world. The first generation of these cohesive gel devices was very stiff; however, newer cohesive gel fillers have a softer, more natural feel and are now the primary implant choice of surgeons in most countries outside the United States. The FDA has lifted its ban on silicone gel-filled implants for cosmetic breast augmentation in the United States; these devices are now widely used in this country and account for a substantial percentage of the devices inserted for breast augmentation. Cohesive form-stable gel devices have not been approved by the FDA for general usage, but it is hoped that they soon will be.

The shape and texture of implant surfaces have also evolved over time. Early implants were round and smooth. Over time, to reduce the incidence of capsular contracture, different surface coatings and textures were developed. Polyurethane-coated implants produced a dramatic drop in the rates of early capsular contracture. Contractures were reduced by the inflammatory response that was induced when polyurethane foam came into contact with tissue, as well as by the large surface area of the resulting capsule over the convoluted surface of a foam shell. Unfortunately, as the polyurethane foam degraded, it exposed the underlying smooth gel implant core, leading to a slow rise in capsular contracture formation beyond 10 years after insertion. Favorable reports on the softness and performance of polyurethane-covered implants, which are no longer available in the United States, combined with studies of the relationship of physical surface properties to biological reactivity of the implants, led to the development of the textured-surface breast implant in 1987, which mimicked the foam surface of polyurethane. This stippled texturing had some limited benefit, although it was never as effective as polyurethane. It was also noted that the density of the surface texturing affected its ability to adhere to the tissues; the denser or deeper the texturing, the greater the adhesion. Some surgeons believe this texturing has been beneficial in reducing capsular contracture; however, the addition of texturing has also resulted in thickening of the implant wall, with increased palpability and visible rippling. Although these features have detracted from the advantages of texturing, the new surfaces have also facilitated the development of realistically shaped implants, which have become popular in recent years. These anatomically shaped devices provide greater flexibility in breast shaping, but rotation of the devices may cause unsightly deformation if the pocket is too large; more aggressive texturing may limit the problem of implant rotation.

Surgical approaches and planes for breast augmentation have also evolved over time. Initially, breast augmentation operations were performed through an inframammary incision accessing the subglandular plane for gel implant insertion. The inframammary subglandular approach gave way to total submuscular placement to reduce capsular contracture and implant visibility. Total submuscular coverage has in turn yielded to a trend toward biplanar placement in which the implant is partially submuscular and partially subglandular in its lower pole. Although both of these goals were achieved to some extent, there has been an interesting swing back toward subglandular placement to achieve better breast shape.

The inframammary approach remains the most common augmentation approach used worldwide, followed by the periareolar approach. Transaxillary augmentation was popularized in 1973, but many surgeons abandoned the technique when problems arose related to implant malposition, asymmetry of the inframammary creases, and control of hemostasis from a remote-access site. The technique was resurrected at Emory University in 1993 when endoscopic approaches made more precise dissection and implant placement possible. Endoscopy also paved the way for the development of the transumbilical approach to breast augmentation (the TUBA procedure). Although this technique is not popular, some surgeons have achieved pleasing results with it. Initial problems with the use of the implant as a pocket expander that resulted in voiding of the implant warranty led the pioneers of this technique to advocate the use of a balloon expander or temporary sizer to create the pocket, with subsequent permanent implant insertion at the end of the dissection. This has led to wider acceptance of the technique.

Advantages and Disadvantages

Breast augmentation is an operation that has a high degree of patient acceptance. It offers definite advantages for patients who seek larger breasts or correction of breast asymmetries. It can produce enhanced breast shape, increased cleavage, some breast lift in individuals with early ptosis, and balance for patients with constricted or tubular breasts. It can also improve a patient's body image and even make her clothes fit better. Breast augmentation has no negative impact on breast-feeding ability, no proven causal relationship with systemic illness, and no link to cancer. In fact, studies have found that breast augmentation may contribute to earlier cancer detection in augmented patients when compared with the unaugmented population.

The major disadvantage of breast augmentation is the significant risk for the development of capsular contracture as well as the possibility that some revision surgery will be required in the future to replace the implants, because implants are not life-

time devices. Reoperation may also be required to address breast distortion and asymmetry that may occur as capsular contracture develops.

Other implant-related problems that may develop include implant rupture, with deflation, leakage, wrinkling, and possible palpability of the implants. The fact that breast implants feel cooler than natural breast tissue, especially in thin, small-breasted women, is also a negative for some patients. Finally, implants may obscure breast tissue, making it more difficult to identify breast problems on mammograms and requiring special views to more effectively image a woman's breast tissue.

Indications and Contraindications

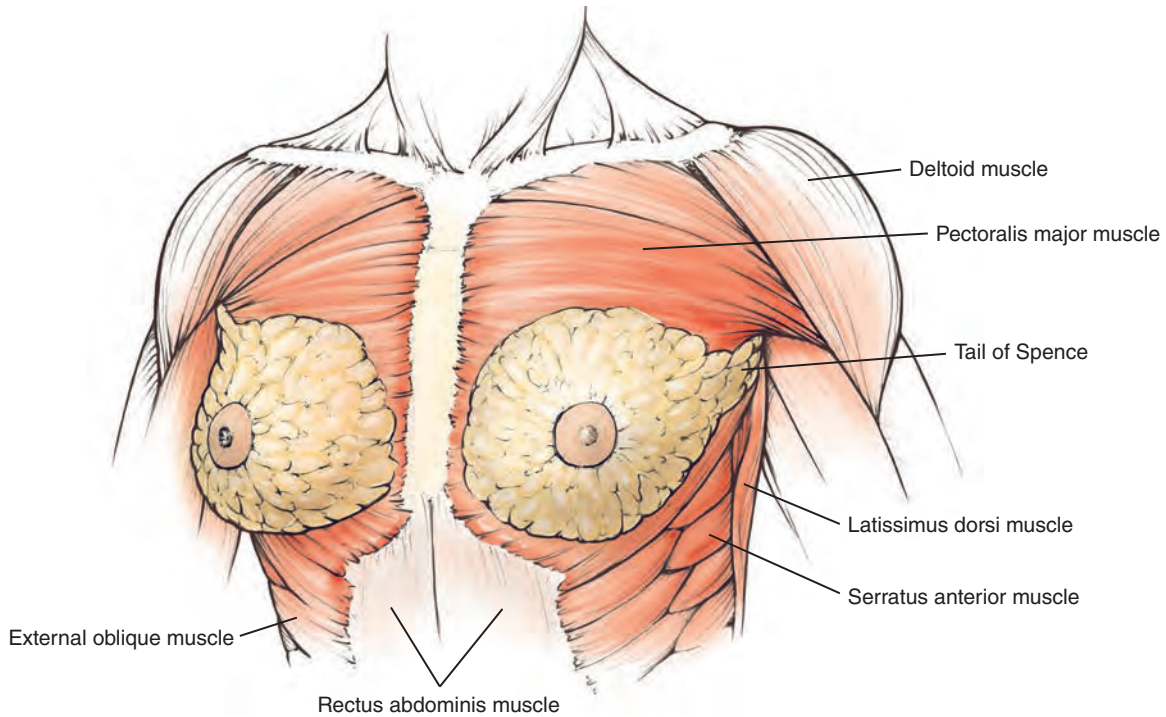
Breast augmentation is indicated under the following circumstances:

- To augment the breasts in women with hypomastia
- To provide a mastopexy effect in women with mild to moderate ptosis
- To provide symmetry in women with developmental anomalies of the breast (for example, Poland's syndrome and constricted breast deformity)
- To provide symmetry in women undergoing breast reconstruction
- To provide upper pole fullness in women with volume loss after pregnancy or massive weight loss, who require both mastopexy and augmentation

The following are contraindications for breast augmentation:

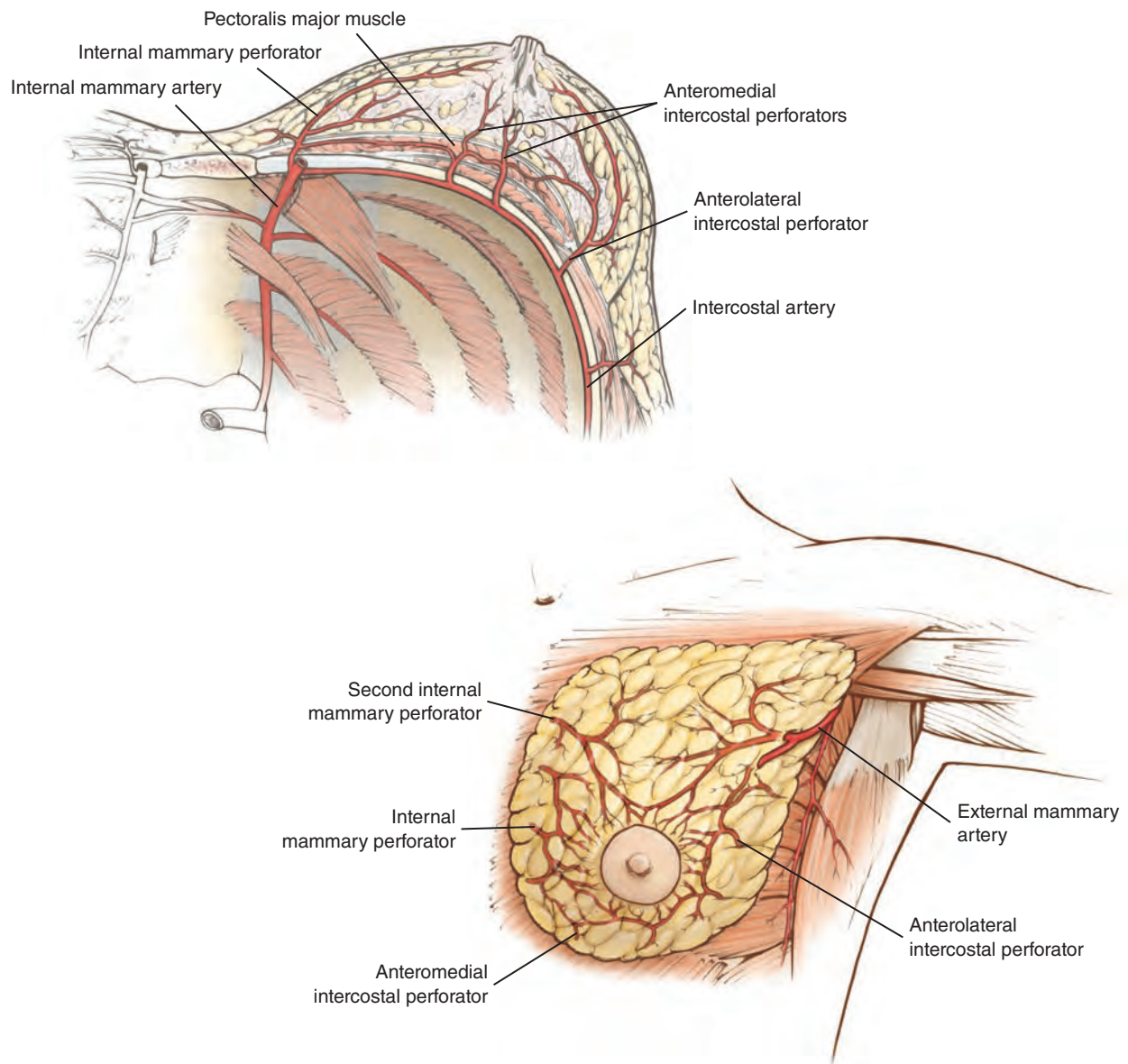
- Women with body dysmorphic disorder and other psychiatrically unstable patients
- Women hoping to salvage a marriage or relationship or to find a husband by having bigger breasts
- Women with collagen vascular disease (these individuals should be advised against breast augmentation in the current legal climate, even though there is no proven cause-and-effect relationship between collagen vascular disease and breast implants)
- Women with severe fibrocystic changes, ductal hyperplasia, and/or atypia whose breasts are difficult to image well or in whom there is a high risk of breast cancer (implants in these women make mammographic screening even more unreliable and may be relatively contraindicated)
- Women under 18 years of age should be discouraged from having augmentation, because they may not appreciate the long-term implications of implantation of a foreign device
- Women who want the procedure in response to spousal, parental, or peer pressure to have the procedure

Pertinent Anatomy

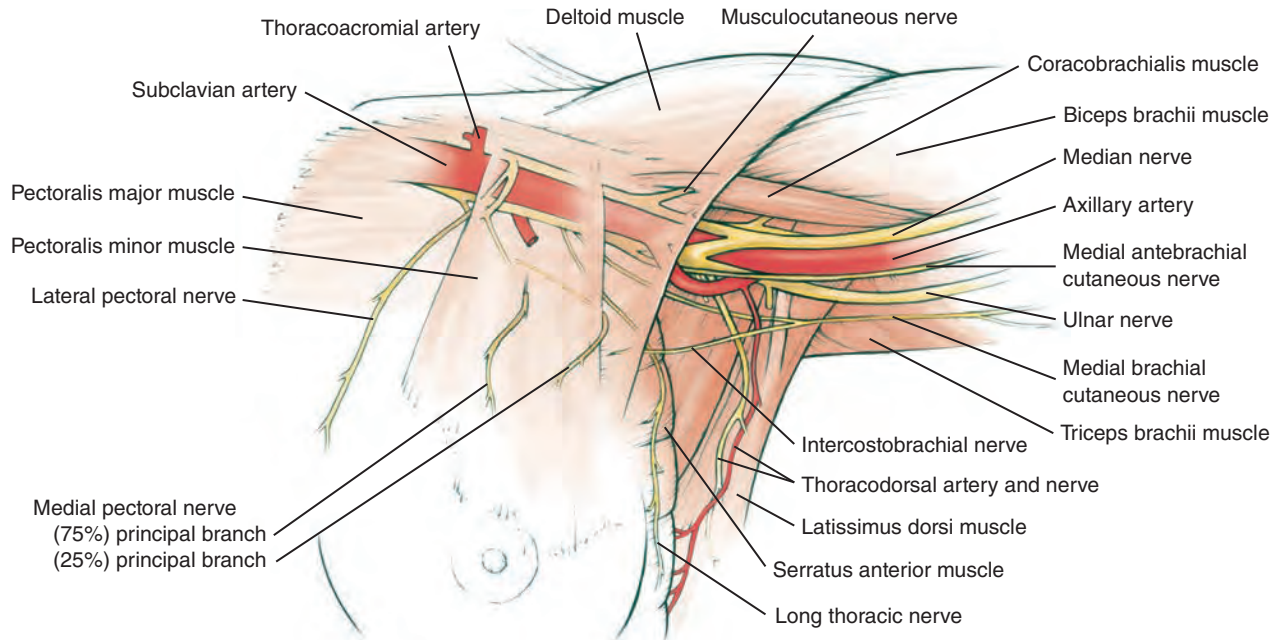


The female breast sits on the pectoralis major muscle overlying the second through the seventh ribs. The nipple is situated at the midclavicular line over the fourth rib in a youthful, nonptotic breast. The tail of Spence extends up toward the axilla over the inferolateral border of the pectoralis major muscle and merges with axillary floor fat. The intercostobrachial nerve crosses the axillary floor in its course to the medial arm and may be at risk during transaxillary dissection.

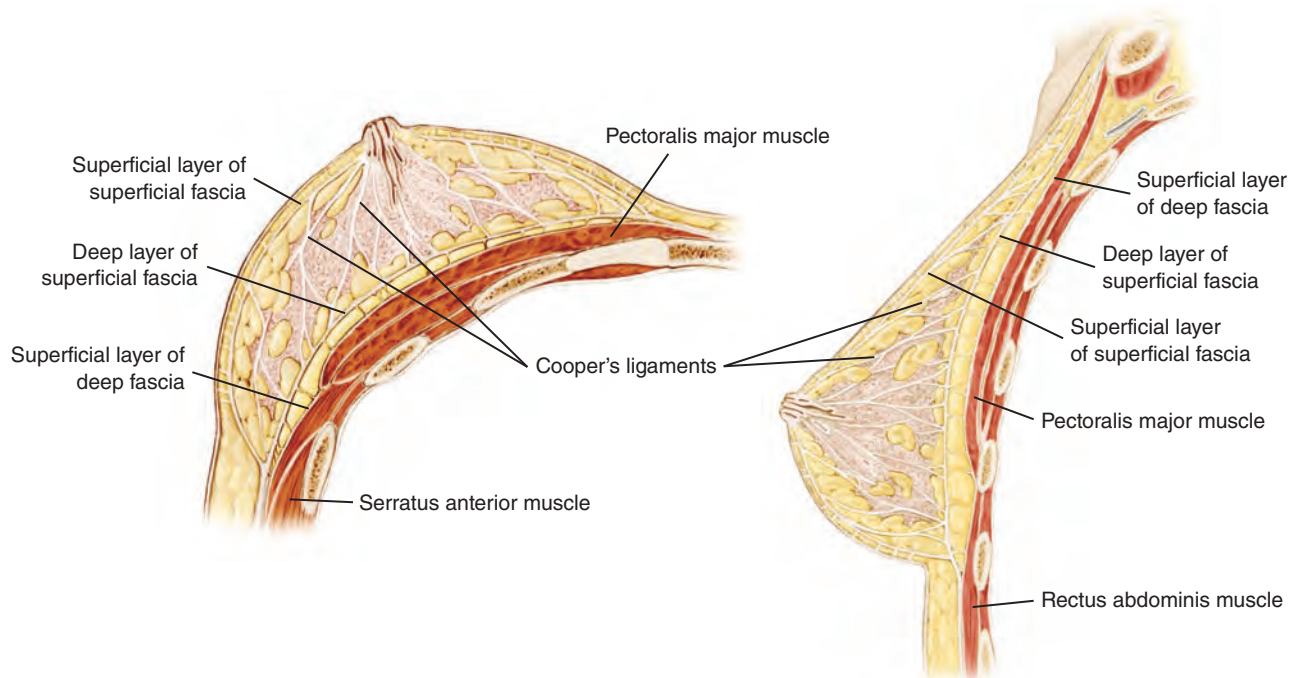
The breast parenchyma is divided into lobules like the segments of an orange, each segment having its own set of draining ducts that terminate in the nipple. This separation is only apparent on ductography.



The blood supply to the breast consists of a complex interlacing system of vessels arising from the internal mammary perforators, the cutaneous branches of the intercostal vessels, the thoracoacromial vessels, and the lateral thoracic vessels, together with a small contribution from the crossing branch to the serratus anterior from the thoracodorsal system.



The nerve supply is from the intercostal nerves (second to seventh); the primary supply to the nipple is derived from the fourth intercostal nerve.



The breast is suspended from the pectoralis major muscle fascia and to some extent by the suspensory ligaments of Cooper. These have to be divided during subglandular augmentation. The inframammary crease is a discrete anatomic structure that may be very tightly developed in some women with hypomastia, particularly those with constricted breasts. Releasing or lowering this anatomic landmark may require radial scoring of the parenchyma up to the dermis in selected cases. Thin patients

with widely separated breasts often have a significant expanse of poorly padded skin overlying the intermammary area and sternum; this may provide inadequate coverage for an implant and result in significant visibility of the implant.

Preoperative Assessment

Physical Examination

A thorough medical history should be taken, including direct questions about any family history of breast or ovarian cancer. I have seen several patients with a history of these cancers who subsequently tested positive for the breast oncogenes when screened. A thorough physical examination should be performed, paying particular attention to evaluation of the skin, nails, and joints for signs of collagen vascular disease and compressive neuropathies.

The surgeon should assess height and weight relationships, particularly the length and width of the chest and trunk. Skin quality and the thickness of subcutaneous fat have a significant impact on the choice of implant location—the thinner the patient, the more likely she is to benefit from submuscular coverage of the implant to mask rippling.

Breast symmetry should be carefully evaluated, and any preoperative differences should be documented photographically and pointed out to the patient. Nipple levels should be measured and differences noted. Nipple size and sensation should also be assessed. The level and tightness of the inframammary fold should be evaluated, and any plan to drop this fold should be discussed with the patient, because this may affect the fit of a bra. The size and thickness of the pectoralis major muscles should be evaluated, because very active, muscular patients often do better with subglandular augmentation than submuscular placement, since the latter may result in rhythmic displacement of the implant during heavy upper body exercise. Finally, and most important, the breast should be examined for masses. The role of preoperative mammography remains a vexing question. I prefer to have mammograms taken of any woman over the age of 35 who is contemplating aesthetic breast surgery.

Patient Education

Patient education is vital during consultations, because breast augmentation has one of the highest incidences of short-term and long-term complications of virtually any cosmetic operation performed today. All complications should be listed and discussed individually with the patient, particularly capsular contracture, rippling, deflation, impact on mammography, and nipple sensation. The potential link with autoimmune disease should be discussed and placed in proper perspective, and patients should

also be reassured that breast-feeding will be unaffected by this procedure. Informative literature should be made available as a routine part of any consultation, and high-quality photographic documentation is essential. If patients are part of a gel implant study, all pertinent documentation should be completed meticulously to satisfy study guidelines. Although breast augmentation often requires subsequent revision surgery and patients need to be informed of that possibility, most patients remain extremely satisfied with this procedure and believe they understand its complications and that its benefits far outweigh the risks.

Preoperative Planning

Determining Breast Volume

The patient's concept of her ideal breast size strongly influences the ultimate decision about breast volume. I always inquire what the patient thinks of her present breast size and ask her to bring in a padded bra or a picture that provides a better indication of a breast volume that is more to her liking. Photographs that illustrate women whose breast size approximates the size that she desires can provide a good indication of the degree of enhancement that the patient is looking for. Digital imaging can also facilitate communication when trying to determine the appropriate breast size. By using an imaging system, the surgeon can demonstrate the various size increases and the resulting impact these will have on body proportions. When using such an imaging system, it is important to emphasize to the patient that no guarantees are implied by the morphed images. This imaging is intended only to give the patient an idea of possible changes and how they would look, and to help her to understand the various treatment approaches from which she can choose.

Implant Selection

Implant Fill

Implant selection is influenced in part by the availability of devices. Outside the United States, cohesive gel-filled form stable implants have become the benchmark for breast augmentation as well as implant-based reconstruction. Cohesive gel implants have been used in Europe since 1995 and have been available in Canada since 2000 through special approval by Health Canada. One of the advantages of the newer generation cohesive gel-filled implants is that they feel more natural. Compared with saline-filled breast implants or even conventional gel filled devices, rippling is less common because they are semisolid. Deflation is also not a problem with

cohesive gel implants, and if a cohesive gel implant ruptures, it still maintains its shape and integrity. There are also a number of implant models with varying projection, height, and width, so there is some flexibility in selecting the best implant size to balance body proportions and breast aesthetics. A disadvantage of cohesive gel-filled implants is that they require a slightly larger incision for insertion because they are semisolid; they are also more expensive. These implants are usually placed through an inframammary incision.

Surface Texture and Shape

The surgeon must also choose between textured or smooth and round or shaped implants, with low, medium, or high profiles. Textured devices have a somewhat lower capsular contracture rate than smooth implants, but they have thicker walls and greater palpability. Texturing may also cause higher rupture rates, but these data are not conclusive. In general, smooth-walled implants are preferable for use in very thin-skinned patients to diminish implant palpability. Textured devices are better tolerated in thicker-skinned women or those with modest amounts of breast tissue.

Round implants work very well in most women, but some surgeons prefer the appearance of anatomically shaped implants. When the upper pole of the breast is deficient, anatomic implants may be particularly helpful, because they can create the impression of a gentler taper onto the chest wall than a round implant might achieve.

A high profile implant has greater anterior projection with a smaller base diameter than an equivalent moderate profile implant. High profile implants are best used in women who want significant anterior projection, as well as in narrow-chested women in whom the use of a larger-diameter device may cause unsightly underarm bulging.



Note the difference in projection between high profile (*left*) and moderate profile (*right*) implants.

Size

In general, it is wise to use implants with volumes of less than 400 cc for breast augmentation; larger volumes tend to be associated with higher complication rates, including complications such as gravitational ptosis.



This 32-year-old woman was referred to me for a second opinion after she had had 450 cc saline-filled implants inserted through an inframammary approach. Overdissection inferiorly and medially, combined with the use of large implants in an effort to produce cleavage, produced a catastrophic result, with imminent erosion inferomedially, derotation of the nipples, and incipient synmastia. The ultimate clinical outcome of this case is unknown.

In recent years there has been a trend toward evaluating implant size based on implant and breast diameter rather than total reliance on implant volume. Although it is true that implant projection increases with volume, it is also notable that implant base diameter increases with volume. Added to this is the fact that a moderate profile implant has a much broader base diameter than an equivalent-volume high profile implant. A narrow-chested woman may benefit more from a high profile implant with a narrower base diameter so as to minimize the risk of the implant bulging into the axilla than she would if a broad-based moderate profile implant were inserted.

Volume requirements are also influenced by the patient's weight: volume requirements become more extreme and the results less satisfying for overweight patients. Although a 220 cc implant will provide good contour improvement for a thin patient, this same implant will not provide adequate contour enhancement for an obese patient.

Measurement of the breast dimensions with calipers provides a reasonable estimate of the implant base diameter required to achieve an appropriate augmentation and can serve as a guide as to whether a patient would be a good candidate for a moderate or high profile implant. Breast diameter as well as medial and lateral breast tissue pinch thickness can be used to determine implant volume.

If the base breast diameter in centimeters is X , the medial pinch thickness is Y , and the lateral pinch thickness is Z , then $X - (Y + Z) =$ the base diameter of the average-sized implant that will fit comfortably beneath the skin envelope. Part of this decision-making process depends on the patient's preference about perceived projection of the final breast shape. Implant companies provide surgeons with detailed tables of implant dimensions including the length, width, and height of any given implant volume; moderate and high profile dimensions and anatomic shape also factor into these tables. (See the Appendix on pp. 2271 through 2277.)

Adjustable Implants and Temporary Sizers

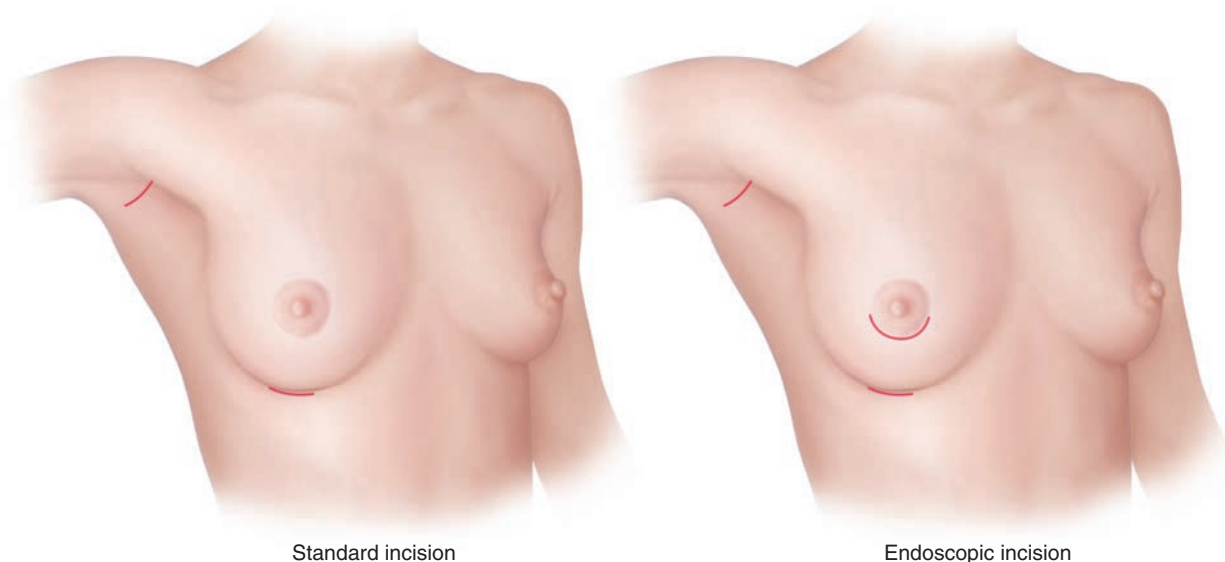
Adjustable implants first appeared on the market in the form of the Becker expander-implant, a double-lumen, gel-saline expander with a pull-out fill tube mechanism. The device is used for breast reconstruction and is designed for permanent placement once expansion to the required volume has been achieved.

The Siltex Spectrum implant is an extension of this principle as applied to breast augmentation. It is a textured saline-filled implant with a pull-out filler mechanism that allows for postoperative volume adjustment once implanted. The device is useful in patients who have breast asymmetry or those who are unclear about what size they would like to achieve. The devices have a leeway of only about 50 to 60 cc once filled, so major changes in volume are not possible.

Adjustable implants carry the risk of deflating when the fill tube is removed, because the valve seal can fail, either early or late. Also, valve removal mandates a second minor procedure in the office, and additional scarring may develop at the site of removal.

Temporary intraoperative saline sizers provide an alternative to adjustable implants. Sizers allow a high degree of intraoperative accuracy in volume assessment, particularly in patients with asymmetrically sized breasts. (See the Appendix on pp. 2271 through 2277.)

Incision Placement

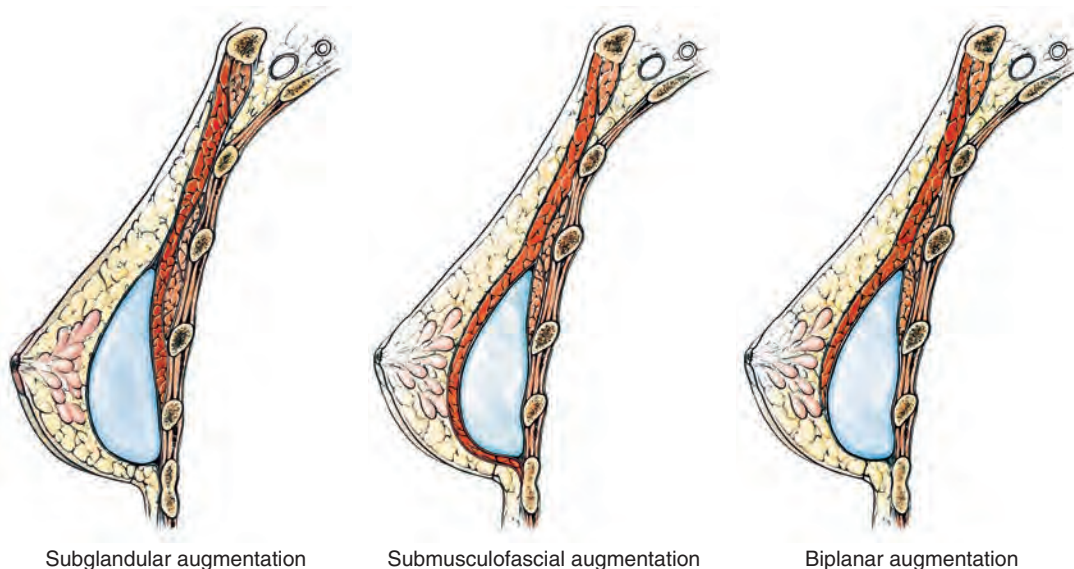


Incision placement is largely dependent on surgeon and patient preferences. There are three basic choices: inframammary, axillary, and periareolar. The transumbilical approach is also used but is less popular than the others. If a patient has a well-defined inframammary crease with mild ptosis, an inframammary incision is easily camouflaged postoperatively. However, if the crease is almost nonexistent, as is the case for patients with severe hypomastia, an axillary placement is preferable. Periareolar incisions are useful in patients with normal to large areolae, but many patients with marked hypomastia have small areolar diameters that do not lend themselves readily to this approach. If a woman has major concerns about nipple sensitivity, it is probably unwise to employ a periareolar approach.

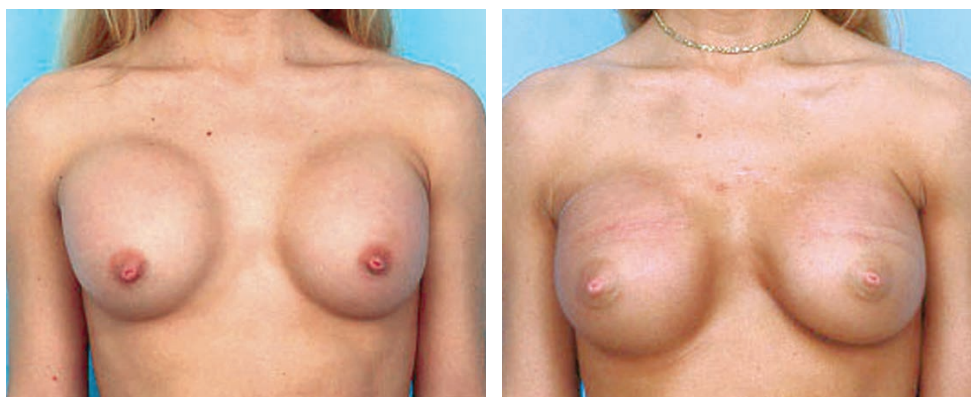


When using the inframammary approach, I prefer to place the incision approximately 1 to 1.5 cm below the existing crease; this allows the scar to glide up into the new breast crease, since the augmentation recruits inframammary skin up onto the breast mound. Failure to perform this simple maneuver results in the scar's creeping up onto the lower breast mound and becoming more visible. Incision lengths should be kept to a minimum, preferably less than 5 cm.

Implant Position



The optimal implant position must also be determined. There are three options: subglandular placement, submuscular placement, or biplanar placement, which is partially submuscular and partially subglandular in its lower pole. Advocates of the subglandular approach believe that it produces a better breast shape. Those who prefer the submuscular approach believe that the layer of muscle over the implant has a cushioning effect, thereby promoting a softer breast with less potential for capsular contracture. The biplanar approach combines the benefits of both approaches.



This 28-year-old woman was referred to me for correction of high-riding implants caused by incomplete inferior dissection, as discussed earlier. A transaxillary endoscopic inferior capsulotomy was done, with her implants left in situ during the procedure. Note the lowering of the inframammary crease bilaterally.

Patient Position

The patient is placed supine on the operating table with her arms stretched out. The arms should be well padded and wrapped onto the arm supports with wool padding to allow the patient to be flexed to an angle of 80 to 90 degrees with safety. This allows accurate intraoperative assessment of implant position in the erect posture; however, it does place the pectoral muscles under tension. The table should be able to break at the waist and flex to an angle of 90 degrees. If a transaxillary endoscopic augmentation is planned, draping should allow access for the surgeon above the arms during the endoscopic portion of the procedure.

Markings



Incorrect scar placement
in relation to inframammary fold



Correct scar placement
1 cm below inframammary fold

The inframammary crease is marked, as is the upper pole of the breast. The midline is marked at the intermammary space. If the inframammary fold is to be adjusted inferiorly, the degree of lowering should be clearly marked and the patient made aware of the new location. The location of the incision and its length are then marked. If an inframammary approach is planned, the incision should be placed 1 cm below the natural crease because recruitment of abdominal skin up onto the new breast mound will inevitably pull the scar into the new crease. Failure to carry out this maneuver results in scar migration into a visible position on the breast mound.

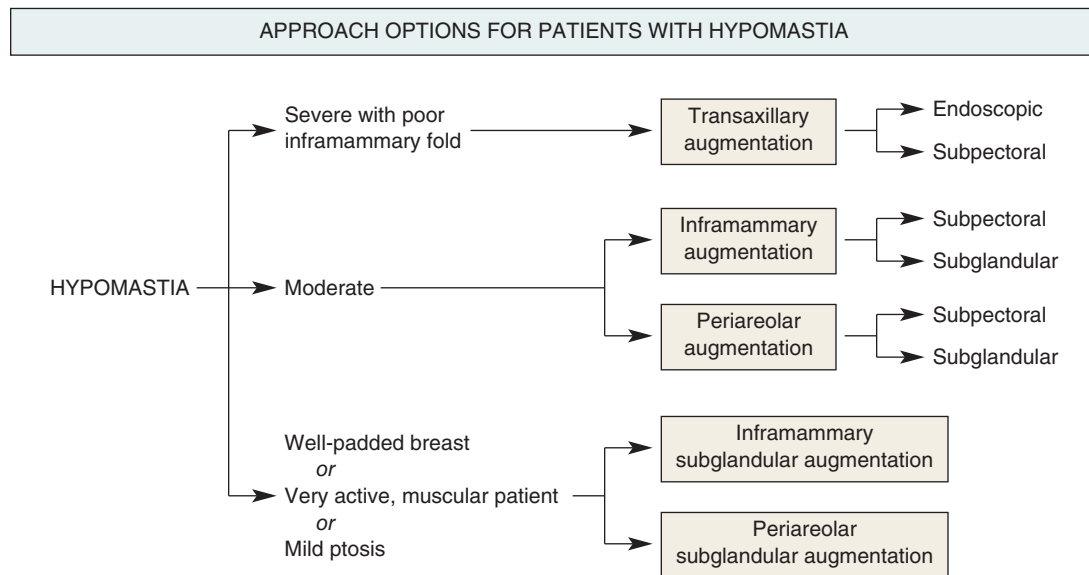
Periareolar incisions should be placed at the juncture of the areola and breast skin, not within the areola itself; any tendency to whitening of the scars will make a scar within the areola very visible.

Transaxillary markings should be placed high within the axillary floor; the surgeon should be careful to keep the anteriormost limit of the scar away from the anterior axillary fold, where it may be visible in sleeveless clothing. In patients with breast asymmetry, the incisions are placed to reflect the final breast shape and position of the

inframammary fold. If a patient has a higher crease on one side than the other, the higher crease should be lowered to match the normal opposite crease, and the scar placement should be positioned lower to reflect the new crease position.

Treatment Algorithms: Choosing the Best Augmentation Approach

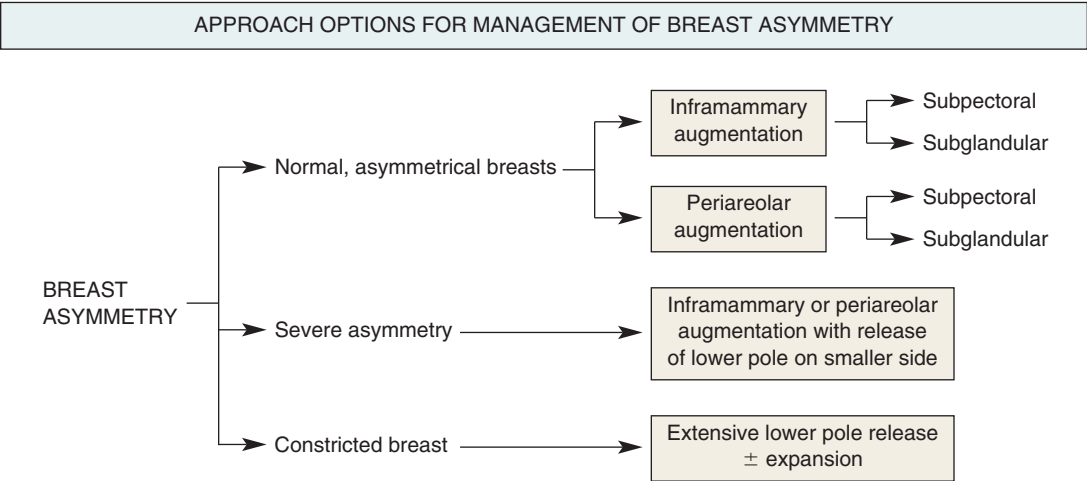
At present, I perform the bulk of breast augmentation procedures through an inframammary incision into the biplanar subpectoral plane in an effort to reduce capsular contracture. This comes at the expense of less projection per cubic centimeter of implant volume and a slightly less pleasing shape. There is no doubt that subglandular augmentation provides better shape and projection overall. Subglandular augmentation is best performed in active or muscular individuals with reasonable subcutaneous padding and a moderate-sized breast to start with. This provides the best implant camouflage and reduces the incidence of visible implant ripples and wrinkles. Very small-breasted women with little or no fold definition are well suited to transaxillary augmentation, as are patients with a propensity for keloid formation, such as women of Asian or African heritage.



Options for Patients With Asymmetrical Breasts

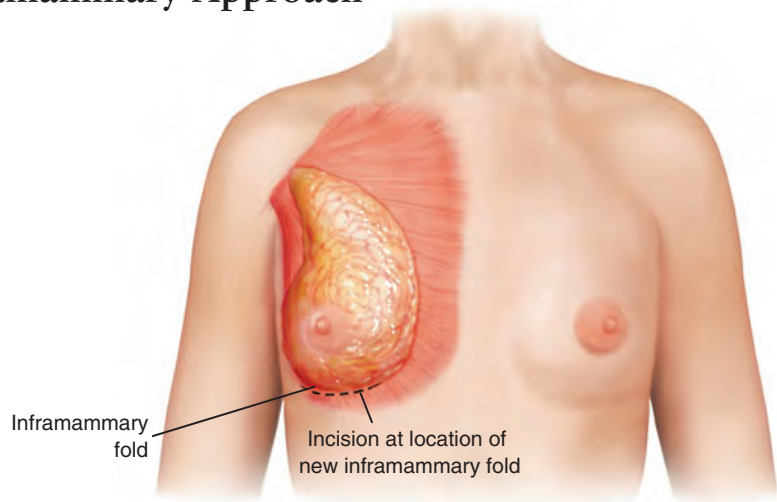
Patients with asymmetrical breasts present unique challenges because of the potential for residual postoperative asymmetry. Breast shape may be complicated by associated ptosis as well as constricted breast deformity. Selection of asymmetrical implant sizes will correct the problem, and the use of saline-filled implants can be really helpful, because they allow some degree of intraoperative adjustment to correct subtle residual differences in breast size. In more complex or severe cases, mastopexy may be necessary, at least on the more ptotic side, a problem that requires patient

acceptance of more extensive, asymmetrical scar placement. In patients with constricted or tubular breast deformity, extensive release of the lower pole of the affected breast may be necessary, and in more severe cases, initial tissue expansion may be the only recourse available to the surgeon. The surgery of constricted or tubular breasts is not the topic of this chapter, but a basic algorithm for the patient with asymmetrical breasts is useful.

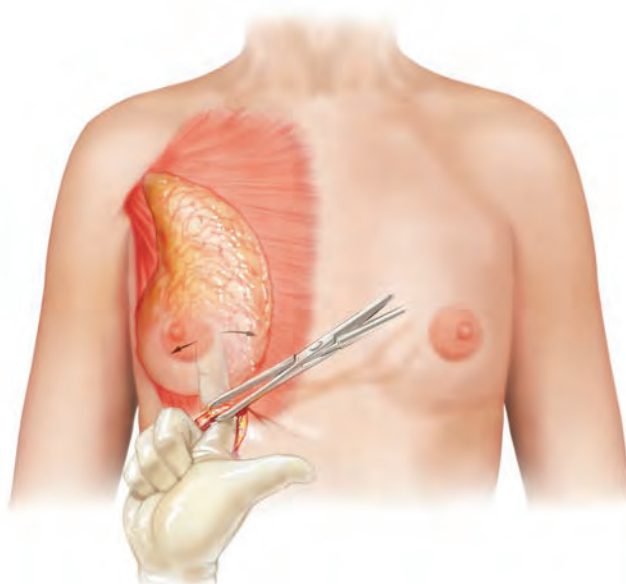


Operative Technique

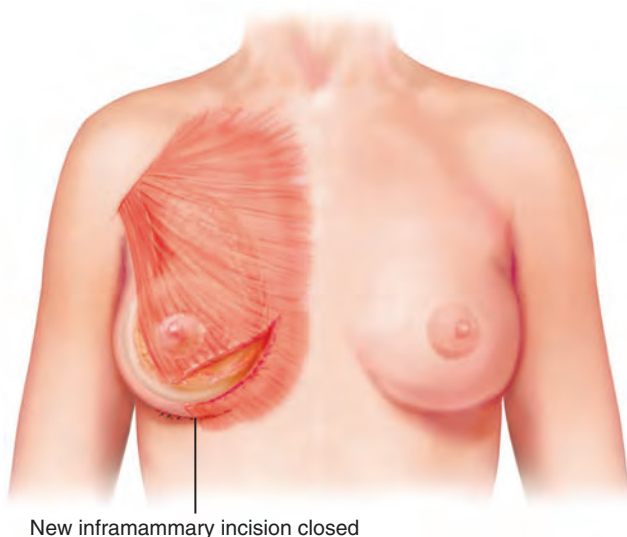
Inframammary Approach



With the patient in the supine position, an inframammary incision is made through skin and subcutaneous fat. Dissection is carried down to the pectoral fascia, retracting the breast in a cephalad direction. The lateral border of the pectoralis major muscle is grasped with an Allis clamp and after the muscle edge is elevated, the subpectoral plane is entered with blunt scissors dissection.



Once entered, the subpectoral plane can be bluntly dissected with either gentle finger dissection or a metal sound or breast dissector. At this point dissection is entirely blunt, with no attempt at muscle avulsion. The cavity thus created is now visualized by inserting a fiberoptic illuminated retractor with suction incorporated.

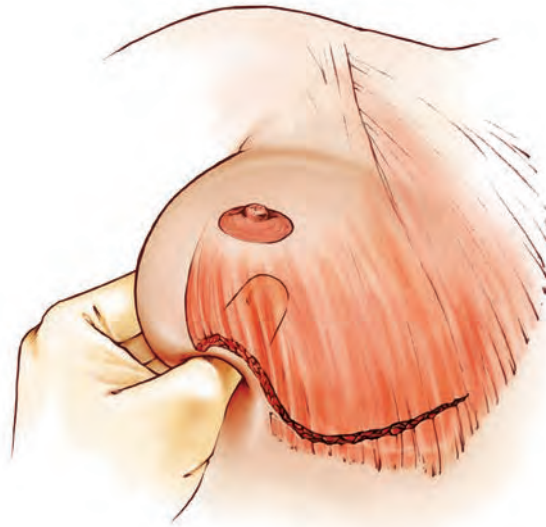


Under direct vision, the medial pectoralis major fibers are divided with cautery from the 3 to 6 o'clock position on the right and the 6 to 9 o'clock position on the left. Muscle division may be carried through the muscle belly until the grayish-white color of the prepectoral fascia is visualized or until fat is just visible. Some authors recommend leaving the muscle intact to prevent visible implant ripples and wrinkles in the cleavage area. Overdissection medially may result in synmastia with time, a problem that is extremely difficult to correct.



Overdissection in an inferomedial direction may result in an unattractive, boxy appearance to the medial breast, as seen in this woman, who required correction by open capsulorrhaphy, with nonabsorbable sutures tacking the dermis to the underlying rib periosteum. The pocket size and location should be created to place the implant exactly where it is wanted.

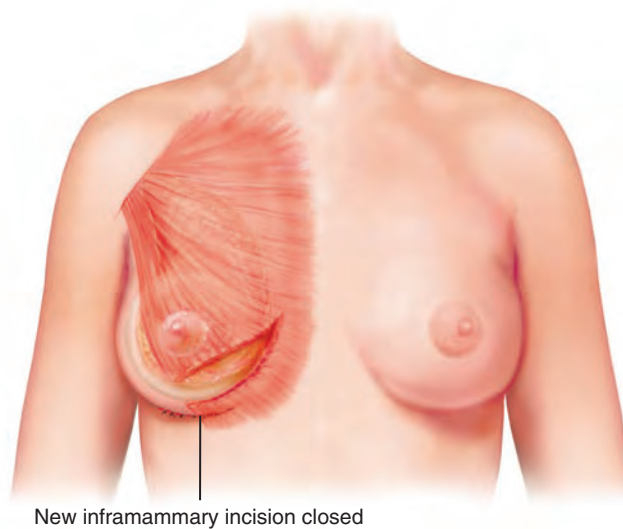
Care should be taken when releasing the inframammary crease to prevent abnormally low implant descent with pseudoptosis and derotation of the nipple areola complex.



Laterally the implant pocket is opened with blunt finger or breast dissector stripping. The loose areolar tissue in this area offers little resistance, although occasionally muscle fibers from the lateral border of the pectoralis major may need division. Care should be taken to avoid overdissecting this area inferolaterally, because it can cause a lateral implant bulge that is extremely difficult to correct. Superior dissection should be kept to a minimum to limit the risk of development of excessive upper pole fullness. Once the pocket has been prepared, it is irrigated with either saline solution or an antibiotic solution containing gentamycin, bacitracin, and a cephalosporin. There is some evidence that this may reduce capsular contracture by limiting skin commensal bacterial contamination. Iodine-containing solutions such as Betadine should

not be used to wash the pocket, because they have been implicated in silicone implant wall compromise.

Symmetry of the dissected pockets is essential and should be carefully checked. With symmetrical pockets in place, temporary sizers may be used to evaluate the effect of different implant volumes on the final shape of the breast.



After further pocket irrigation, the definitive implants are selected and inserted. Before insertion, it is useful to apply an occlusive dressing such as Tegaderm or Ioban over the breast to prevent any contact of the implant with the skin. The surgeon's gloves should be changed at this juncture to further minimize implant contamination with bacteria. The use of a Keller funnel is another useful but currently expensive technique that can reduce bacterial contamination of the device during insertion. Implant position is carefully adjusted, particularly if textured surface devices are used.

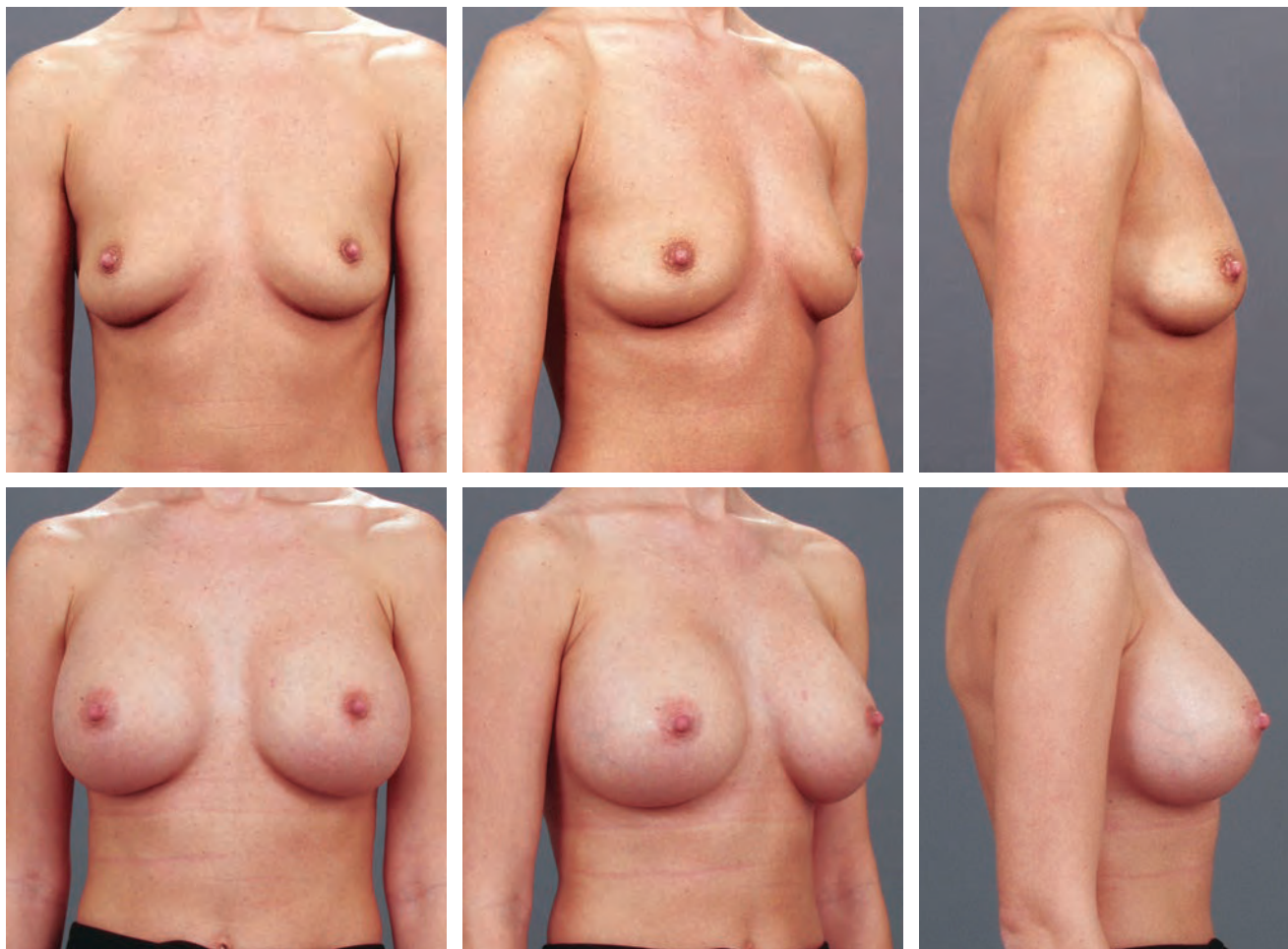


Closure is performed in three layers with a running subcuticular suture, starting with a deep fat and fascial layer, followed by a subcutaneous layer. Steri-Strips and an adhesive transparent dressing such as Tegaderm or Op-Site are then applied, followed by a soft, supportive bra.

Results



This nulliparous 28-year-old woman requested breast augmentation and liposuction of her suprapubic area. She had small B cup breasts and well-formed inframammary folds, with modest suprapubic lipodystrophy. Inframammary subpectoral augmentation was performed with 275 cc smooth, round, saline-filled, high profile implants; liposuction was also done in the suprapubic area. She is shown 9 months postoperatively.

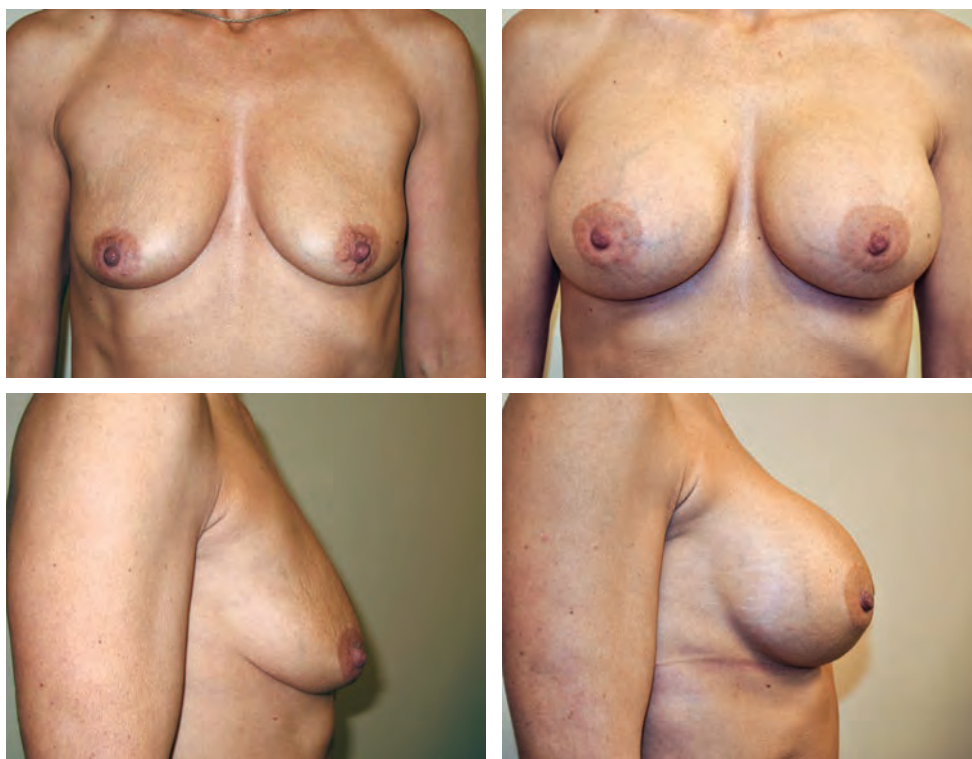


Inframammary augmentation was performed in this 27-year-old woman with a long, narrow chest and small B cup breasts. Her breasts were augmented with 325 cc smooth, round, saline-filled implants inserted in a subpectoral position. She is shown preoperatively and 12 months postoperatively.

Subglandular Approach

If a subglandular placement is planned, dissection is carried down to the pectoralis major fascia, and the breast gland is simply dissected off the muscle until an adequately sized pocket has been fashioned. Care should be taken medially, where internal mammary perforators may penetrate the breast from within the substance of the muscle; these should be meticulously cauterized. Care should also be exercised to not dissect too close to the skin to reduce the potential for visible wrinkling, palpability, and erosion. Implant placement, sizing, and closure remain the same as for partial subpectoral placement. Subglandular positioning will tend to provide more anterior projection of a given implant volume than would be the case with a partial subpectoral position.

Results



This 38-year-old woman with grade 2 ptosis requested a breast augmentation and lift without mastopexy scars; inframammary subglandular augmentation with 325 cc smooth, round, gel-filled implants was performed. She was willing to accept less-dramatic nipple elevation if she could avoid the scarring associated with a mastopexy. The lift produced by subglandular implant placement could not have been achieved with submuscular augmentation. Although this did not produce an ideal mastopexy effect, the patient was satisfied with the outcome, which achieved her goals.

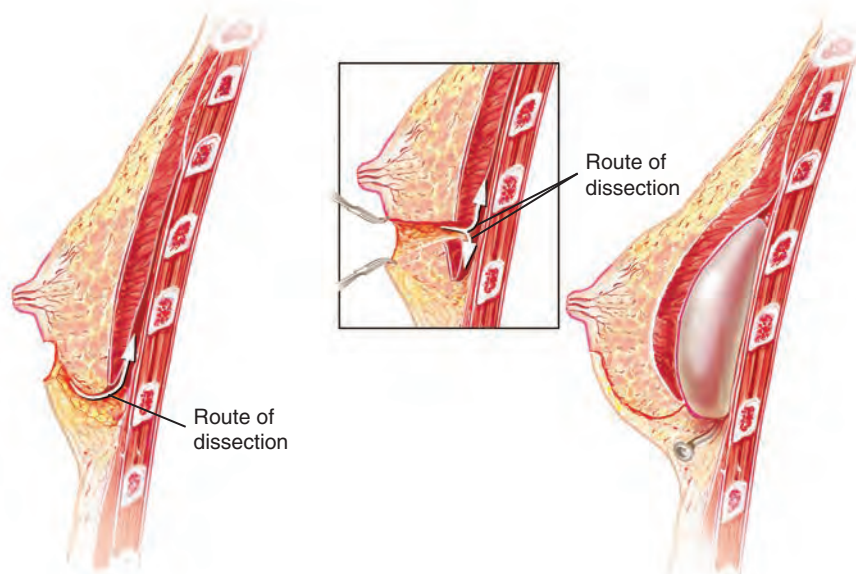


This 32-year-old aerobics instructor specifically requested subglandular placement to minimize implant displacement during exercise. She is shown after inframammary subglandular augmentation with 300 cc smooth, round, saline-filled implants.

Periareolar Approach



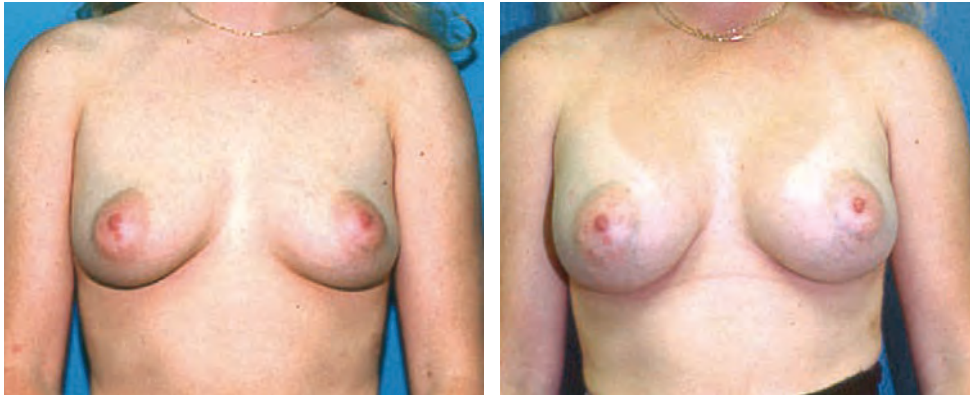
The periareolar approach requires an adequate areolar diameter through which to operate. The incision should be made directly at the areola-cutaneous junction to best camouflage the scar. Attempts at placing the scar within the areola may result in the scar being visible if it turns white on maturation.



Periareolar access to the subpectoral plane through either subcutaneous or transglandular dissection

Dissection is begun subcutaneously over the breast and proceeds down to the inframammary fold. This is then lifted to expose the underlying pectoralis major muscle, which can then be elevated for a partial submuscular placement. Alternatively, a subglandular dissection is easily performed through this incision. Another technique used by some surgeons is to bisect the breast below the areola and approach the implant pocket directly through the substance of the breast. Either approach works satisfactorily, but patients should be warned of the potential for some sensory loss in the nipple-areola complex, usually temporary in nature.

Results



Periareolar subglandular augmentation with 325 cc smooth, round, saline-filled implants was performed in this 26-year-old woman with small C cup breasts. The patient had a pleasing result, with restoration of upper pole fill and enhanced cleavage.

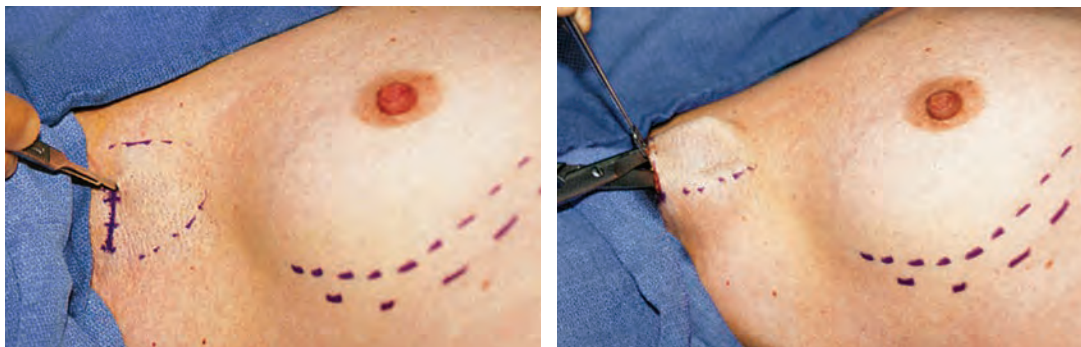
Transaxillary Approach

The original transaxillary approach was an essentially blind operation that made medial visualization difficult for securing hemostasis or accurately dividing muscle fibers. The use of the endoscope has substantially improved the accuracy and predictability of this operation. Crease symmetry, muscle division, and implant positioning can be achieved with a greater degree of confidence and ease.

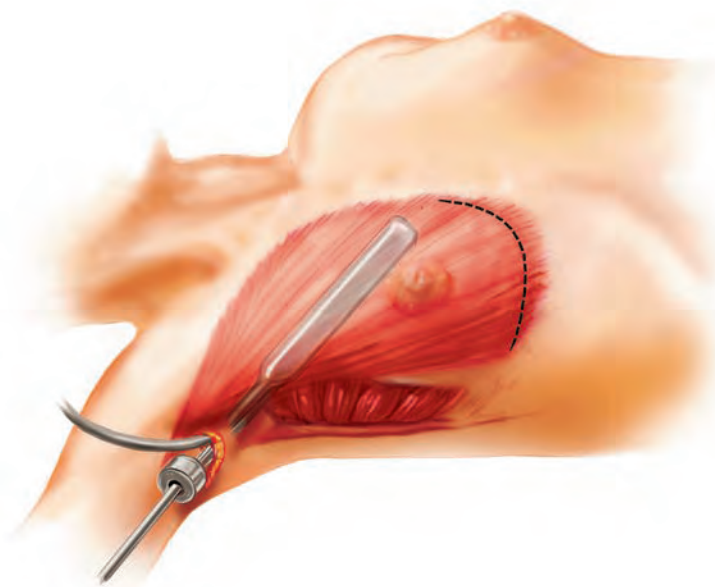
Equipment Required for Endoscopic Transaxillary Augmentation

- 10 mm 45-degree down-viewing breast endoscope
- Three-chip endoscopic camera with compatible O ring connector
- Emory breast retractor handle (right-angled handle) with incorporated suction port
- Fiberoptic cable with compatible connection to the endoscope
- Suction tubing
- Emory insulated cautery dissector and handle (right- and left-handed variants)
- Electrosurgical unit with appropriate connecting cable to the cautery dissector handle
- Blunt dissector (several designs available)
- Fog-reduction agent
- Long vertical container for warm saline solution to heat the endoscope lens for fog reduction
- Mobile wheeled endoscopic cart containing camera-video output and monitor with video recorder

The patient is placed supine on the operating table with adequate access above the arms for the operating surgeon.

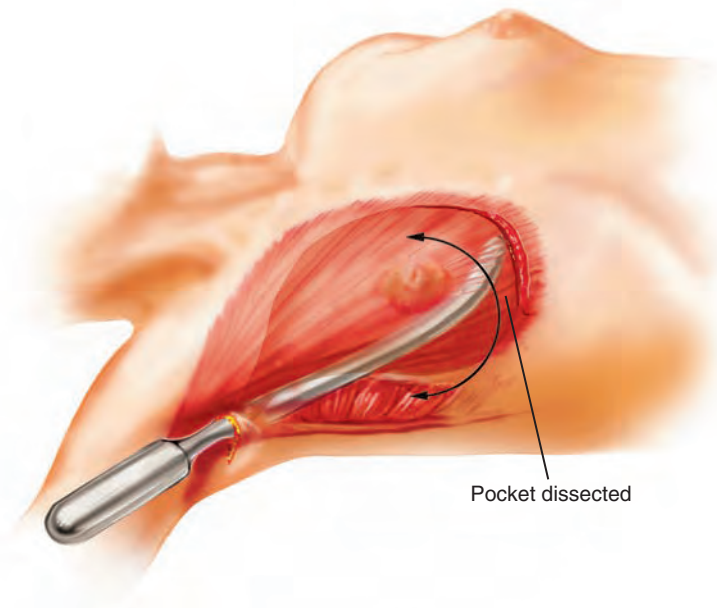


Before surgery, if lowering of the crease is planned, the surgeon should mark the original inframammary crease as well as its new, lower location. The axillary incision is made in the midaxillary floor behind the anterior axillary fold to camouflage the scar adequately. The fat of the axillary floor is dissected with a blunt scissors-spreading action to prevent damage to the intercostobrachial nerve. The lateral pectoral fascia is opened by perforating it bluntly with closed scissors; with the use of a spreading action, the subpectoral plane is entered. This is facilitated by grasping the lateral pectoral muscle border between the thumb and index finger of the left hand while dissecting beneath it with scissors. Once the subpectoral plane has been breached, it can be bluntly opened up with an Emory dissector, Hegar dilator, or similar instrument. No attempt is made at this point to divide muscle fibers. The endoscope sheath is then inserted into the pocket while the endoscope itself is placed in warm saline solution or water to prevent lens fogging.

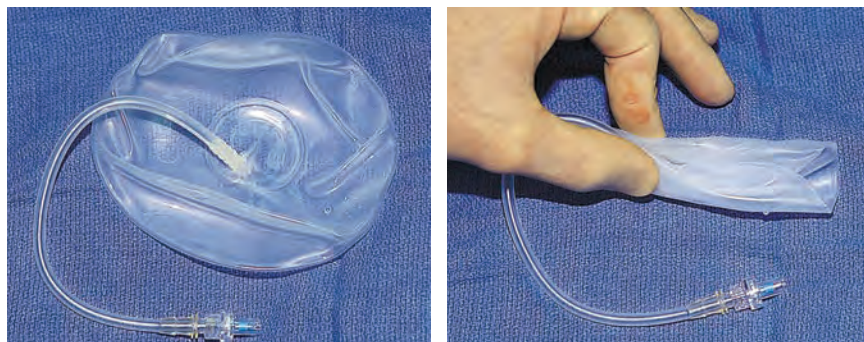


Transaxillary breast augmentation is illustrated, with endoscope insertion into the subpectoral plane. The planned muscle division is marked inferomedially. Once the retractor is in place, the warmed endoscope is inserted through the sheath. The orientation of the camera is carefully checked to ensure that the anatomy is correctly visualized. The toe of the retractor is pulled upward to expose the work face of the deep

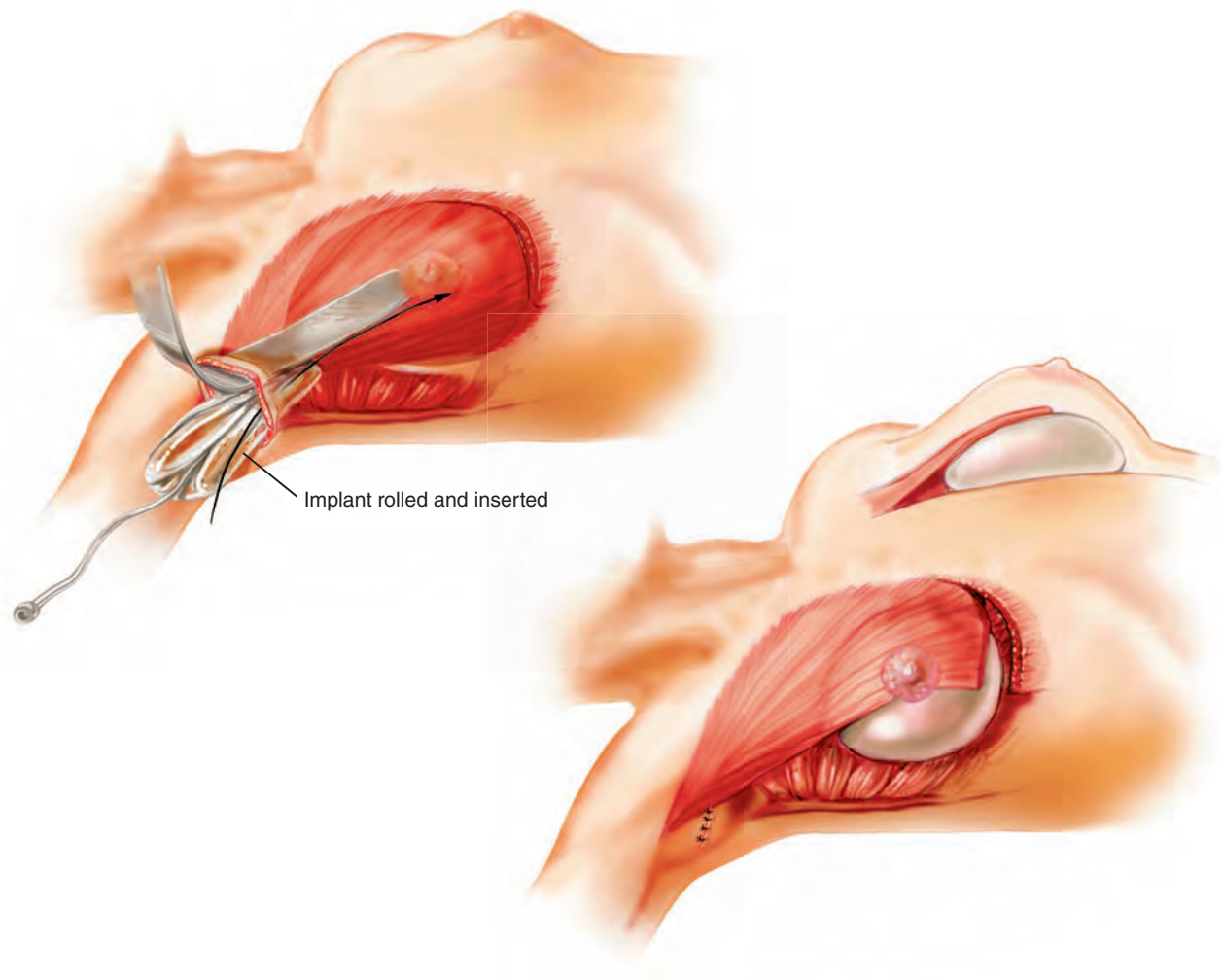
surface of the pectoralis major muscle medially. Suction is connected, because smoke evacuation is vital to this part of the operation. Using a tested, insulated, spatula-tipped cautery, the medial muscle fibers are divided until the prepectoral fascia is seen; this marks the endpoint of dissection. The extent of muscle release is identical to that described for the inframammary approach. The pocket should be inspected carefully to ensure that division of the inferolateral muscle fibers is adequate.



The released pectoral muscle and pocket are bluntly dissected inferolaterally before the implant is inserted. Adequate inferior dissection is essential to correct implant position; failure to perform this maneuver may result in high-riding implants. The inferior dissection should match the external markings placed on the breast mound preoperatively if the surgeon plans to lower the breast crease. After the pocket is irrigated, the implants are inserted.



The implants are removed from their containers, fill tube valves are placed on the ends of the tubing, and a small volume of saline solution is instilled to remove any extra air. The deflated implant is then prepared for insertion by shaping it into a double row that is narrowed at the end for easier insertion.

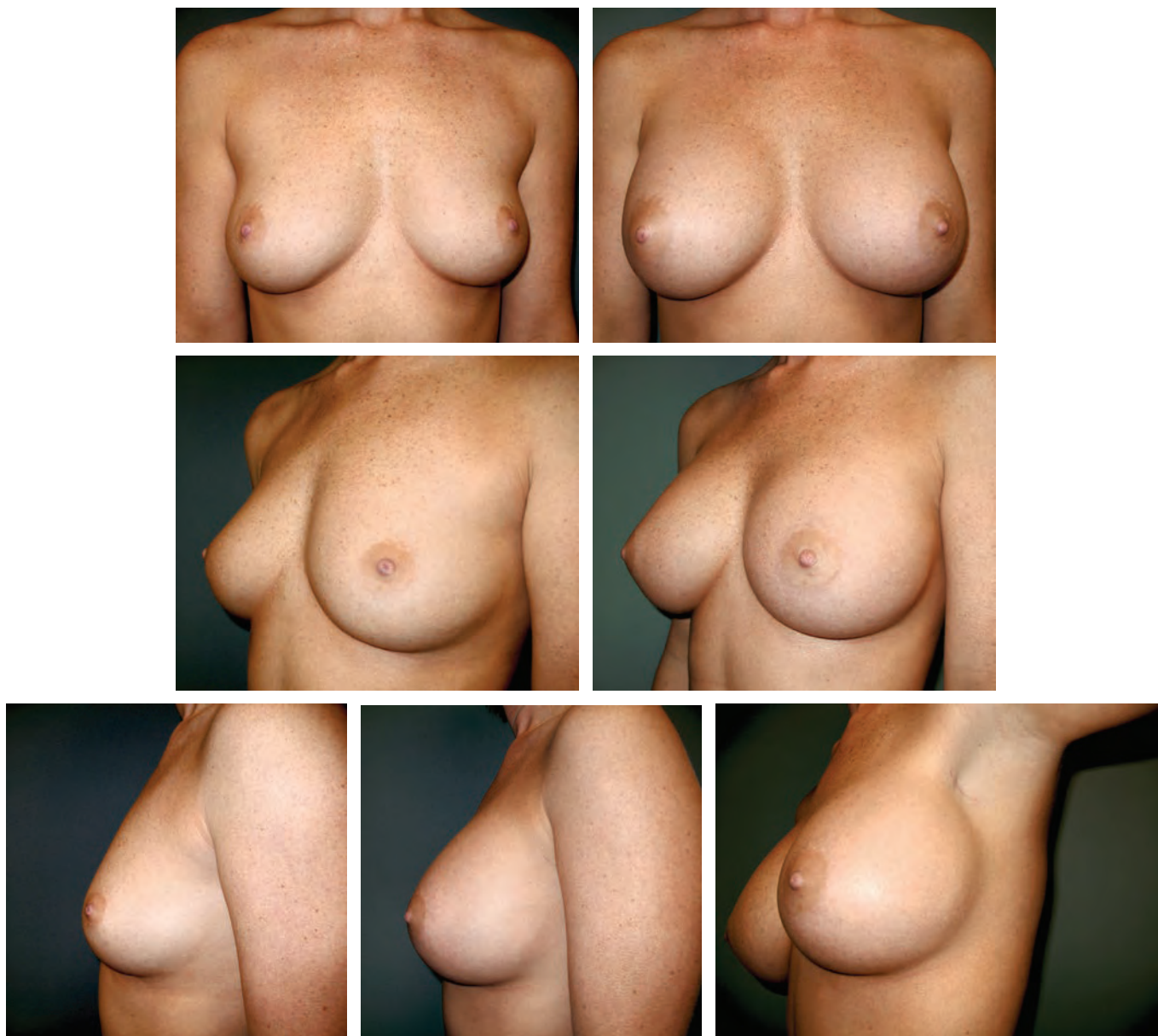


The implant is inserted into the prepared submuscular pocket and inflated. Note its biplanar position.

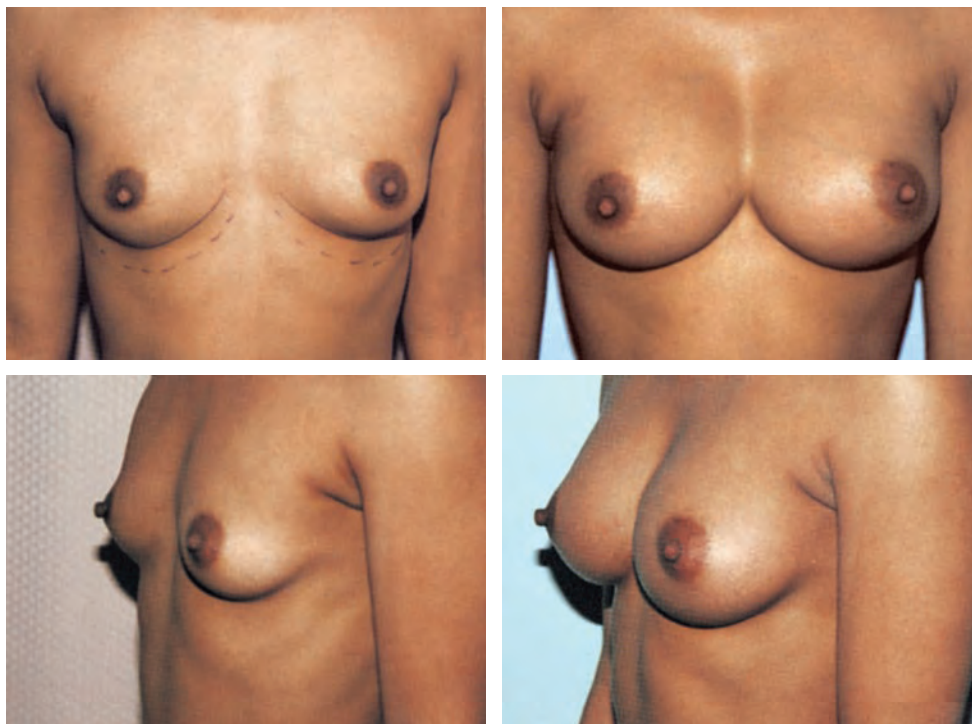


The patient should be evaluated in the sitting position to establish conclusively that symmetry has been achieved and that the implants are not positioned too high. The axilla is closed in a two-layer fashion; no drains are placed. An transparent occlusive dressing is applied.

Results



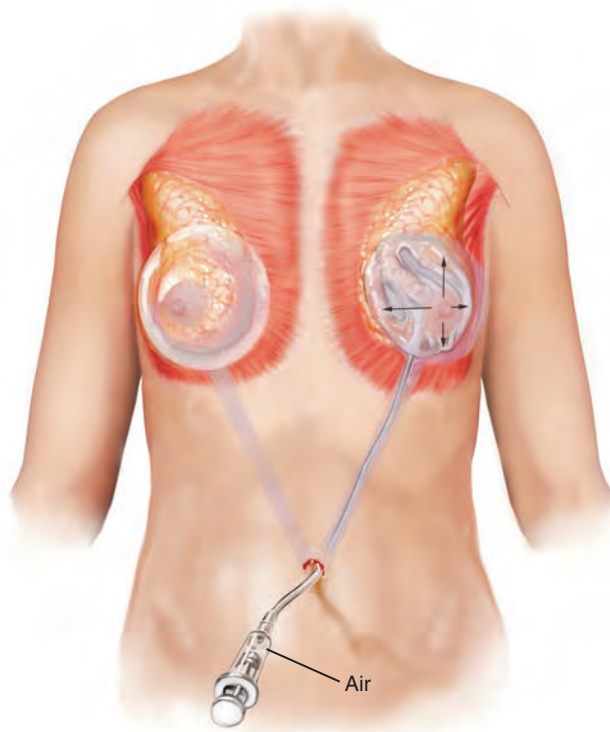
This 26-year-old woman with very mild breast asymmetry requested breast augmentation with the least noticeable scar. Her right breast was slightly larger and more ptotic than the left. She had transaxillary augmentation with placement of 375 cc smooth, saline-filled implants inflated to 400 cc on the left and 375 cc on the right. She is shown 6 months after surgery; asymmetrical transaxillary augmentation improved her symmetry and achieved her goals of not having visible scars on the breast mound. A transaxillary scar is seen in the left axilla.

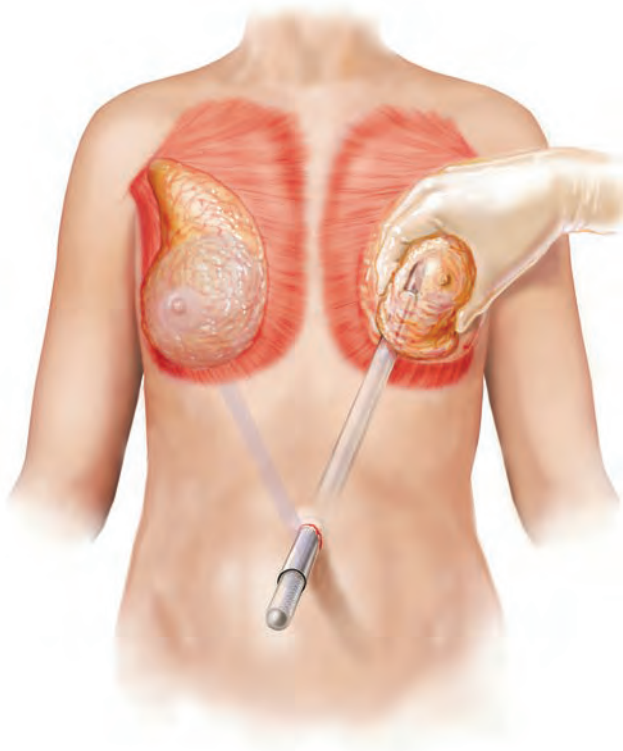


This young woman requested transaxillary augmentation. She is shown before and 1 year after augmentation with smooth, saline-filled moderate profile implants. The patient had an excellent cosmetic result with an enhanced, natural-appearing cleavage, fullness of the lower poles, and restoration of upper pole fullness.

Transumbilical Breast Augmentation

Transumbilical breast augmentation (the TUBA procedure) is performed through a superior periumbilical incision. Blunt dissection into the inferomedial aspect of the breast is performed, and a sigmoidoscope-like sheath is passed into the tunnel. A blunt dissector may be inserted into either the subglandular or subpectoral plane.





A balloon tissue expander is inserted and then inflated with saline solution to create the implant pocket. It is difficult to adjust the pocket with this procedure, and asymmetry or high-riding implants are potential complications. Once the pockets are dissected, the expanders are removed and the implants are inserted and inflated to volume before the fill tubes are removed.

Postoperative Care

Analgesia can be achieved with opiates, or the use of antiinflammatory agents such as nonsteroidal drugs and COX-2 inhibitors. Preloading with an oral dose on the day before surgery seems to help in achieving adequate pain control, and these drugs do not appear to worsen the incidence of hematomas. Instillation of 10 ml of plain 0.25% bupivacaine into the implant pocket before closure also provides early postoperative pain relief, as does the use of bupivacaine infusion pumps such as the OnQ or Stryker devices.

A soft bra without underwiring is used. Patients should not drive for at least 2 weeks postoperatively, and high-impact aerobic exercise is discouraged for 6 weeks. Implant massage may be helpful and certainly does not seem to cause harm; it can be started as soon as the patient is comfortable enough to massage the breasts. The use of leukotriene inhibitors such as zafirlukast (Accolate) is of debatable benefit but carries few side effects. Postoperative antibiotics are still used by most surgeons, although there are no hard data that their use is of any more value than that of perioperative antibiotics alone in limiting postoperative wound infections.

Outcomes

The results of breast augmentation are gratifying and provide patients with an immediate enhancement in breast size. The impact of this shape and volume change on the patient's psyche has been positively documented. Careful patient selection results in a highly satisfied patient population on the whole. Clinical outcomes in breast augmentation are highly satisfactory, with the exception of the occurrence of capsular contracture and implant leakage, both of which will be discussed later in this section. Early complications of primary breast augmentation, such as hematoma and infection, are exceptionally rare. Hematoma rates are reported at less than 4% in most series, and careful attention to intraoperative hemostasis should lower this to 1%. Infection is also extremely rare, and the use of perioperative antibiotics, antibiotic lavage of the implant pocket, and meticulous attention to technique with the incorporation of a no-touch technique have substantially reduced infection rates. Although implant and expander infection rates have ranged from 3% to 35% in reconstructive breast surgery, cosmetic augmentation mammoplasty infection rates should be less than 1% in experienced hands. The importance of meticulous operative technique has been emphasized repeatedly, not only for implant infection reduction but what is more important, for reducing capsular contracture, which is thought to be related to subclinical infection.

Capsular contracture undoubtedly remains the most frustrating and most common complication of breast augmentation. Numerous investigators have reported their experience with saline, gel, and smooth and textured devices, with markedly differing results. The Mentor and Allergan studies have helped clarify some of the data. Mentor reported an 8.3% risk in primary augmentation and a 16.3% risk in secondary augmentation. Allergan reported a 15% to 20% risk in both augmentation and reconstruction patients together. These figures remain high. From the plethora of retrospective and some prospective data available, several conclusions seem valid. Saline-filled implants are clearly associated with a reduction in capsular contracture rates in most reported studies. Polyurethane coating of gel-filled devices reduces capsular contracture to less than 1% during the first 10 years after surgery. In an effort to mimic the polyurethane surface by texturing of the gel implant wall, some reduction of capsular contracture occurs. Alternative fillers have been disappointing both in their rupture rates and their capsular contracture rates; hydrogel implants (polyvinylpyrrolidone [MISTI Gold]) and lipid-filled devices (Trilucent) failed to live up to expectations and were withdrawn from the market. Double-lumen saline-gel combination implants have had a good performance record, and texturing appears to further reduce their contracture rates. Although U.S. surgeons have limited access to cohesive gel implants, plastic surgeons elsewhere have had considerable experience and report positive results with the newer form-stable cohesive gel devices; however, accurate long-term follow-up data are still sparse. Capsular contracture is purportedly low, but patients often complain of breast stiffness because of the firmness

of the gel. The new generation of softer cohesive gels appears to have solved this problem. Implant position is still a significant factor in reducing capsular contracture. Partial submuscular placement does appear to reduce contracture rates, possibly because of the massaging effect of the pectoral muscles. A 58% incidence of capsular contracture has been noted when smooth silicone devices were placed in the subglandular position, compared with a 9% rate when implants were placed in the subpectoral plane; similar results were found with smooth saline implants.

To prevent capsule formation, steroids have been instilled intraoperatively into saline implants, with variable success. A reduction in capsular contracture has been reported with the use of 40 mg of methylprednisolone within a double-lumen prosthesis, whereas a higher incidence of erosion, skin atrophy, and ptosis has been demonstrated, despite a drop in capsular contracture rates, when steroids were instilled within the implant. This is not surprising, given that steroids are heavier than water and gravitate to the lower pole of the implant, thereby enabling diffusion to occur to the lower pole of the breast. Intraluminal steroid injection should not be performed, because steroids tend to settle inferiorly, and diffusion into the tissues can cause thinning of the lower pole of the breast, increasing the potential for extrusion. Systemic antibiotic prophylaxis, per se, has not been shown to affect contracture rates, but it has been shown that topical pocket lavage with a mixture of cephalosporin and gentamycin may positively affect contracture rates. Use of Mladick's no-touch technique also appears beneficial. Some consider postoperative breast compression helpful, and it carries the benefit of involving the patient in her own care. The value of oral vitamin E therapy is highly conjectural.

For treating established capsular contracture, the use of saline and textured implants may be helpful, whereas subglandular implants may be converted to the submuscular or biplanar location. The question of whether a total capsulectomy is preferable to an anterior capsulectomy remains unanswered. It has been shown that subglandular capsules should be totally removed, because an anterior capsulectomy alone tends to result in higher recurrence rates. Implant malposition remains a significant cause for reoperation at rates of 1.4% to 4.6% in primary augmentation and as high as 14.8% in secondary augmentation.

Concluding Thoughts

Implant-based breast augmentation is gaining in popularity once more and is an effective procedure for breast enhancement. There are more implant choices, both in filler materials and contours. Careful selection of the appropriately shaped device for a given breast morphology can produce stable, long-lasting results. These results depend on good surgical technique based on clear anatomic principles.

Clinical Caveats

Inframammary incisions should be placed below the inframammary fold, because they tend to rise up onto the breast mound as skin is recruited from below.

Overdissection should not be done in any direction; the pocket size and location should be created to place the implant exactly where it is wanted.

Overdissection through the pectoralis major muscle medially, as well as dissection into the subcutaneous fat, may increase the propensity for ripples and wrinkles to appear, whereas inferomedial overdissection produces a boxy breast deformity.

The cavity should never be washed with Betadine solution.

When using endoscopic equipment, the camera orientation should be checked to prevent inadvertent thoracic penetration.

To prevent cutaneous burns, endoscopic cautery insulation should be checked before it is used.

The no-touch technique is used whenever possible to reduce implant contamination.

Extremely large implants should be avoided, because implant volumes of more than 400 cc tend to be associated with higher complication rates.

Annotated Bibliography

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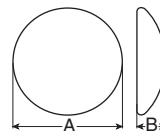
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APPENDIX: IMPLANT OPTIONS

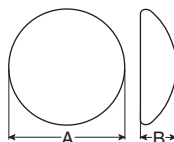
Saline Implants—Smooth (Mentor)

**Smooth Round
Moderate Profile
Style 1600**



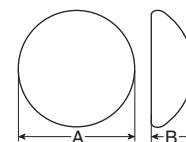
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150 + 25	10.0	3.1	9.6	3.7
175 + 25	10.6	3.3	10.0	3.9
200 + 25	11.0	3.4	10.4	3.9
225 + 25	11.5	3.5	10.9	4.0
250 + 25	11.9	3.6	11.2	4.1
275 + 25	12.3	3.7	11.7	4.2
300 + 25	12.6	3.7	12.1	4.3
325 + 50	13.0	3.8	12.3	4.5
350 + 50	13.3	3.9	12.6	4.7
375 + 50	13.6	4.0	12.8	4.8
425 + 50	14.2	4.1	13.5	4.9
475 + 50	14.8	4.2	14.2	4.9
525 + 50	15.0	4.2	14.5	5.1
575 + 50	15.0	4.5	14.8	5.1
625 + 75	15.2	4.6	14.9	5.6
700 + 75	15.6	4.9	14.9	5.8

**Smooth Round
Moderate Plus Profile
Style 2000**



Volume (cc)	Nominal Fill		Maximum Fill	
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250 + 50	10.8	4.0	10.5	4.7
275 + 55	11.0	4.1	10.8	4.9
300 + 60	11.5	4.3	11.2	5.0
325 + 65	11.9	4.4	11.5	5.2
350 + 70	12.1	4.5	11.7	5.3
375 + 75	12.3	4.6	12.0	5.4
400 + 80	12.6	4.7	12.3	5.5
425 + 85	12.9	4.8	12.5	5.6
450 + 90	13.0	4.9	12.8	5.7
475 + 95	13.3	5.0	13.0	5.8
500 + 100	13.6	5.1	13.2	5.9
550 + 110	14.0	5.3	13.7	6.1
600 + 120	14.5	5.5	14.1	6.3
650 + 130	14.8	5.6	14.4	6.5
700 + 140	15.2	5.8	14.8	6.6
750 + 150	15.6	5.9	15.1	6.8
800 + 160	16.1	6.0	15.5	7.0

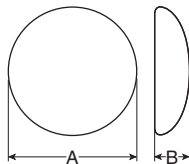
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190 + 35	9.3	4.1	9.1	5.1
210 + 40	9.6	4.2	9.5	5.3
230 + 45	10.0	4.3	9.8	5.5
250 + 50	10.2	4.5	10.0	5.6
270 + 55	10.4	4.6	10.2	5.8
290 + 60	10.8	4.7	10.5	5.9
310 + 65	11.0	4.8	10.7	6.0
330 + 70	11.3	4.8	11.0	6.2
380 + 70	11.7	5.2	11.4	6.4
420 + 80	12.0	5.4	11.7	6.7
460 + 90	12.4	5.5	12.1	6.9
500 + 100	12.8	5.6	12.4	7.1
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630 + 120	13.8	5.9	13.4	7.4

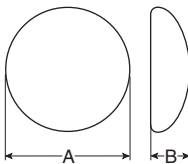
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Smooth Round
Low Profile
Style 68LP



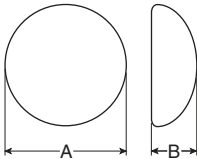
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200-220	11.0	3.0	10.9	3.4
225-245	11.4	3.1	11.3	3.4
250-270	11.9	3.2	11.7	3.5
275-295	12.2	3.3	12.1	3.6
300-320	12.5	3.4	12.4	3.7
325-345	12.9	3.5	12.7	3.8
350-370	13.3	3.6	13.2	3.8
400-420	13.5	3.8	13.4	4.2
420-440	13.9	3.9	13.8	4.1
440-460	14.2	3.9	14.1	4.1
480-500	14.5	4.0	14.4	4.3
525-545	14.8	4.2	14.7	4.5
550-570	15.1	4.3	15.0	4.5
600-620	15.4	4.4	15.3	4.6
640-660	15.8	4.5	15.7	4.7
680-700	16.2	4.5	16.1	4.7

Smooth Round
Moderate Profile
Style 68MP



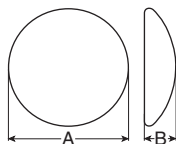
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210-240	10.6	3.7
240-270	11.1	3.8
270-300	11.6	3.9
300-330	11.9	4.1
330-360	12.3	4.2
360-390	12.7	4.2
390-420	13.0	4.5
420-450	13.4	4.5
450-480	13.7	4.6
480-510	14.1	4.6
510-540	14.4	4.6
550-600	14.6	4.9
600-650	15.0	5.0
650-700	15.2	5.3
700-750	15.6	5.4
750-800	15.9	5.6
800-850	16.4	5.6

Smooth Round
High Profile
Style 68HP

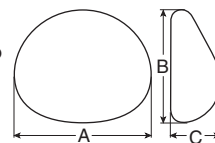


Volume (cc)	Minimum Dimensions		Maximum Dimensions	
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200-220	9.6	4.2	9.5	4.6
240-260	10.2	4.4	10.0	5.0
280-300	10.6	4.7	10.5	5.2
320-340	11.1	4.9	11.0	5.3
350-380	11.6	4.9	11.4	5.5
400-430	11.9	5.0	11.7	5.9
425-455	12.3	5.3	12.1	5.9
465-505	12.6	5.6	12.5	6.1
500-540	13.0	5.7	12.8	6.3
550-590	13.3	5.8	13.1	6.4
600-640	13.7	6.0	13.5	6.6
650-700	14.0	6.1	13.8	6.9
700-750	14.4	6.2	14.1	7.1
750-800	14.6	6.5	14.4	7.2
800-850	15.0	6.7	14.7	7.2

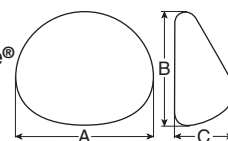
Saline Implants—Textured (Mentor)

**Siltex® Round
Moderate Profile
Style 2600**

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150 + 25	10.0	3.1	9.6	3.7
175 + 25	10.6	3.3	10.0	3.9
200 + 25	11.0	3.4	10.4	3.9
225 + 25	11.5	3.5	10.9	4.0
250 + 25	11.9	3.6	11.2	4.1
275 + 25	12.3	3.7	11.7	4.2
300 + 25	12.6	3.7	12.1	4.3
325 + 50	13.0	3.8	12.3	4.5
350 + 50	13.3	3.9	12.6	4.7
375 + 50	13.6	4.0	12.8	4.8
425 + 50	14.2	4.1	13.5	4.9
475 + 50	14.8	4.2	14.2	4.9

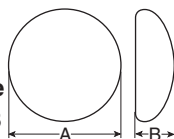
**Siltex® Contour Profile®
Moderate
Style 2900**

Volume (cc)	A Width (cm)	B Height (cm)	C Projection (cm)
175 + 25	10.2	8.5	4.3
225 + 25	11.2	9.4	4.5
275 + 25	12.2	10.3	4.5
350 + 50	13.1	11.0	4.7
425 + 50	13.8	11.6	5.2
525 + 50	14.9	12.5	5.6

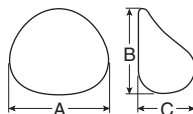
**Siltex® Contour Profile®
High
Style 2700**

Volume (cc)	A Width (cm)	B Height (cm)	C Projection (cm)
275 + 25	11.5	9.5	5.1
350 + 50	12.3	10.5	5.3
450 + 50	13.2	11.0	6.1
550 + 50	14.0	11.9	6.4
650 + 75	15.0	12.7	6.6

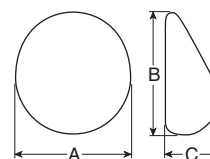
Saline Implants—Textured (Allergan)

**BIOCELL®
Round Moderate
Profile Style 168**

Volume (cc)	A Width (cm)	B Projection (cm)
120-150	9.0	3.0
150-180	9.6	3.3
180-210	10.2	3.4
210-240	10.6	3.7
240-270	11.1	3.8
270-300	11.6	3.9
300-330	11.9	4.1
330-360	12.3	4.2
360-390	12.7	4.2
390-420	13.0	4.5
420-450	13.4	4.5
450-480	13.7	4.6
480-510	14.1	4.6
510-540	14.4	4.6
550-600	14.6	4.9
600-650	15.0	5.0
650-700	15.2	5.3
700-750	15.6	5.4
750-800	15.9	5.6
800-850	16.4	5.6

**BIOCELL® Shaped
Low Height
Style 363LF**

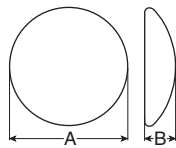
Volume (cc)	A Width (cm)	B Height (cm)	C Projection (cm)
170-180	10.4	8.6	4.2
200-210	10.8	9.0	4.5
230-240	11.2	9.4	4.7
260-275	11.8	9.8	4.9
300-315	12.2	10.2	5.1
330-350	12.6	10.6	5.3
370-390	13.0	11.0	5.5
410-430	13.6	11.4	5.6
450-475	14.0	11.8	5.8
510-535	14.4	12.2	6.1
560-585	15.0	12.6	6.2
620-645	15.4	13.0	6.5
690-720	15.8	13.4	6.8

**BIOCELL® Shaped
Full Height
Style 468**

Volume (cc)	A Width (cm)	B Height (cm)	C Projection (cm)
195-205	10.0	10.5	4.0
230-240	10.5	11.0	4.2
270-285	11.0	11.5	4.3
300-315	11.5	12.0	4.6
350-370	12.0	12.5	4.8
380-400	12.5	13.0	4.9
450-475	13.0	13.5	5.3
495-520	13.5	14.0	5.5
560-590	14.0	14.5	5.7
620-650	14.5	15.0	5.9

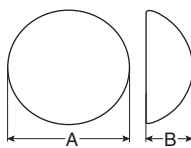
Gel-Filled Implants—Smooth (Mentor)

Smooth Round Moderate Profile



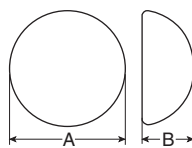
Volume (cc)	A Diameter (cm)	B Projection (cm)
100	9.3	2.1
125	10.0	2.2
150	10.3	2.3
175	11.2	2.4
200	11.7	2.5
225	12.2	2.6
250	12.3	2.8
275	13.2	2.9
300	13.5	3.0
325	13.9	3.0
350	14.2	3.1
375	14.4	3.2
400	14.5	3.2
450	14.9	3.4
500	15.2	3.6
550	15.9	3.6
600	16.5	3.7
700	17.4	3.9
800	18.2	4.1

Smooth Round Moderate Plus Profile



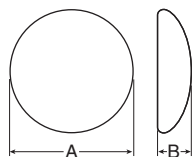
Volume (cc)	A Diameter (cm)	B Projection (cm)
100	8.2	2.7
125	8.9	2.8
150	9.5	2.9
175	10.0	3.1
200	10.5	3.2
225	10.9	3.3
250	11.3	3.4
275	11.7	3.5
300	12.0	3.6
325	12.3	3.8
350	12.5	4.0
375	12.8	4.0
400	13.1	4.0
425	13.4	4.1
450	13.6	4.2
475	13.9	4.2
500	14.1	4.3
525	14.3	4.4
550	14.6	4.5
575	14.8	4.5
600	15.0	4.6
650	15.4	4.7
700	15.8	4.9
750	16.1	5.0
800	16.5	5.1

Smooth Round High Profile

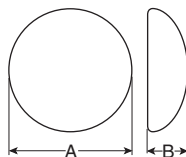


Volume (cc)	A Diameter (cm)	B Projection (cm)
125	8.3	3.5
150	8.8	3.7
175	9.3	3.9
200	9.7	4.0
225	10.1	4.2
250	10.5	4.3
275	10.8	4.4
300	11.1	4.5
325	11.4	4.6
350	11.7	4.8
375	12.0	4.8
400	12.2	5.0
425	12.5	5.0
450	12.8	5.1
475	13.0	5.3
500	13.2	5.3
550	13.6	5.5
600	14.0	5.6
650	14.4	5.7
700	14.8	5.8
750	15.2	5.9
800	15.5	6.0

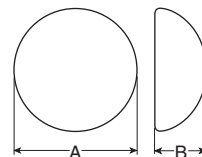
Gel-Filled Implants—Smooth (Allergan)

Smooth Round
Moderate Profile
Style 10

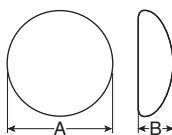
Volume (cc)	A Diameter (cm)	B Projection (cm)
120	9.4	2.5
150	10.1	2.7
180	10.7	2.9
210	11.2	3.0
240	11.7	3.2
270	12.2	3.3
300	12.6	3.5
330	13.0	3.6
360	13.4	3.7
390	13.6	3.8
420	14.0	3.8
450	14.4	3.9
480	14.8	3.9
510	15.1	4.0
550	15.4	4.0
600	15.8	4.3
650	16.0	4.5
700	16.4	4.6
750	16.8	4.8
800	17.2	4.9

Smooth Round
Midrange Profile
Style 15

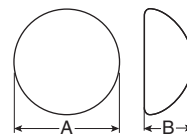
Volume (cc)	A Diameter (cm)	B Projection (cm)
158	9.5	3.2
176	9.9	3.3
194	10.3	3.4
213	10.6	3.5
234	10.9	3.6
265	11.4	3.7
286	11.7	3.8
304	11.9	4.0
339	12.4	4.0
371	12.9	4.1
397	13.1	4.2
421	13.3	4.3
457	13.7	4.5
492	14.0	4.6
533	14.4	4.7
575	14.8	4.8
616	15.2	4.9
659	15.4	5.0
700	15.8	5.1
752	16.2	5.2

Smooth Round
High Profile
Style 20

Volume (cc)	A Diameter (cm)	B Projection (cm)
120	9.0	2.7
140	9.1	3.3
160	9.4	3.5
180	9.6	3.8
200	9.7	4.0
230	10.0	4.2
260	10.4	4.3
280	10.6	4.5
300	10.9	4.5
325	11.2	4.6
350	11.4	4.9
375	11.7	4.9
400	11.9	5.0
425	12.0	5.2
450	12.4	5.2
475	12.6	5.5
500	13.0	5.2
550	13.5	5.6
600	13.6	5.7
650	14.2	5.9
700	14.5	6.2
750	15.0	6.0
800	15.3	6.1

Smooth Round
Moderate Profile
Style 40

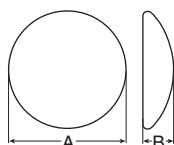
Volume (cc)	A Diameter (cm)	B Projection (cm)
80	8.8	1.7
100	8.9	2.2
120	9.1	2.5
140	9.4	2.7
160	9.7	3.1
180	10.0	3.3
200	10.2	3.5
220	10.5	3.6
240	10.9	3.7
260	11.2	3.8
280	11.4	3.8
300	11.7	3.9
320	12.0	3.9
340	12.3	4.0
360	12.5	4.1
400	12.7	4.2
460	13.8	4.2
500	14.2	4.3
560	14.7	4.6

Smooth Round
Full Profile
Style 45

Volume (cc)	A Diameter (cm)	B Projection (cm)
120	7.4	3.6
160	8.2	3.7
200	9.0	4.1
240	9.6	4.3
280	10.0	4.6
320	10.4	4.8
360	10.8	5.1
400	11.2	5.1
460	11.4	5.9
500	11.9	5.7
550	12.4	6.0
600	12.8	6.1
650	13.2	6.2
700	13.5	6.4
800	14.2	6.7

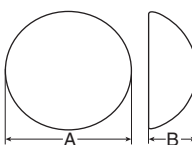
Gel-Filled Implants—Textured (Mentor)

**Siltex® Round
Moderate Profile**



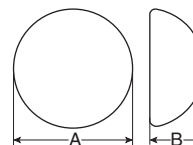
Volume (cc)	A Diameter (cm)	B Projection (cm)
100	8.8	2.5
125	9.3	2.8
150	10.2	2.7
175	10.7	2.8
200	11.2	2.8
225	11.4	3.0
250	11.5	3.3
275	12.4	3.4
300	12.6	3.5
325	12.9	3.6
350	13.4	3.7
375	13.4	3.8
400	13.5	3.9
450	13.9	4.1
500	14.2	4.3
550	14.8	4.4
600	15.4	4.5
700	16.8	4.3
800	17.2	4.6

**Siltex® Round
Moderate Plus Profile**



Volume (cc)	A Diameter (cm)	B Projection (cm)
100	8.1	2.7
125	8.8	2.9
150	9.4	3.0
175	10.0	3.2
200	10.5	3.3
225	10.9	3.5
250	11.3	3.6
275	11.7	3.7
300	12.0	3.7
325	12.3	3.8
350	12.6	3.8
375	12.9	3.9
400	13.2	4.0
425	13.4	4.1
450	13.7	4.1
475	13.9	4.2
500	14.1	4.2
525	14.3	4.3
550	14.4	4.4
575	14.8	4.4
600	14.7	4.5
650	15.4	4.6
700	15.7	4.8
750	16.1	4.9
800	16.6	5.0

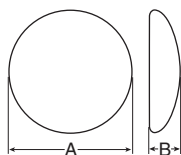
**Siltex® Round
High Profile**



Volume (cc)	A Diameter (cm)	B Projection (cm)
125	8.4	3.6
150	8.9	3.8
175	9.4	4.0
200	9.9	4.1
225	10.2	4.3
250	10.5	4.5
275	10.9	4.6
300	11.1	4.7
325	11.5	4.8
350	11.7	4.9
375	12.0	5.0
400	12.3	5.1
425	12.5	5.2
450	12.7	5.2
475	13.0	5.2
500	13.2	5.4
550	13.5	5.6
600	14.0	5.7
650	14.3	5.8
700	14.7	6.0
750	15.2	5.9
800	15.4	6.3

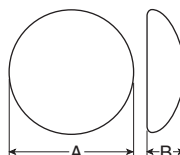
Gel-Filled Implants—Textured (Allergan)

**BIOCELL® Round
Moderate Profile
Style 110**



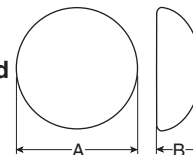
Volume (cc)	A Diameter (cm)	B Projection (cm)
90	8.7	2.0
120	9.0	2.4
150	9.7	2.5
180	10.3	2.7
210	11.1	2.8
240	11.7	2.9
270	12.3	3.0
300	12.6	3.1
330	12.8	3.1
360	13.5	3.2
390	13.7	3.2
420	13.9	3.3
450	14.3	3.3
480	15.1	3.3
510	15.5	3.4

**BIOCELL® Round
Midrange Profile
Style 115**



Volume (cc)	A Diameter (cm)	B Projection (cm)
150	9.7	3.1
167	10.0	3.2
185	10.4	3.3
203	10.7	3.3
222	11.0	3.5
253	11.6	3.6
272	11.8	3.7
290	12.0	3.8
322	12.5	3.9
354	13.0	4.0
378	13.2	4.1
401	13.4	4.2
435	13.8	4.3
469	14.1	4.4
507	14.5	4.5
547	14.9	4.5
586	15.3	4.6
627	15.6	4.8
666	16.0	4.9
716	16.4	5.0

**BIOCELL® Round
High Profile
Style 120**

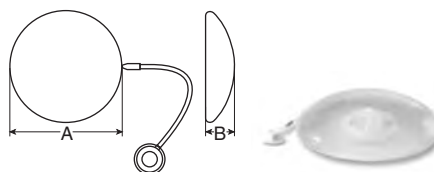


Volume (cc)	A Diameter (cm)	B Projection (cm)
180	9.4	3.3
220	9.9	3.7
260	10.6	4.0
300	11.0	4.2
340	11.5	4.3
400	12.1	4.5
440	12.7	4.6
500	13.5	4.7
550	13.9	4.8
600	14.5	4.9
650	15.5	5.0

Saline Postoperatively Adjustable Implants (Mentor)

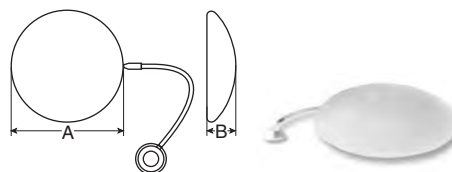
This product serves as both an expander and an implant.

Spectrum® Postoperatively Adjustable Smooth Round, Style 1400



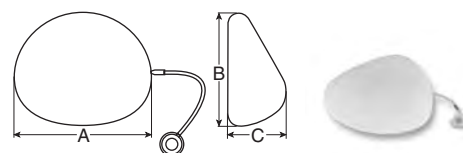
Volume (cc)	Minimum				Maximum		
	Temporary Volume (cc)	Final Volume (cc)	A Diameter (cm)	B Projection (cm)	Final Volume (cc)	A Diameter (cm)	B Projection (cm)
125	105	125	9.4	2.7	150	9.3	3.2
175	150	175	10.3	3.1	210	10.2	3.8
225	190	225	10.8	3.5	270	10.9	4.3
275	230	275	11.6	3.8	330	11.5	4.6
325	275	325	12.4	4.0	390	12.1	4.9
375	320	375	13.5	4.1	450	13.0	4.9
425	360	425	14.0	4.2	510	13.7	4.8
475	405	475	14.3	4.4	570	13.8	5.4
525	450	525	15.0	4.4	630	14.4	5.6
575	490	575	14.7	4.8	690	14.2	6.0

Spectrum® Postoperatively Adjustable Siltex® Round, Style 2400



Volume (cc)	Minimum				Maximum		
	Temporary Volume (cc)	Final Volume (cc)	A Diameter (cm)	B Projection (cm)	Final Volume (cc)	A Diameter (cm)	B Projection (cm)
125	105	125	9.4	3.0	150	9.2	3.5
175	150	175	10.5	3.1	210	10.4	3.9
225	190	225	11.3	3.3	270	11.1	4.2
275	235	275	12.0	3.6	330	11.4	4.4
325	275	325	12.9	3.7	390	12.6	4.5
375	320	375	13.4	3.9	450	13.1	4.8
425	360	425	14.0	4.2	510	13.6	5.0
475	400	475	14.5	4.5	570	14.2	5.7

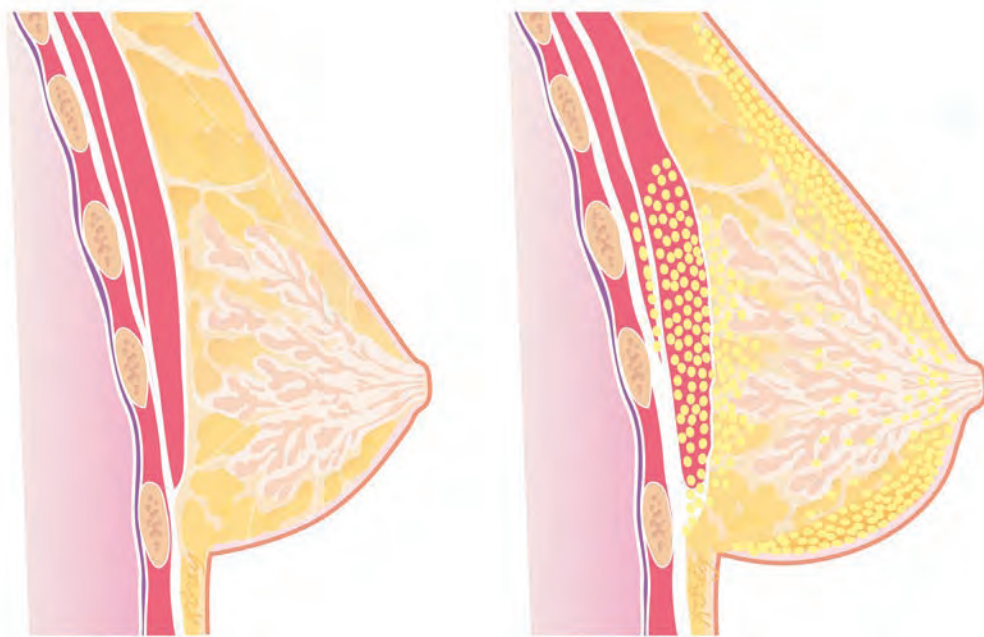
Spectrum® Postoperatively Adjustable Siltex® Contour Profile®, Style 2500



Volume (cc)	Minimum					Maximum			
	Temporary Volume (cc)	Final Volume (cc)	A Width (cm)	B Height (cm)	C Projection (cm)	Final Volume (cc)	A Width (cm)	B Height (cm)	C Projection (cm)
275	235	275	11.5	9.5	5.1	330	11.1	9.4	6.3
350	300	350	12.3	10.5	5.3	420	11.9	10.1	6.9
450	380	450	13.2	11.0	6.1	540	12.7	11.0	7.5
550	470	550	14.0	11.9	6.4	660	13.7	11.9	7.9
650	550	650	15.0	12.7	6.6	780	14.5	12.5	8.2

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CHAPTER 63



Fat Grafting to the Breast

EMMANUEL DELAY, MICHEL MOUTRAN

Transferring fat from body areas where it is present in excess (as in the abdomen and thighs) to the breast for cosmetic and aesthetic purposes is not a new concept. This approach has been considered since the very beginning of liposuction, particularly after publications by Illouz and Fournier. However, the concept remained controversial and did not become widely used until the development of more precise tools and techniques. It was feared that autologous fat transfer would generate fat necrosis and calcifications that at that time could not be readily assessed because of the limitations of available imaging modalities.

Fat grafting regained popularity after the confirmation by Coleman that fat tissue can be transplanted safely if meticulous care is exercised in the preparation and transfer of fat cells. Coleman's preliminary work was mainly on facial rejuvenation. In 1998, given the proven efficacy of fat transfer to the face for facial rejuvenation or postsurgery reconstruction, we developed a research program to evaluate the efficacy and safety of the procedure for thoracomammary reconstruction. We adapted the technique for breast procedures and named it *lipomodeling*. We assessed its efficacy and tolerance in patients and demonstrated an absence of significant clinical or radiologic signs of adverse effects.

In this chapter we present the evolution of ideas and the progress of knowledge about fat grafting to the breast, describe its indications and contraindications, and highlight its advantages and disadvantages. We also present some of our results obtained with this promising technique.

Evolution of Technique

First Attempts

Fat grafting for breast plastic surgery has long been advocated by prominent surgeons. In 1895 Czerny described the first clinical case of breast reconstruction by transplantation of a giant lipoma of the buttock region to the left breast. Adipose cells were used to fill the void left in the breast after tumor resection in a patient with a fibroadenoma. Some investigators performed breast reconstruction or augmentation using fasciocutaneous flaps, gluteous fat implants, or local pedicled flaps. Others have injected fat either directly into the breast or into previously inserted implants. Some have even reported the cases of women undergoing augmentation mammoplasty with cadaver fat allografts. However, tolerance of fat allografts is poor, and all of these grafts had to be removed eventually because of inflammatory reactions, sometimes after several years. In 1991 Fournier described the fat grafting technique he used in patients who did not want a prosthesis and who requested only moderate breast augmentation. The quantity of fat grafted to these patients was between 100 and 250 cc, injected in the retroglandular space, not in the mammary parenchyma.

The Controversy

Fat grafting to the breasts has been highly controversial since the presentation by Bircoll, first in Bangkok in 1984, then at the California Society of Plastic Surgeons in 1985, of a patient undergoing breast augmentation by injection of fat cells obtained by liposuction. The patient was a 20-year-old woman who requested a moderate augmentation of her breasts while undergoing fat grafting to repair the damage caused by a dog bite. Bircoll and Novack considered that the technique should only be used for women requesting moderate augmentation because of the potential risk of necrosis when large quantities of fat were grafted. In 1987 Bircoll reported the principal advantages of the procedure: its simplicity, the absence of a scar, and rapid recovery. In addition, a prosthesis was not necessary and thus prosthesis-related complications were avoided. He also noted the positive slimming effects at the harvest site. Bircoll and Novack reported the case of a patient undergoing bilateral fat grafting after unilateral reconstruction by TRAM flap; the fat grafting improved the aesthetic results and symmetry. The two papers triggered reactions from the medical community; many expressed strong disapproval, citing the possibility that autologous fat injections in the breasts could generate microcalcifications and cysts that could potentially interfere with the detection of early breast carcinoma. Bircoll argued that cancer-related calcifications and those following fat transplantation occur in different sites and have different radiologic aspects and therefore cannot be mistaken, and further, that breast reduction surgery also results in microcalcifications. But in 1987, the Ad-Hoc Committee on New Procedures of the American Society of Plastic and Reconstructive Surgeons issued a position paper that stated, "The committee is unanimous in deploring the use of autologous fat injection in breast augmentation," and further, that "much of the injected fat will not survive, and the known physiologic response to necrosis of this tissue is scarring and calcification. As a result, detection of early breast carcinoma through xerography and mammography will become difficult and the presence of disease may go undiscovered."

There was no reference in the paper to scientific findings, and the report expressed only the opinion of the members of the committee. Despite the paucity of scientific information, and although it had long been recognized that any mammary surgery can cause oily cysts or mammographic changes, the injection of fat into the breasts became taboo among surgeons, limiting research and experimentation on this topic.

Ironically, in the same journal in 1987, Brown et al published a retrospective study of mammographic changes after breast reduction, reporting that calcifications were detectable in 50% of all mammograms at 2 years after surgery. The authors insisted that in most cases these benign calcifications were easily distinguishable from changes associated with cancer. Despite this high incidence of calcifications and the risk that mammographic abnormalities might interfere with cancer detection, there was no subsequent discussion of discontinuing breast reduction mammoplasties on the basis that such a procedure might interfere with breast cancer detection.

Lifting the Taboo

Fat grafting had proved very efficient for facial rejuvenation and for the correction of facial deformities. Thus in 1998 we focused our research on the subject and adapted the technique to breast reconstruction. First, we used fat grafting in conjunction with autologous latissimus dorsi flap reconstruction. This flap reconstruction, previously developed by our surgical unit, allowed satisfactory reconstruction in 70% of cases, but the other 30% resulted in insufficient breast volume. Reduction of the contralateral breast was needed, or else a prosthesis had to be inserted, which was precisely what we wanted to avoid in the first place, because the procedure would no longer be autologous and because of the drawbacks associated with prostheses (unnatural shape and texture and the need to replace the prosthesis at some point).

We started using fat grafting in patients undergoing autologous latissimus dorsi flap reconstruction who were at low risk of local recurrence. We named the technique *lipomodeling*, from the Greek root *lipo* for “fat,” and the Latin *modello*, “to give shape or volume,” which is exactly the objective of this procedure. At first we used the fat grafting technique only on 20 volunteer patients who agreed to undergo strict initial follow-up for 1 year. After the efficacy of the technique had been demonstrated, with results yielding optimal shape and texture as well as a natural décolleté, we proposed lipomodeling to almost all patients treated by latissimus dorsi flap reconstruction. The study of mammography, CT scan, and MRI findings conducted on patients in parallel demonstrated that fat grafting did not interfere with our ability to perform imaging studies on the patients. It was thus progressively extended to other indications of breast reconstruction, then to the correction of breast deformities, and finally to the treatment of sequelae of conservative treatments. Our first presentations at the Société Française de Chirurgie Plastique Reconstructrice et Esthétique and the International Confederation for Plastic Reconstructive and Aesthetic Surgery raised considerable controversy, of the same order as the criticisms made in 1987. Point-by-point debate gradually overcame the skepticism of the clinical community, and fat grafting has now become a standard procedure in breast reconstruction.

Indications

Lipomodeling of the breast and chest wall has many indications. It has been of great benefit in reconstructive breast surgery. In aesthetic breast surgery and in selected cases, fat transfer precludes the need for an implant (augmentation, and mastopexy with a slight lack of fullness in the upper pole). It can also efficiently correct certain defects of implant augmentation. Fat grafting has become a standard and useful procedure for enhancing the outcomes of breast aesthetic surgery.

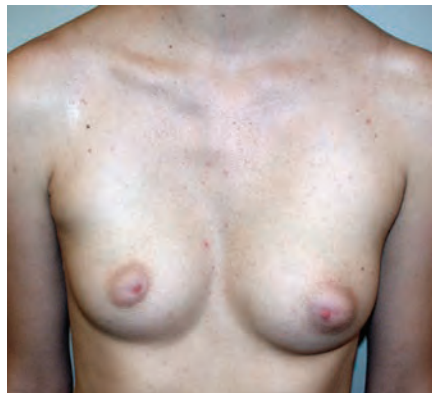
Patient Profiles

Poland's Syndrome



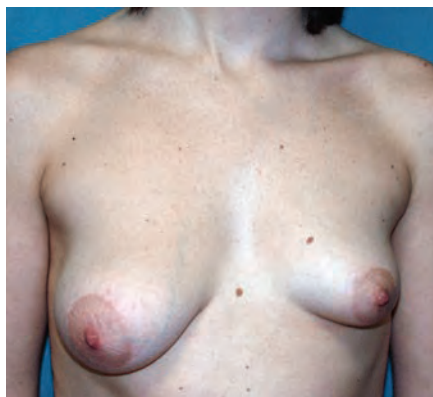
Correction of the deformities of the breast and thorax associated with Poland's syndrome remains a daunting challenge. Lipomodeling appears to be very effective in these cases. Breast rehabilitation with fat grafting only leads to excellent outcomes with simple but repeated procedures, resulting in very limited scarring and donor site morbidity. We have treated 16 patients with different severities of Poland's syndrome, among them 14 requiring lipomodeling alone and 2 treated with a combination of lipomodeling and pedicle flap reconstruction. In this series, three sessions, on average, were required to obtain the desired result, with a mean of 244 cc injected during each session. The results were notable: it was possible to restore the breast, giving it a shape almost identical to that of the contralateral breast. The introduction of this technique appears to be a major breakthrough for the management of thorax and breast deformities in patients with Poland's syndrome.

Pectus Excavatum



Pectus excavatum is a complex deformity with hollowing of the anterior sternocostal wall; it usually has little or no impact on respiratory function. Most patients are principally concerned about structure and aesthetics when there is significant deformity of the breast, especially in severe or lateralized pectus excavatum. Fat transfer techniques can be used alone to produce satisfactory correction for mild to moderate forms, or in association with a custom-made rigid implant (based on three-dimensional CT images) for more severe forms.

Tuberous Breasts



Tuberous breast deformity is an uncommon breast anomaly in which there is a constriction in the lower pole of the breast. It becomes apparent at puberty with the growth of the breast. Various surgical approaches have been described, and a wide range of techniques are available to produce an optimal result. Among them, lipomodeling can correct the lack of volume (especially if this is unilateral) and improve the base and shape of the breast. It is a very useful adjunct in the treatment of tuberous breasts. Recently Coleman reported encouraging results in patients with tuberous breast deformity treated by fat injection.

The ideal indication is a unilateral hypoplastic tuberous breast (which usually requires two fat transfer sessions) associated with a lack of fullness of the upper pole. In cases of bilateral breast hypoplasia associated with tuberous deformity, implants remain the standard treatment, unless the condition is associated with sufficient lower body adiposity to augment the two breasts satisfactorily. Lipomodeling can significantly enhance the results of these corrections by improving the décolleté area.

Asymmetrical Breasts



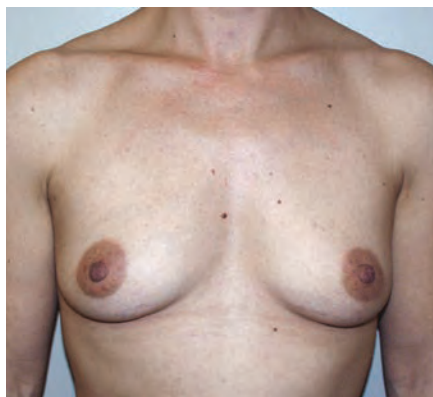
Asymmetry is a difficult problem when one breast has satisfactory fullness and perfect shape and the other is hypoplastic. Conventionally, augmentation with an implant in the underdeveloped breast is the standard treatment. Although the initial results of this approach are generally satisfactory, asymmetry of shape and volume often reappears several years later. In this indication, lipomodeling yields a breast

very similar to the normal breast, and the change over time is natural, particularly in regard to ptosis. Depending on the degree of asymmetry and hypoplasia, one to three fat transfer sessions will be needed for an optimal result.

Bilateral Breast Augmentation

Lipomodeling in aesthetic surgery is developing rapidly. Our studies have shown that if lipomodeling is carried out according to the technique we describe in this chapter, it does not generate radiologic images that raise problems of differential diagnosis with breast malignancy or problems of radiologic follow-up for radiologists who specialize in breast imaging.

The main radiologic risk is that breast cancer may occur coincident with lipomodeling. To reduce this risk, imaging studies (mammography and ultrasonography) are carried out before lipomodeling by a specialized radiologist to confirm the absence of any suspicious lesions. If there is any doubt, lipomodeling is deferred or contraindicated. The radiologist must concur before lipomodeling is performed and thereby becomes co-responsible for the follow-up. The patient gives written consent to undergo the same studies by the same radiologist 1 year after the procedure. If the radiologist observes a suspicious lesion on imaging at 1 year, a micro biopsy is performed to establish a definitive diagnosis. In this indication, the information given to the patient must be particularly thorough and extensive, with comprehensive handouts provided during the preoperative consultations.



The indications for breast augmentation with fat grafting (*lipoaugmentation*) differ from those of implant augmentations. Lipoaugmentation is suitable for patients requesting a moderate or even slight increase of breast volume or who want to recover the upper pole fullness they had before weight loss or pregnancy. The ideal patient is a young woman with a slim upper body and moderately small breasts who has sufficient localized adiposity of the lower body to allow one or even two lipomodeling sessions. In such a patient, fat harvesting should enhance the lower body contour and can be combined with standard liposuction to improve the final result. We encourage the patient to maintain a stable weight after this procedure, because any change in weight might affect the shape of the breasts.

Revision After Implant Augmentation

Aesthetic lipomodeling is a treatment option for correction of the imperfections of implant augmentation. It enhances the cleavage and décolleté area; improves tissue coverage of the implant, especially in the lower pole; reduces rippling in thin patients; and reduces the demarcation of the implant in the upper pole. We also have the clinical impression, though no scientific data as yet, that complementary fat grafting might improve capsular contractures in moderate cases. We usually recommend fat transfer with the previous implant still in place. After all deformities are corrected, the implant is replaced; this avoids any risk of leaving a punctured implant.

Managing Severe Complications of Breast Aesthetic Surgery With Residual Sequelae

Breast reduction, breast augmentation, and mastopexy are commonly performed procedures in aesthetic breast surgery. The outcomes are usually satisfactory for the patient and surgeon. In rare cases, complications occur. In thin patients who smoke, exposure of an implant can result in the need to remove the implant. Reduction of large breasts can result in fat and skin necrosis with subsequent breast deformity.



Some patients are referred to our clinic for revision and secondary procedures. We find lipomodeling to be very useful in these cases. It efficiently enhances tissues thickness and improves tissue quality.

After implant complications leading to implant removal, lipomodeling prepares the tissues to render the secondary augmentation safer. After complicated breast reductions, fat transfer can restore the suppleness of the breast while improving the quality of the damaged skin.

These complementary fat grafting procedures have reduced donor site morbidity while reducing the incidence of breast sequelae. We have also found lipomodeling to be very useful in the management of difficult patients with high expectations who may present a risk of medicolegal issues.

Preoperative Assessment

The patient's weight should be stable at the time of the procedure, because the injected fat will retain the characteristics of the fat deposits in the donor site. If the patient loses weight after lipomodeling, she will lose some of the benefits of the procedure.

The operative technique, its benefits, and potential risks and complications are thoroughly discussed with the patient, and she is provided with an informational handout with an informed consent to sign. We have four handouts: lipomodeling in breast reconstruction, lipomodeling to correct the sequelae of conservative treatment, lipomodeling to correct breast deformities, and aesthetic breast lipomodeling.

Preoperative Planning

Markings

The areas of the breast that require correction are identified and marked on the patient. In some patients we now perform a three-dimensional morphologic study, in addition to the usual two-dimensional photographs; this provides further useful information for assessing the amount of fatty tissue to be transferred and evaluating secondary fat resorption.

The various adipose areas of the body are examined to identify excess fat deposits. Generally, we harvest fat from the abdomen, because harvesting in this area does not require a change in the patient's position during the procedure, and liposuction in the region can lead to beneficial recontouring. The second site is the trochanteric region (saddlebags) and the inside of the thighs and knees. The areas to be harvested are outlined with a skin marker.

Operative Technique

Anesthesia

Because of the significant amounts of fat harvested, lipomodeling is performed with the patient under general anesthesia in most cases. Conventional prophylactic antibiotics are usually given perioperatively, as we customarily do in various plastic surgery procedures. Local anesthesia can be used for minor revisions to correct any residual defect.

Incision Placement

In the harvest sites, incisions are made with a No. 15 blade. For abdominal harvesting, four incisions are made around the umbilicus, and a lateral incision is made on each side if lateral abdominal and suprailiac fat is to be harvested. For harvesting from the thighs, the patient is placed in a ventral decubitus position, and an incision is made in each subgluteal fold. A complementary incision on the inside of the knees can be made for fat harvesting of this area.

At the recipient site on the breast, punctiform incisions are done with a 14-gauge needle; it is ideal to hide these sites in previous scars. To create a network of transfer tunnels, five or six incisions are needed, two of which are in the inframammary fold and one in the décolleté area. The incisions are usually made with the sharp bevel of a trocar.

Fat Harvesting

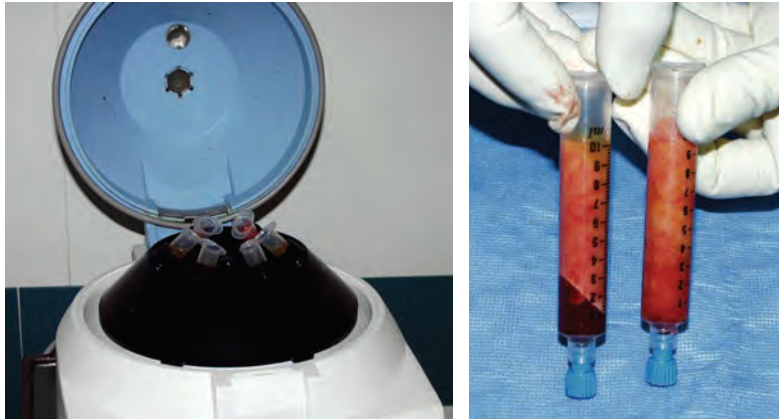
Recent published studies on fat transfer have contributed to standardization of the procedure for harvesting and injection, thus reducing the potential pitfalls at each stage. Meticulous technique throughout the process enhance fat survival in the short, medium, and long term. A disposable or Coleman cannula is used for harvesting. These cannulas have a blunt tip that can be inserted in a 4 mm incision made with an No. 15 blade. Harvesting is done with a syringe. Subcutaneous infiltration is done with 500 ml of a 9% normal saline solution and 0.5 mg of epinephrine. A 10 cc Luer-Lok syringe is fitted directly onto the harvesting cannula.



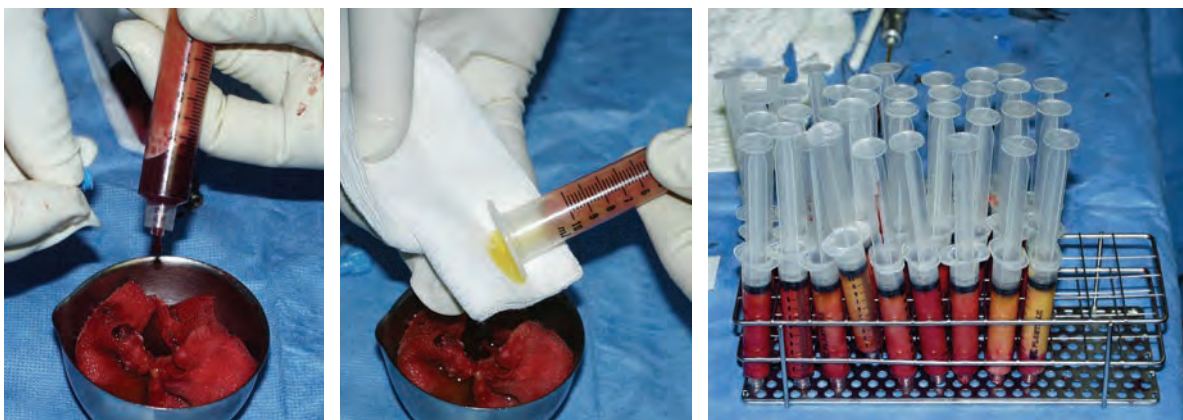
Moderate suction will minimize damage to the fat cells; mechanical suction that is too strong might have a harmful effect on adipocyte survival. More fat than has been calculated for transfer must be harvested in anticipation of the separation resulting from centrifugation and the expected resorption of fat in the breast after transfer.

Finally, to perfect the morphologic result, the harvested areas are smoothed with conventional liposuction using a 4 mm cannula. The cutaneous incisions are closed with fine, rapid-absorbing sutures.

Fat Preparation



As harvesting continues, the assistant prepares the syringes for centrifugation. They are sealed with a screw top and then centrifuged in batches of six for 1 minute at 3200 rpm. Centrifugation separates the harvested fat into three layers: a top layer of oily fluid containing chylomicrons and triglycerides resulting from cell lysis; a lower layer of blood, debris, and serum, as well as the infiltration fluid, especially if the harvesting is done with a local anesthetic; and a middle layer of purified fat. This is the useful layer that will be injected.

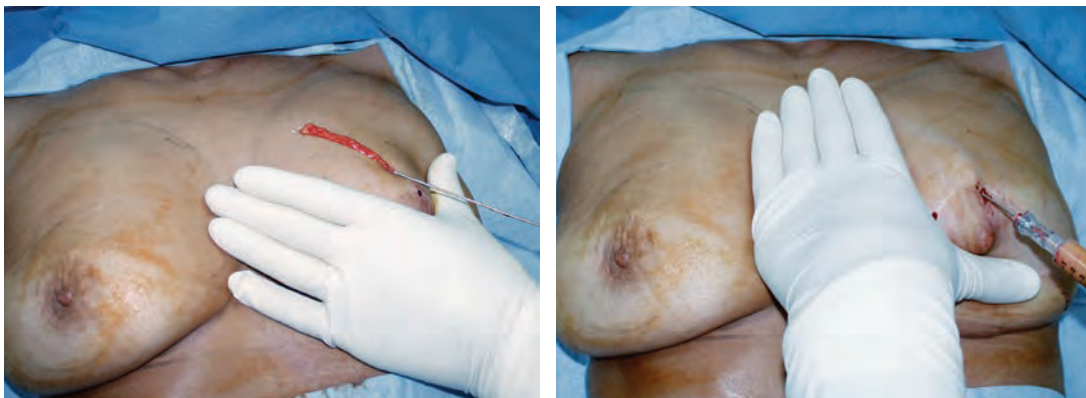


The other two layers are disposed of, the lower layer simply by removing the cap and the upper layer by pouring off the oil the covers the middle layer. The team must be well organized so that fat preparation is carried out efficiently and rapidly. With a three-way tap, the purified lipoaspirate is grouped into 10 cc syringes by transfer from one syringe to another, thus producing a sufficient quantity of 10 cc syringes of purified fat.

Fat Transfer



After the fat has been prepared, the 10 cc syringes of fat are ready for transfer. The fat is transferred directly to the breast areas with the 10 cc syringes fitted with special disposable 2 mm transfer cannulas. These cannulas are longer and stronger than the cannulas used for facial fat grafting procedures, because the recipient breast tissue is firmer and more fibrous. The incisions are made using a 17-gauge trocar. This produces an adequate incision while limiting scarring. Several incisions are made to create a honeycomb of multiple microtunnels for fat transfer.



The fat is injected in 1.5 to 2 cc per pass in the form of fine cylinders resembling spaghetti. Microtunnels must be created in many directions. Transfer is done from the deep to the superficial layer. Good spatial visualization is necessary to form a three-dimensional matrix and to avoid areas of fatty collections that would lead to fat necrosis. Each microtunnel must be designed to be surrounded by well-vascularized tissue. *Fat is injected under light pressure as the cannula is gently withdrawn, not during advancement of the cannula.*

As noted, one must overestimate the quantity of fat transferred when possible, anticipating a 30% expected fat resorption. A 140% rule must be applied, meaning that 140 cc of fat must be injected for a desired final volume of 100 cc.

When the recipient tissues are saturated and cannot absorb more fat, it is useless to persist because of the risk of inducing areas of fat necrosis. *Oversaturation of the recipient site with fat grafts must be avoided.* Planning a supplementary session in a few months is preferable and leads to more stable results. Very fine, rapid-absorbing sutures are placed, and the breast is covered with an ordinary dry dressing for a few days.

Ancillary Procedures to Improve Results

Liposuction of the Inframammary Fold

In patients with a bulky inframammary area anterior to the inferior ribs, we perform a heavy liposuction of the area (7 to 8 cm under the inframammary fold). This liposuction enhances the projection of the breast and lends inframammary definition while giving the impression of a complementary breast augmentation.

We use this method in major breast reduction procedures in overweight patients to improve the definition of the breast. It can also be used in tuberous breasts and in lipomodeling-only breast augmentation to improve the final outcome.

The technique consists of significant liposuction, going from the deep to the superficial layers of the skin in the predefined area while restoring the inverted V resulting from the junction of the two inframammary folds and the intermammary valley. Because liposuction in this area is painful, we infiltrate dilute ropivacaine at the end of the procedure.

Inframammary Fold Definition

In some cases of aesthetic breast surgery, the inframammary fold is ill defined or has been damaged by previous surgery. A push-up bra will enhance the fullness of the upper pole by displacing the mammary gland to the upper region, simultaneously displacing the necessary amount of tissue to define the inframammary fold from the lower pole.

We consider the inframammary fold to be the foundation of the breast. To create or re-create the inframammary fold (see p. 2303), we use a technique derived from our reconstructive experience in cases of latissimus dorsi reconstruction with a low-situated inframammary fold.

We locate the desired level of the inframammary fold and draw a horizontal marking on the midclavicular line. We mark a horizontal ellipse under this desired inframammary fold (5 to 6 cm wide and 2 to 3 cm high). The ellipse is deepithelialized and the upper border of the ellipse is incised to the thoracic wall with cautery.

The deepithelialized flap is kept attached to the thoracic skin while the deep plane is undermined for 5 to 6 cm. This deepithelialized flap is pulled up under the breast and sutured to the thoracic wall with 1 Vicryl at the predefined position of the inframammary fold. The lower pole of the breast is undermined at the level of the pectoralis muscle, then rolled to define the lower pole contour and sutured to the fixed inframammary fold.

The disadvantage of this technique is the resulting 6 cm scar, but this can usually be hidden in the inframammary fold. The main advantage is the enhancement and efficient correction of the inframammary fold.

In the rare cases in which this technique is used for lipomodeling augmentation of the breast, we start by fixating the inframammary fold, then we do the fat transfer.

Release of Fibrous Strings and Adhesions

While transferring fat to the breasts, the surgeon sometimes encounters fibrous strings or adhesion areas, making lipomodeling difficult. The inferomedial area in tuberous breasts is a typical example. In such cases we recommend the use of V-shaped transfer cannulas or the tip of a 14-gauge trocar to selectively rupture these strings and adhesions under local tension. Care must be taken not to undermine the area, because the transferred fat will not take if it is not in proper contact with a vascular recipient site.

External Expansion of the Breast

External expansion of the breast with the Brava breast enhancement and shaping system (Brava, Coconut Grove, FL) was developed by Roger Khouri in the 1990s for breast augmentation without surgery. A gentle three-dimensional vacuum is applied via two silicone domes that place the breast under tension. The expected outcome is breast tissue augmentation, given strict adherence to the protocol, which means that the device must be worn 10 hours a day for 10 weeks. The use of the system alone did not lead to significant volume enhancement because of the constraint of wearing the Brava bra daily for an extended time.

With the recent development of fat grafting to the breasts, Dr. Khouri decided to combine fat grafting with the Brava system. The external expansion is used for the preparation and optimization of the recipient site. The concept behind this is to increase the initial breast volume so larger amounts of fat can be transferred to the breasts. External tissue expansion might also enhance the vascular supply to the breast and thus improve graft take.

At present, we are evaluating the Brava system in conjunction with our lipomodeling procedures. Our preliminary experience shows that we are able to transfer larger amounts of fat in one lipomodeling session as compared with the traditional tech-

nique. Our second impression is that there is improvement in areolar projection with the combined use of the Brava system and lipomodeling.

The external expansion system might change the surgical indications in cases of severe Poland's syndrome and breast reconstruction with fat transfer only. It might even eliminate the need for flap reconstruction in some cases. A study is underway in our department to determine more precisely the advantages of the Brava system and its indications.

Processed Fat Grafting With Enrichment Procedures

Fatty tissue is rich in adipose-derived stem cells at different levels of differentiation with multiple progenitors. It has been proposed to modify the composition of the fat transferred by enriching it with adipose-derived stem cells. The protocol consists of harvesting the fat, then processing it in the Celution system (Celution System, San Diego, CA), which will release concentrated stromal cells. These stromal cells are mixed with the fat harvested before its transfer to improve the take of the graft. Studies are underway in Europe and Asia to determine the efficacy of this system. At present the system has not yet obtained FDA approval in the United States or AFSAPS approval in France.

Postoperative Care

Harvest Sites

Pain in the harvested areas is similar to the pain after liposuction. Patients complain of moderate pain that typically lasts 48 hours; this can be treated with level 1 analgesics, prescribed for 2 weeks. We infiltrate dilute ropivacaine at the end of harvesting to control pain during the first 24 hours. At the end of the procedure, a compressive elastic dressing is left in place for 5 days.

Considerable bruising occurs in the harvest sites and persists for 2 weeks. Postoperative edema resolves totally or almost totally in 3 months. To hasten resorption, we ask patients to massage the harvest sites with a circular motion. An abdominal support belt may be advisable for 6 weeks but is not prescribed routinely. In rare cases, if edema persists, we advise 10 sessions of endermologie drainage.

Breast

Bruising resolves in 2 weeks, edema in 1 month. During the first 3 postoperative months, 30% to 40% of the added volume is gradually lost. But because of the initial edema, the patient may have the impression that she has lost about 50% of her breast volume, because she saw the breast the day after the procedure, when the breast was the most swollen.

Complications

At the harvest site, scars must be concealed as much as possible, generally in a fold or in the periumbilical region. No patients have complained of unaesthetic scars in a donor site. We had one case of irregularity in the suprailiac region that required secondary correction by lipomodeling. The majority of patients are satisfied with the slimming of the donor site; this additional benefit probably contributes to the very high rate of satisfaction with this technique. Irregularities at the donor site may be caused by uneven harvesting of the fat grafts, so harvesting is sometimes completed by liposuction to further improve the result and for greater patient satisfaction.

This procedure must be carried out by experienced plastic surgeons who have completed their learning curve, because previous experience with cosmetic liposuction is essential in these circumstances to limit the risk of complications and to produce the best possible cosmetic result.

Local infection occurred in only 1 of our 950 lipomodeling procedures. This was seen as redness around the umbilicus and was treated with antibiotics and local application of ice, with no long-term sequelae.

In the breast the incisions must be well placed, in the submammary fold or in its axillary tail, or in the areolar region, where scars are always of good quality. The presteral area should be avoided because there is an increased risk of hypertrophic scarring, seen as small, red, hypertrophic, punctate scars. The incisions are usually invisible: because they are made with a trocar, they measure only 1.5 mm.

Infections occurred at the recipient site in 6 of our 950 lipomodeling patients. Redness at the recipient site was seen, and sutures were removed. An effusion of fat and pus was evacuated. Topical treatment, antibiotics, and applications of ice completely resolved the problem in each case, with no impact on the final results.

We had one case of intraoperative pneumothorax in 950 procedures, probably as a result of the transfer cannula piercing the pleura. The pneumothorax was revealed by oxygen desaturation during the procedure. In the recovery room, a pleural drain was inserted, and oxygen saturation returned to normal, with total recovery and no sequelae. To avoid this complication, the projection of the areolar region should be improved through two incisions in the submammary fold, not through the areolar region itself.

There were no instances of fat embolism in our series. There is a potential risk of this if fat is injected into a large vessel. Extreme caution is recommended in the subclavian area, especially in the breast and chest wall deformities of Poland's syndrome, where the subclavian vessels may lie lower than in a patient with normal anatomy.

In 3% of cases we observed focal fat necrosis. The risk is higher during a surgeon's early experience (15% in the first 50 cases). In these cases, fat necrosis occurred in areas overtreated and oversaturated with fat; the recipient site could not absorb the amount of fat grafted. When the recipient tissue is saturated with fat, the surgeon should not persist, because areas of fat necrosis may develop. Clinical signs of fat necrosis are typical: tender, slightly sensitive but stable over time, then gradually decreasing. *Any increase in the size of a hard swelling, even in a reconstructed breast, should signal the need for microbiopsy by a radiologist to rule out a malignant change.*

Fat necrosis nodules are mainly seen in the early stages of the surgeon's learning curve and decrease as experience increases, if he or she respects the principle of the three-dimensional injection network and avoids oversaturation of the recipient site.

Outcomes and Long-Term Follow-Up

Based on the first author's (E.D.) personal experience of 880 procedures of reconstructive and aesthetic breast surgery, and with a 10-year follow-up for the first patients, reliable indications on long-term follow-up can be stated.

Clinical

All patients were clinically followed and seen in consultation after 15 days, 3 months, and 1 year. Photographs were taken at each visit. A detailed follow-up protocol was used to assess the quality of the result from the patient's and surgeon's viewpoint, to document patient satisfaction, and to note any adverse effects or complications.

The results were considered very good or good in the majority of cases. Very few results were considered to be moderately good, and none was evaluated as poor. The percentage of good or very good results depends on the subpopulation studied in relation to the indications. For example, for correction by lipomodeling of sequelae of breast-conserving therapy, 50% were considered very good, 40% good, and 10% moderately good.

Patients who had had breast cancer and underwent a lipomodeling procedure after breast-conserving therapy or breast reconstruction were then followed by their oncologist, who referred them to us if there was any change in the follow-up clinical and imaging findings. For the other patients, computerized medical records were shared among the radiologist, oncologist, breast surgeons, and plastic surgeons to complete the long-term follow-up.

Radiologic

In 1998, when we developed this area of research, the main fear concerning fat transfer in the breast was the risk that it would compromise imaging studies. This fear had in fact led to the earlier described controversy of 1987 and its consequences. For this reason, we undertook analysis of the effect of fat transfer on breast imaging. We carried out three studies with imaging of breasts reconstructed by autologous latissimus dorsi flaps and lipomodeling (mammography, ultrasonography, and MRI), imaging of breasts treated with breast-conserving surgery after lipomodeling (mammography, ultrasonography, and MRI), and imaging of breasts with defects corrected by lipomodeling (asymmetry, tuberous breasts, and Poland's syndrome) (in process).

Our findings showed that if lipomodeling is carried out according to modern standardized principles, it does not hinder correct breast imaging and follow-up. It is noteworthy that all procedures were performed by a surgical team that has completed its learning curve and with specialized radiologists who are familiar with the analysis of image findings potentially induced by fat transfer. These prerequisites are of fundamental importance for successful fat transfer in aesthetic breast surgery.

Imaging in the majority of reconstructed breasts yielded normal results, with some images of oily cysts and fat necrosis. Any abnormal findings observed indicated benign lesions, easily distinguished from suspicious lesions. Abnormal images were essentially oily cysts, occurring in 15% of cases.

The most complex situation concerned lipomodeling for the sequelae of conservative partial mastectomy. In this population fat necrosis develops in about 20% of patients postoperatively; lipomodeling doubles this incidence, generating mainly oily cysts but sometimes more complex lesions of fat necrosis.

Because of the spontaneous local carcinoma recurrence rate of 1.5% per year, follow-up must be rigorous. We believe that this indication should be restricted to multidisciplinary teams working with radiologists who have excellent mastery of the subject.

Oncologic

Ten years of oncologic follow-up have not revealed an increased risk of local recurrence after mastectomy or after conservative treatment. In fact, the clinical impression seems to be to the contrary. But to confirm this clinical impression, more-complex oncologic studies must be performed that match treated populations with reference populations with the same oncologic status.

Evaluation of the Success Rate

Clinical Evaluation

The success rate of fat transfer is easy to evaluate by clinical examination, the patient's opinion, and comparison of the photographs taken at each consultation with earlier photographs. Of the volume initially obtained through fat transfer, 30% to 40% is gradually lost. Volume is stable after 3 to 4 months and remains so if the patient maintains her weight. If the harvested fat is very oily (retains a very high percentage of oil after centrifugation), resorption may be higher (up to 40% to 50%) and may continue over a longer period (5 to 6 months).

If the patient loses weight, the volume of the transferred fat decreases, and the result is a smaller breast with possible asymmetry. Therefore it is important for the patient to understand that she must maintain a stable weight. Inversely, if she gains weight, breast volume increases.

When a second fat transfer session is performed to produce sufficient volume, resorption seems to be less, between 20% and 30%.

Very long-term evaluation (5 to 6 years) confirms that breast volume remains stable. If asymmetry appears after weight loss or gain (for example, after discontinuation of antihormonal treatments in adjuvant therapy for breast cancer), a complementary lipomodeling session can easily be performed. This technique offers flexibility and precision for a long-lasting revision that is appreciated by the patients.

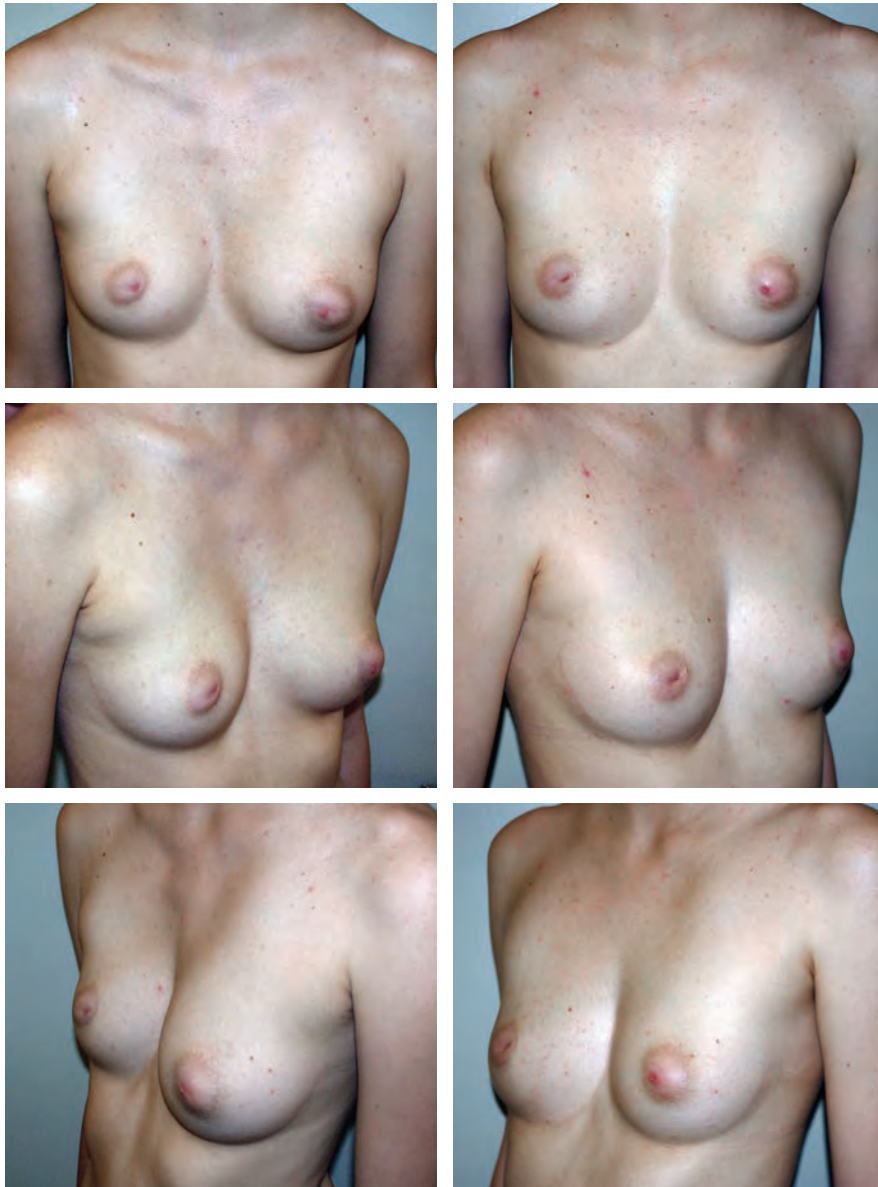
Evaluation by Interferometry

Using three-dimensional interferometry technology, we studied changes in breasts over time after lipomodeling. The technique consists of light projection and reflection over three-dimensional structures (in this case, the fat grafted breasts). The reflected light is processed using modeling algorithms. This produces a three-dimensional representation of the breasts from which measurement of distance and volumes can be calculated. By comparing the models of the breast, breast volume can be accurately studied and the quantity of fat remaining after resorption can be assessed. This study confirmed our clinical impression: the rate of fat absorption at 3 months was estimated to be 30% to 40%. It also confirmed that volume remains stable after this period if the patient maintains a constant weight.

Results



This 17-year-old patient with Poland's syndrome was treated with two sessions of lipomodeling (205 cc, 297 cc) at an interval of 6 months. She is shown 1 year after the second procedure.



This 17-year-old patient with lateralized pectus excavatum was treated with two lipomodeling sessions of the right breast (200 cc, 360 cc). She is shown 1 year after the second procedure.



This 27-year-old patient with tuberous breasts was treated with two lipomodeling sessions of the left breast (209 cc, 179 cc), and right mastopexy and lipomodeling (100 cc). Her result 30 months after the second procedure is shown. The patient had a pregnancy before the final result without affecting the results.



This 22-year-old woman had marked asymmetry (unilateral hypoplasia). She was treated with one lipomodeling session of the left breast (250 cc). One year after the procedure, she is shown with improved symmetry and correction of her hypoplasia.



This 38-year-old woman had bilateral breast augmentation with one lipomodeling session (left breast 235 cc, right breast 220 cc). She is shown 15 days and 1 year postoperatively.



This 48-year-old patient was seen as a secondary case with severe sequelae after failure of many breast implant augmentations, and further mastopexy. She was treated with one lipomodeling session (left breast 250 cc, right breast 280 cc) and inframammary fold fixation. The flap was marked, then incised and deepithelialized. Incision of the upper part of the flap is shown, and finally flap fixation to the thoracic wall. Three months after the procedure, the restored inframammary fold is evident; a second session of lipomodeling is scheduled.

Concluding Thoughts

Lipomodeling is a major development in reconstructive and aesthetic surgery of the breast; we consider it to be one of the major advances of the past 20 years. The technique is now well codified, and the associated complication rate is very low. Clinical long-term follow-up shows that the morphologic result regarding volume is stable 3 to 4 months after the procedure. The development of focal fat necrosis is strongly operator dependent, occurring in 15% of cases in the surgeon's early experience and becoming stable at 3% after more experience. The radiologic appearance of the breasts is usually normal, sometimes with images of fat necrosis seen as oily cysts, or more rarely, calcifications or complex cysts. None of these images is likely to be confused with a diagnosis of cancer for radiologists who are experienced in breast imaging. If there is the slightest doubt, the next step must always be micro-biopsy of the suspect area to obtain a definitive diagnosis. Oncologic follow-up (now 10 years for our first patients) shows no increased risk of local recurrence or of development of a new cancer.

Evaluation of the success rate by clinical examination and by interferometry shows that 30% to 40% of the injected fat is resorbed. The final volume is reached in 3 to 4 months and is stable over time if the patient maintains a constant weight. If a second fat transfer session is performed, resorption will be somewhat less, usually between 20% and 30%.

Because of the low complication rate, the very good results obtained, and the excellent acceptance of the technique by patients, lipomodeling has completely modified our indications in plastic, reconstructive, and aesthetic surgery of the breast.

The use of lipomodeling to correct deformities of the chest wall and breast is rapidly being adopted. For the treatment of Poland's syndrome, lipomodeling appears to represent a major advance and will probably revolutionize the treatment of severe cases, producing reconstruction of unequalled quality after fat transfer procedures with a simple postoperative course and little scarring. Lipomodeling can also correct the breast and chest wall deformities associated with some cases of lateral pectus excavatum and is a useful adjunct to custom-made implants for more severe forms of pectus excavatum. It is a promising alternative treatment for tuberous breasts and implant-free correction of asymmetry caused by unilateral hypoplasia.

Finally, the applications of lipomodeling will no doubt continue to develop in aesthetic surgery for the correction of inadequate mammoplasty, correction of defects or complications of implants, and in lipoaugmentation for patients desiring moderate, natural breast enhancement and who have sufficient adipose deposits. Preoperative and postoperative imaging by a radiologist who specializes in breast imaging is essential to limit the risk that a cancer may occur coincident with lipomodeling.

Clinical Caveats

Careful preoperative clinical and radiologic assessment and clearance for the procedure are essential before a fat transfer procedure.

Fat must be injected in a multilayered fashion, starting from the deep plane and moving to the superficial plane.

Fat must be injected in fine tunnels in a consistent fashion to avoid fat necrosis.

Fat transfer should be stopped at each injection site when the recipient site is saturated.

Resorption rates, the quality of the fat transferred, and characteristics of the recipient site must be taken into account in initially overcorrecting volumes to produce the desired contour and volume.

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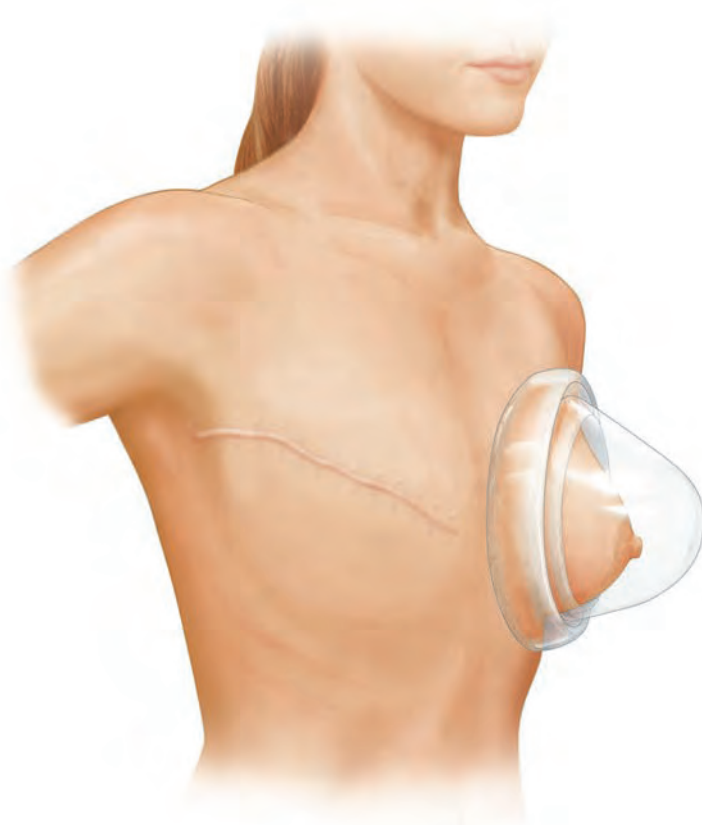
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CHAPTER 64



Breast Augmentation With External Expansion and Megavolume Autologous Fat Grafting

ROGER K. KHOURI, DANIEL A. DEL VECCHIO

In aesthetic plastic surgery no topic stirs as much excitement, curiosity, and on-going controversy as fat grafting to the breasts. Despite the increased popularity of the procedure, many unanswered questions remain, and there is an unmet clinical need for standardization of the process and for understanding the physiology and true fate of transplanted fat. In 2009 the American Society of Plastic Surgeons (ASPS) modified their previous position against fat grafting to the breasts, thus paving the way for more investigation into this procedure. Today many surgeons realize that with optimal technique, fat grafts to the breast survive indefinitely, and further, that the radiographic arguments behind the previously imposed ban are no longer valid, so many investigators around the world have begun sharing their previously unpublished experience with fat grafting to the breast.

Fat grafting is a powerful tool for filling and reshaping body contours. When this technique is combined with external expansion, it offers a viable option for breast augmentation and treatment of breast asymmetries. The key to this technique is preparation of the breast with preexpansion, controlled low-pressure graft harvesting, and infiltration of autologous fat through multiple needle puncture sites, with diffuse grafting in a three-dimensional fanning-weave pattern.

In this chapter we describe our rationale for external breast expansion with the Brava expansion system combined with megavolume fat grafting based on our clinical experience with more than 100 breast augmentation procedures, which have produced consistent results comparable to those achieved with implant augmentation (as documented by MR imaging and three-dimensional volumetric determination). We provide information on indications and patient selection criteria and outline our techniques and the results that may be expected when this combined technique is used for breast augmentation.

Background



The Brava external tissue expander

The Brava bra (Brava, Coconut Grove, FL) was initially developed in the 1990s as an external soft tissue Ilizarov expander to enlarge the breast. The device consists of a pair of semirigid domes with a silicone gel rim cushion that interfaces with the skin; it is worn around the breasts like a bra. A small, concealed, battery-operated pump maintains a low negative pressure inside the domes that does not interrupt capillary flow and that imparts on the breast surface a constant gentle isotropic distraction force. Studies have shown that when the device is worn in an uninterrupted fashion for 10 to 12 hours per day, true and long-lasting breast augmentation ensues over a period of weeks to months.

Combining a regimen of Brava external expansion with structural fat grafting can predictably yield a 200 to 300 cc breast augmentation per grafting session. For adequate expansion it is recommended that the Brava domes be worn at least 10 to 12 hours per day for a minimum of 4 weeks. Although the smaller domes can be concealed under loose clothing, most women prefer to wear the bra at home and to sleep with it on. Adequate expansion is attained when the breasts are estimated to have enlarged threefold to fourfold in volume. The better the preoperative expansion, the more fat that can successfully be grafted, and thus the larger the augmentation.

Indications for External Expansion With Megavolume Fat Grafting

Women with excess fat in the lower body and a fat deficiency in the breasts are obvious candidates for external expansion combined with fat grafting to the breasts. However, some of the most impressive results are seen in very small-breasted women (less than 100 cc), in whom a 200 cc breast augmentation can make a real differ-

ence, compared with women who already have breasts of 500 cc or more. This procedure is reserved for an informed patient who understands the concept of fat grafting and accepts responsibility for her result by adhering to the expansion protocol.

The best candidates for this technique:

1. Have favorable anatomy (donor fat, breast anatomy)
2. Do not have active detectable breast cancer (although the test has poor specificity, we recommend a preoperative MRI as the most sensitive test for any breast abnormality)
3. Have realistic expectations (a cup size increase)
4. Are reliable (can comply with the Brava regimen)
5. Are nonsmokers (smoking is an absolute contraindication)

Patient Profiles

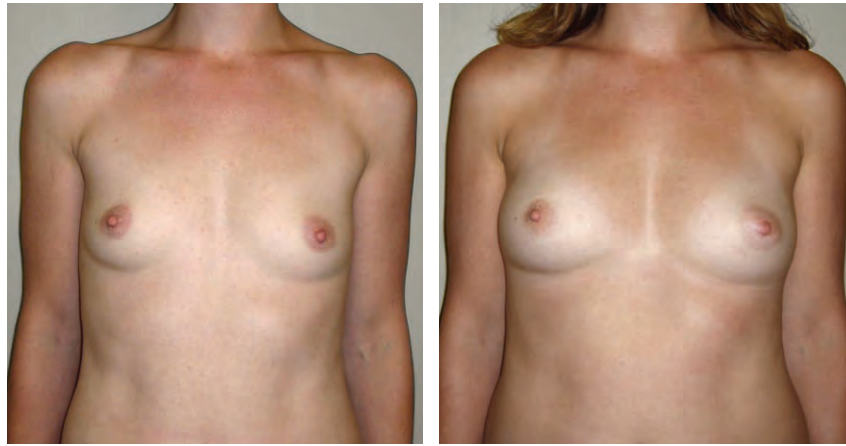
Women After Childbearing With Preexpanded Breasts



Anatomically speaking, an ideal patient for Brava preexpansion and megavolume fat grafting is a patient who has had one or more children, has breast deflation but not frank ptosis, and has an adequate amount of donor fat. Patients who have had children have already undergone one or more episodes of parenchymal expansion from engorgement with breast milk. Engorgement creates a natural stretching and loosening of the parenchymal ligaments. Although this may have occurred years before the Brava expansion, this prior stretching of breast tissues allows an easier, more rapid expansion when Brava is applied, given the same degree of negative pressure and time used.

Often the breast deflation seen in multiparous patients is low-grade ptosis or pseudoptosis. Patients with frank ptosis who require a breast lift can also benefit from external expansion, but the timing of the mastopexy surgery is best performed at the completion of the grafting process.

Women With Small Breasts



Thin patients with small breasts often do not want a major volume increase; therefore even thin patients may be candidates for Brava preexpansion with fat grafting, as long as realistic expectations are discussed preoperatively. Smaller breasts, even if doubled in volume, are still not very large.

Women With Small, Dense Breasts

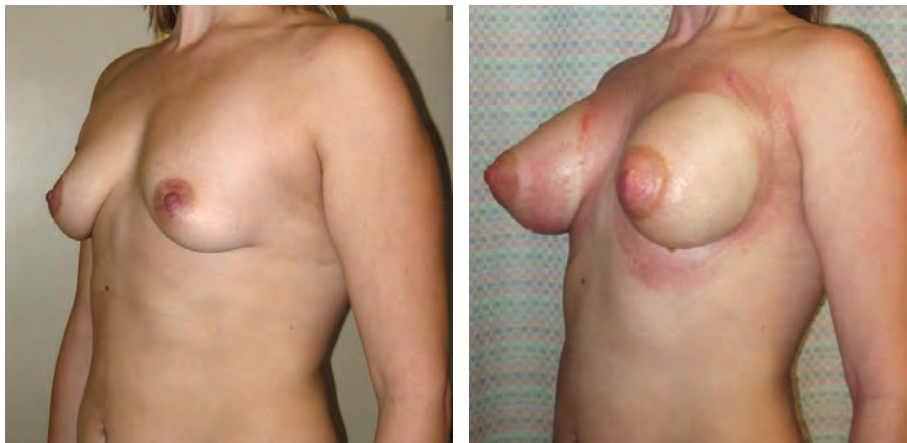
Breasts with dense parenchyma will expand with more difficulty than the soft breasts of a multiparous woman. Patients with dense-parenchyma breasts must be coached effectively to increase the negative pressure on the domes to achieve adequate preoperative expansion. Often the dense parenchymal breast will expand more in some areas, such as the periareolar region, than in others. This can result in a double-bubble constriction deformity that must be released at the time of surgery.



After expansion, there is a step-off deformity at the breast-areolar junction as a result of the lower resistance of the areolar tissue compared with the breast tissue. The problem can be seen in this patient, who will require three-dimensional mesh release intraoperatively to address this deformity.

Women With Constricted or Tuberous Breasts

Constricted or tuberous breasts require aggressive expansion, and following this the constrictions can be released mechanically using the “Rigotomy” three-dimensional mesh release technique (see p. 2334).



Constricted breasts, before and after expansion (and before fat grafting)

This patient is shown before and after expansion with the Brava system; no fat grafting has been done yet. She will require aggressive release of the inferior mammary fold using a three-dimensional mesh release Rigotomy technique at the time of fat grafting. Postoperative expansion is also often required for constricted breasts.

Patient Evaluation

Similar to the regimen for breast augmentation with implants, we think it is important to obtain a baseline evaluation of the recipient breasts before any intervention is planned. Our routine protocol calls for a baseline MRI for all women requesting augmentation with fat grafting. In young women with dense breasts, this is the most sensitive test. It also provides a three-dimensional image analysis of the breasts that is unattainable with conventional biplanar mammography.

Patients should also be evaluated for associated medical conditions that might otherwise exclude them from safely undergoing a liposuction procedure. We believe this is the aspect of the intervention that probably produces higher morbidity than breast fat grafting. Smokers, with their impaired microcirculation, are not candidates for fat grafting. Potential fat donor sites are evaluated for their availability.

Patient Selection and Education

Compliance

There are two critical areas of compliance: the patient's tissue and the patient. The mechanical compliance of the breast tissue is an important consideration in effective preexpansion and fat grafting. A properly motivated patient is vital for the success of preexpansion, which in turn is vital for the success of the fat grafting procedure. The surgeon and patient must be equally committed to the preexpansion process to achieve a successful result.

No Expansion—No Surgery

Despite adequate screening for compliant behavior, some patients who initially intend to proceed with Brava preexpansion and grafting will simply fail to expand. In these patients, fat grafting is not performed until satisfactory expansion is obtained. It is far better to postpone a procedure after a failed expansion than it is to move forward and perform what may result in a failed operation. Without adequate preexpansion, the results of fat grafting to the breast may be limited to small graft volumes (100 cc or less) that do not exceed high interstitial pressures in the recipient site. In breast augmentation, such volumes are rarely adequate to achieve core tissue projection replacement. Therefore, if a surgeon performs grafting on a patient whose breasts have failed to expand, it is likely that repeat procedures will be necessary. Inevitably, this will be interpreted as a failure of the procedure, resulting in the need for repeat procedures, a dissatisfied patient, or both.

Classification of Breast Morphologies

Based on our experience with diverse breast types, we have developed a hierarchy of preoperative breast morphologies, as shown in the table.

Preoperative Classification of Brava Breast Morphology

Type	Description of Breasts	Sessions
I	Multiparous, soft	1
II	Nulliparous, dense	1-2
III	Constricted or tuberos	2
IV	Mastectomy, nonirradiated	1-4
V	Mastectomy, irradiated	3-5

This classification takes into account the compliance of the patient's parenchymal tissue and the starting volume of tissue available for expansion. With this information one can advise patients about the effort required for the expansion and the realistic number of sessions required to achieve the desired result.

Patient education is crucial in ensuring adequate compliance with the expansion regimen. We show the patients pictures of the expected expansion effect and explain that the more their breasts are expanded and the larger they are at the time of grafting, the more grafts we can inject and the larger their breasts will be. An educated, informed patient then becomes a full participant in achieving her result. We plan an office visit a week or so before surgery to confirm patient compliance and to ensure adequate expansion. On occasion, we have postponed the surgery to allow more expansion time.

We believe there is no substitute for sufficient preexpansion. Last minute "cramming" by the patient does not result in successful preparation. It is ultimately the responsibility of the surgeon to adequately select, educate, coach, and follow up with patients to ensure that optimal preexpansion is attained.

Preoperative Planning

Overview of Megavolume Fat Grafting

Conceptually, megavolume fat grafting can be compared with sowing seeds in a three-dimensional field. Four critical components need to be optimized to maximize the potential for producing a high-yield crop:

1. *Seeds*: Fat harvesting and processing
2. *The field*: Preparation of the recipient breast: this remains the main limiting factor
3. *Planting*: Grafting technique
4. *Nurturing the planted seed*: Care of the breast after grafting

Fat Harvesting and Processing

A vast amount of literature has been written on the preparation and harvesting of fat. Unfortunately, there is little that is definitive and not subject to dispute. We present our preferred techniques and biases.

Harvesting Pressure



While a standard liposuction machine can generate up to 1 atmosphere (atm) (760 mm Hg) of negative pressure, a 60 cc syringe connected to an inline manometer can also generate nearly 1 atm of negative pressure. The adipocyte is impartial to the source of negative pressure; it is the absolute pressure and not the source of this pressure that makes a difference in adipocyte trauma. It is well recognized that at pressures higher than 0.5 atm there is adipocyte damage. Thus there are two alternatives: either use a liposuction aspirator where the pressure can be dialed to approximately 300 mm Hg (12 inches Hg), or use a syringe system that maintains the pressure at about 300 mm Hg (KVAC). The former is readily available in most operating rooms but has the drawback of increased air exposure, with the potential for fat desiccation in the long tubing. The latter provides a gentler closed system with less fat loss. We use both techniques and when the fat is scarce and precious, the closed system is preferable, whereas in patients with ample fat, there is probably no difference.

A completely closed technique for fat harvesting and grafting is performed with the Lipografter (Lipocosm, Key Biscayne, FL). This KVAC spring-activated syringe aspirates the fat at a constant 300 mm Hg pressure throughout the excursion of the plunger. When the syringe is full, pushing the plunger down cocks up the spring for the next cycle of suction and sends the lipoaspirate through a nonclogging tissue valve to a bag where the fat is prepared for reinjection using the tissue valve in reverse mode. The system allows rapid harvesting and processing of larger lipoaspirate volumes; the controlled low pressure harvesting with no air exposure is thought to be safer for adipocytes.

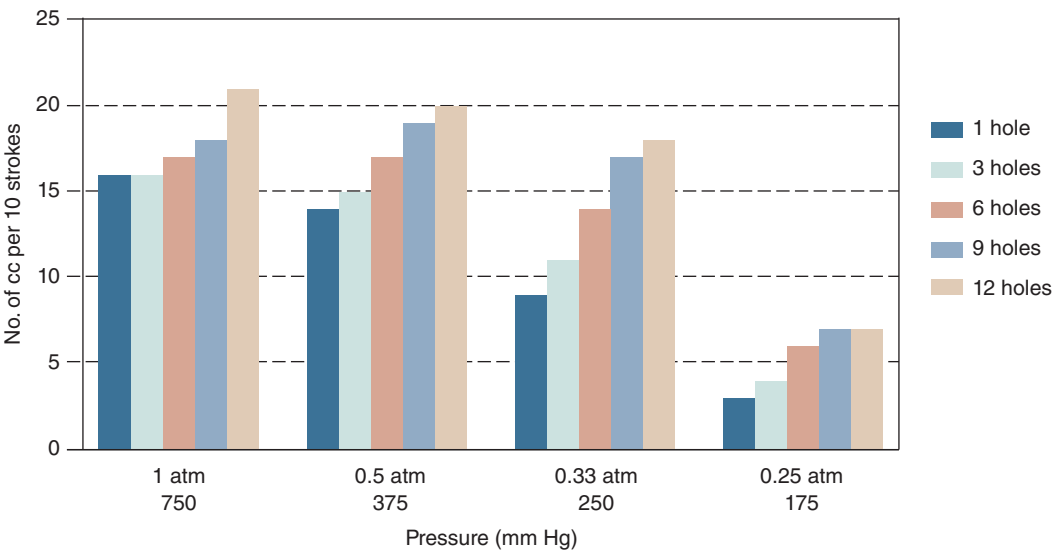
Cannula Size

Smaller cannula sizes theoretically create less donor site trauma and allow removal of smaller lobules of fat, which may revascularize more easily, improve flow characteristics, and reduce trauma during reinjection. An important consideration besides cannula size is *cannula hole size* and the *number of holes*. A 12-gauge cannula with 6 to 8 side holes 2 by 1 mm in size can extract a significant amount of fat despite the small caliber. The total surface area of individual openings on a 12-gauge, 12-hole cannula approaches or exceeds the hole size of the classic 10 mm one-hole cannula used in the 1980s, and produces much less donor area trauma. Further, each hole selects for lobules of uniform small size, which are more likely to flow easily through the injection cannula during the grafting phase of the procedure without the need for further processing.



We have found that increasing the number of holes in the cannula while amply compensating for the lower vacuum force improves harvesting efficiency. Our preferred cannula is 12-gauge (2.7 mm), with 9 to 12 side holes of 1 by 2 mm each.

Varying Negative Pressure and the Number of Cannula Holes



We have found that a 6- to 12-hole cannula operating at 0.33 atm is just as efficient in harvesting fat as a single-hole cannula operating at 1 atm of pressure.

Choice of Donor Site

It has been postulated that specific donor areas may promote increased survival of grafted fat. Clinically we have not observed the anatomic location of donor fat to be of significance in our patients. This is consistent with the results seen in limited animal studies. What is more important to consider is the volume requirements for donor grafting in each individual case and the donor areas with relative abundance to meet that requirement.

The surgical plan should try to avoid or minimize creation of any donor site deformities. It may turn out that adipocyte cell size, which varies in different body regions and among patients, may be a more important variable. Larger cells have a higher likelihood of mechanical cell membrane damage during extraction, and this variable of cell size relative to cannula hole size may prove more critical than the specific body area selected for harvesting.

Using fine (2.4 mm) cannulas, we can afford to harvest through a multitude of needle stick entry sites that leave essentially no scar, thus allowing a more diffuse harvest with less chance for contour irregularities, even in the most slender of patients.

Air Exposure

Another variable of unknown import in fat harvesting remains the negative impact of air exposure. Despite its widespread mention, there is a paucity of scientific data quantifying the effect of air exposure on adipocyte viability. Fat processing techniques range from completely high air exposure systems whereby fat is dried on Telfa rolls to completely closed systems employing intravenous tubing tissue valves and bags for collection and reinjection (see p. 2317). In addition to reducing air exposure, closed systems reduce the likelihood of bacterial contamination.

Fat Processing

Peer's cell survival theory of grafted en bloc fat dates back more than 50 years and suggests the number of cells transferred at the time of transplantation may correlate with the ultimate fat graft survival volume. Following Illouz's application of liposuction, fat became available in a fragmented form. The cell survival theory of solid fat transplantation may have served as the initial logic for high-speed centrifugation and hyperconcentration of graft, but this paradigm requires reexamination.

Centrifugation is the chosen method of fat processing that has been popularized as a potential strategy for effective fat grafting. Historically, our penchant for centrifugation arises from the need to graft as much adipocyte biomass as possible into a limited space.

Although centrifugation can process highly concentrated fat, there are six potential problems with centrifugation:

1. Adipocytes may be damaged by the high G forces.
2. It is a time- and labor-consuming process.
3. Adipocytes trapped in the concentrated centrifuged paste have less recipient contact and ability to engraft than loosely dispersed adipocytes.
4. There is increased risk of overgrafting with a concentrated paste.
5. The flow of the pastelike graft is more difficult during reinjection.
6. There is a loss of beneficial growth factors, platelets, and other components present in the gross lipoaspirate.

Concentrating adipocyte stem cells and remixing them with mature adipocytes to increase cell viability is an exciting prospect. The theoretical benefit of a stem cell-enriched graft is that the stem cells promote neovascularization to the recipient site, improving yields. Although this may be an effective strategy in the future, there is no evidence today that it provides a worthwhile advantage over conventional fat grafting. Washing harvested graft with cell preservatives that stabilize the cell membrane and repair “holes” resulting from trauma has recently been described and may have a role in improving percent yields. We do not employ these techniques, since they are not currently FDA approved.

One of the most confusing metrics in fat grafting is a lack of standardization when one discusses *percent yields*. Once fat is lipoaspirated as a donor graft, there is an infinite number of different concentrations of adipocyte volume relative to non-adipocyte volume (blood, serum, crystalloid solution) that can be reached before grafting the recipient site. Unless the concentration of adipocytes in the grafted material can be accurately measured and unless the process of fat concentration is standardized, one cannot reliably measure the percent of grafted adipocyte volume that survived grafting.

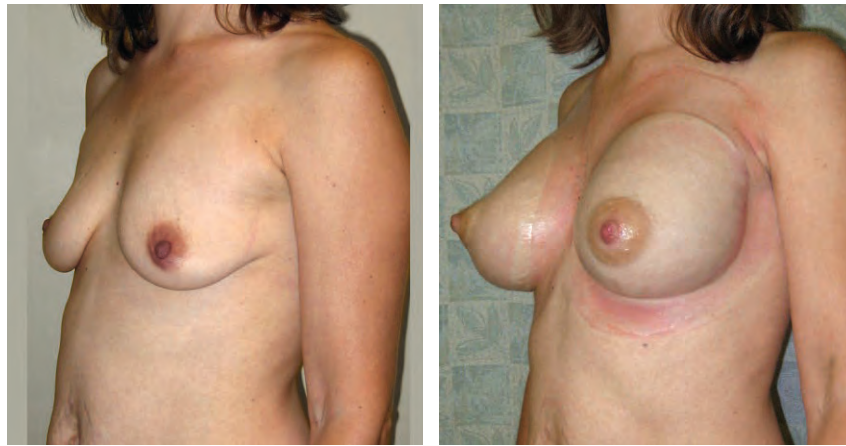
The Recipient Site in Fat Grafting

Compared to the attention devoted to graft material and its preparation, the role of the recipient site has been largely neglected in the literature. To better appreciate the role of the recipient site in fat grafting, consider the historical advances of fat grafting compared with those of skin grafting. From descriptions in Sanskrit, small skin grafts were taken by Hindus in 3000 BC after preparing the donor area (usually by beating the patient’s backside) to increase edema and dermal thickness. Several thousand years later, improvements in instrumentation afforded more-uniform donor thicknesses. During the past 60 years in the post–World War II era, a combination of more advanced wound care and debridement, antibiotics, and methods of graft immobilization have helped to improve graft take. The introduction of the vacuum-

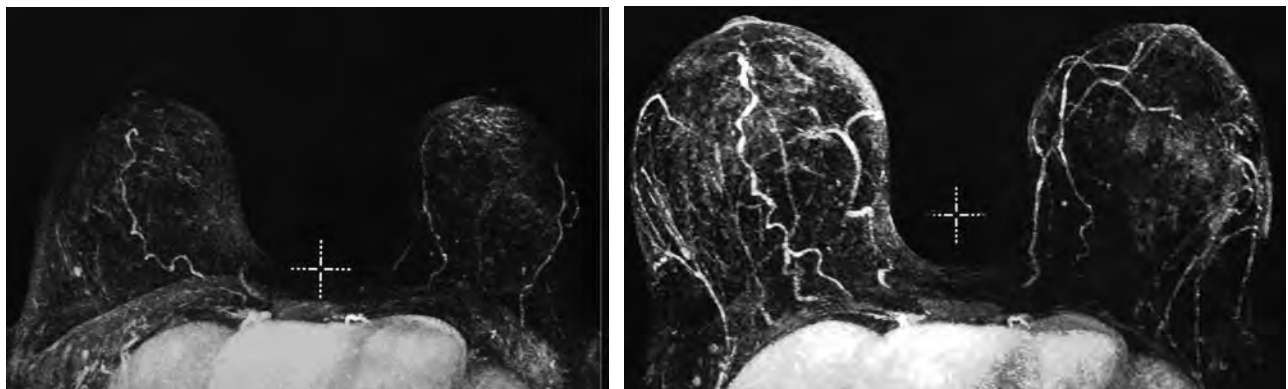
assisted closure (VAC) method has further revolutionized skin grafting by a variety of postulated effects, including bacterial clearance, neovascularization, and reduction in edema of the wound bed.

Parallels Between External Expansion and Vacuum-Assisted Closure

Negative pressure on the breast creates internal expansion of the breast parenchyma by drawing in more fluid and increasing the size and caliber of blood vessels.



This patient is shown before and 3 weeks after Brava expansion, immediately before grafting. The volumetric increase is three to four times that of the preexpansion state. A total of 380 cc of fat was injected into each breast.

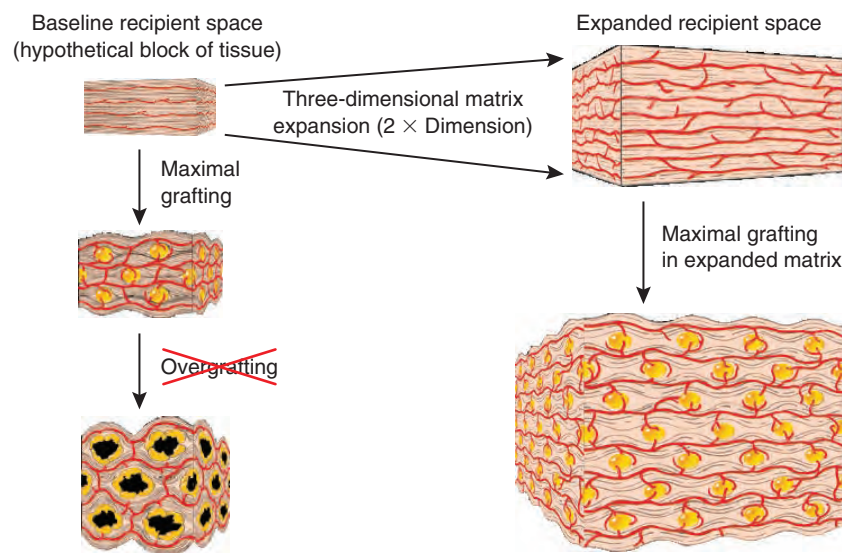


This MRI of the breasts of this patient demonstrates the contrast in her breasts before and 3 weeks after use of the Brava preexpansion bra 10 hours per day. As can be seen, there is significant expansion of the breasts, with the creation of a larger and more fertile recipient matrix that will allow more fat grafts to be placed. There is an evident increase in the number and size of blood vessels.

We postulate that the external expansion process enhances fat grafting results in five ways:

1. Bigger potential spaces are available for larger graft volumes.
2. Reduces demand on adipocytes to create the expansion, which may destroy them.
3. Augments tension on internal constrictions and scars, so breast *shape* can be addressed.
4. Variables that are time consuming (such as centrifugation) become less demanding.
5. Angiogenesis effect may increase recipient site capillary density and oxygen tension and improve graft take.

The increased parenchymal space created by external expansion before fat grafting permits more volume of graft to be inserted before high subcutaneous interstitial pressures. It is this high interstitial pressure that often limits the graft volume that can be achieved in more conventional grafting techniques. Our collective experience with nearly 100 patients treated with external expansion and fat grafting revealed that the single most important determinant of final volume augmentation was the pregrafting volume expansion. We demonstrated a linear dose-response curve with better expansion, leading to larger augmentations.



The concept of megavolume grafting after expansion is illustrated. The block of tissue is first shown as maximally filled with fat grafts; it is then overfilled to crowding; next, temporary three-dimensional stretching is done of that block of tissue, showing how many more grafts can be placed in the expanded and hypervascular space.

With Brava preexpansion, the patient and the expansion bra drive the volume of expansion, not the injected fat. In conventional fat grafting techniques, grafted fat is required to act in four key ways:

1. To serve as an internal positive pressure expander
2. To survive by oxygen diffusion for 5 to 7 days
3. To eventually reconnect its capillary circulation to that of the recipient site
4. To remain viable and to act as a spacer

This first demand, the internal positive pressure expansion, theoretically works against the other three demands and probably leads to adipocyte necrosis. Brava potentially relieves the adipocyte from this first burden.

Many breasts demonstrate a range of deformities, from subtle, often underappreciated, internal ligamentous constrictions to tuberous or severely constricted breasts. Some of the more subtle effects, like occult double-bubble deformities, are only appreciated at the time of prosthetic breast augmentation when internal tension and volume changes exacerbate these underlying deformities. Using our external preexpansion system before fat grafting serves two valuable functions in reshaping breasts:

1. Deformities, even subtle ones, can be demonstrated to the patient before any surgical intervention is performed.
2. During fat grafting, internal scar ligaments can be selectively lysed percutaneously using three-dimensional mesh grafting, or the Rigottomy technique, described on p. 2334.

By increasing the recipient site space, there is less dependence on concentrating the donor volume, which may reduce the need for time-consuming, high-speed centrifugation and syringe-to-syringe fat transfer. Eliminating high-speed centrifugation from our procedure has resulted in the following advantages:

1. Reduced transfer to smaller syringes, less air exposure, less potential contamination.
2. Less-concentrated fat can be injected, because there is more space in the recipient site.
3. Less-concentrated fat disperses better and leads to less clumping of the graft.
4. Less-concentrated fat flows better, resulting in less clogging and less potential cell trauma.
5. Fat grafting efficiency is improved, allowing the surgeon to graft large volumes even in patients with a low BMI.
6. The operation can be performed in 2 hours or less.

Using the Brava system to preexpand the recipient site has emancipated the technique of megavolume fat grafting from the need for high-speed centrifugation and its potential disadvantages.

Choice of Fat Grafting Technique

Donor cells have the highest chance of survival with the technique that best ensures an even, three-dimensional dispersion of the fat. There are currently two methods of fat grafting: the “mapping” technique and the “reverse liposuction” technique (see technique descriptions later in this chapter). There are presently no data on which technique yields a better result. Each of us employs a different method, yet our independent volumetric data in breast augmentation is nearly identical, with an average volume increase of 250 cc at 6 months by MRI. Overall, the mapping technique may be more suitable for surgeons beginning megavolume fat grafting for breast augmentation, because it is more exacting and deliberate. For breast reconstruction, it is clearly beneficial, especially in scarred areas caused by mastectomy and/or irradiation, where a careful and deliberate graft placement is necessary. The reverse liposuction technique is more time efficient and can be used in cases in which there is no internal breast scarring, no dense adherence of skin to the chest wall, and where the breast is adequately expanded.

Cautions When Grafting Fat to the Breast

In grafting to the breast, the physician should avoid the following:

1. Grafting the parenchyma itself, because it is traumatic to the gland, and there is an increased risk of infection, because the ducts are not sterile.
2. Overgrafting; that is, grafting beyond what the recipient site can bear. A telltale sign of overgrafting is increased tissue turgidity and/or peau d'orange skin changes. Overgrafting often leads to total graft loss.
3. Delivering macropackets of fatty tissue (from which central necrosis will lead to oil cysts) instead of micropackets (which completely revascularize and survive).
4. Uneven grafting and grafting the same area twice to create uneven deposits or lakes.

Once the fat is grafted, the internal breast parenchyma pressure increases and congenital irregularities due to internal ligamentous tethering become more obvious. This is commonly seen at the interface between the natural inframammary fold and the newly augmented breast mound injection area. One of the advantages of fat grafting the breast is its unique ability to correct the constricted, tuberous breast deformity without any incision.

Preoperative Preparation of the Recipient Site

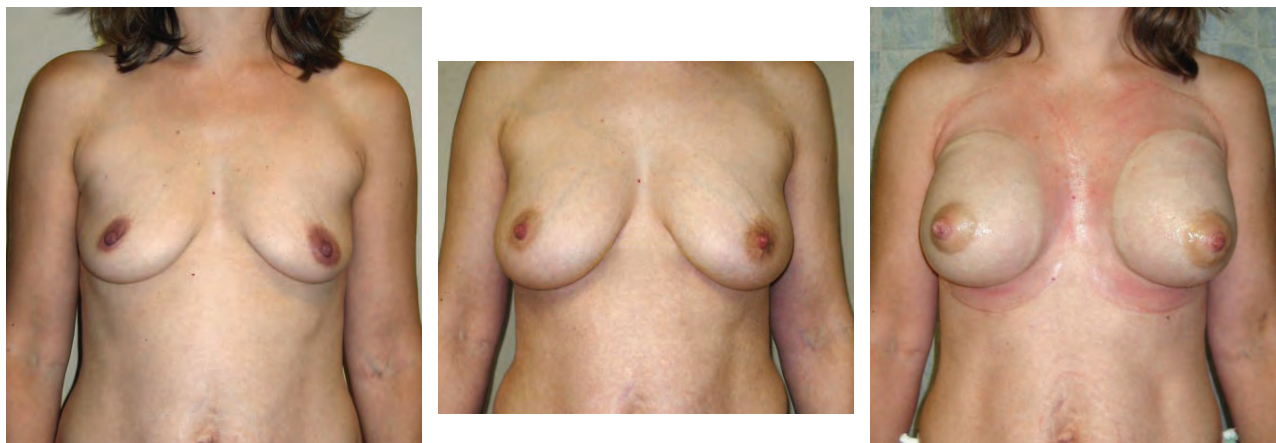
In no other procedure in plastic surgery is the preoperative preparation more vital than in fat grafting to the breast with Brava preexpansion. Mammograms are performed on all patients to obtain a baseline screening for breast pathology. Patients have three-dimensional MRI or three-dimensional photographic imaging to determine preexpansion baseline volume. Before expansion begins, candidates for the procedure are given a specific “goal volume” to achieve and agree they will follow the expansion guidelines. On a volumetric basis, a quantitative doubling of breast volume is the minimum goal set.

The expansion bra is then fitted on the patient by the nurse or by the surgeon, who makes certain that the patient can apply the bra and achieve the suction on her own. The bra comes in several dome projections and in several base diameter sizes and the correct size must be selected for each patient. It is important to educate the patient how to apply the bra so there is no room for error or lack of compliance during the expansion process.

Surgeon's Endpoints for Expansion

Surgery is not guaranteed unless the patient adequately expands. Patients are seen weekly in the office to monitor compliance and to quantify the expansion progress, and to make necessary corrections to the program. A standard doubling of breast volume by three-dimensional imaging is realistic and is usually obtained in 3 weeks in patients who follow the program of expansion. Although this process is planned to take 3 weeks, it is not as much a matter of time as it is a matter of adequate volumetric expansion. Some patients simply expand faster and better than others. In our practice, we have seen patients expand to four to five times the initial volumes in 3 weeks, whereas in other cases, we have seen patients who had little or no expansion after the same period of use. The duration of use in terms of hours per day and the negative pressure during use are the two variables that can be modified to achieve the desired expansion.

Patient's Endpoints for Expansion



1-2-3 Rule

It is important to educate the patient about the extent of the desired expansion. Often patients think they need to expand to their desired breast size and then stop, but this is not optimal. The Brava expansion should be greater than the desired volume, so there is a much larger potential space created compared to the desired volume of fat to be grafted. We have developed the “1-2-3 Rule” for our patients so they can easily understand the endpoints of expansion while they visually monitor their progress at home: If you are a “1” and you want to be a “2,” you must expand to a “3.” A patient who wants to double her final volume must triple in expansion.

Technique

Markings

Patients arrive in the operating room on the day of surgery wearing their expansion bra. Preoperatively, the patient is initially marked for areas to be suctioned, and the breasts are marked circumferentially for areas of proposed needle insertions. Any constricted areas are outlined for planned release using the percutaneous three-dimensional mesh release, as described by Rigotti et al. Markings are placed at 8 to 10 proposed sites circumferentially around the breast. Once markings are completed, the Brava bra is reapplied. Once in the operating room under general anesthesia, the patient is positioned supine with the domes still in place and under manual bulb suction. The anesthesiologist monitors the suction intermittently during the liposuction phase of the procedure, so the negative pressure can still be applied to maximize the recipient site space.

Harvesting

Liposuction is performed using a 12-gauge 9- to 12-hole cannula. Smaller cannula sizes produce less subcutaneous tissue trauma, promote faster recovery, and create smaller fat parcels that result in better fat flow and less clumping. Multiple holes facilitate fat removal increasing both efficiency and speed. Two collection techniques are currently employed.

Syringe Collection Method (Khoury)



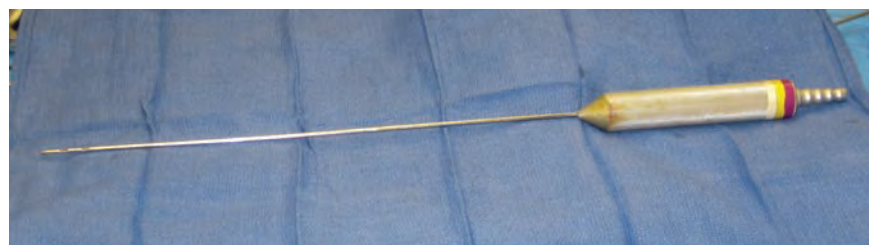
Lipoharvesting with the KVAC syringe and a 12-gauge, 12-hole cannula

For the syringe method of fat harvesting, a spring-loaded, 300 mm Hg constant-vacuum (KVAC) syringe is connected with a nonclogging atraumatic tissue valve and intravenous tubing to a 100 cc sterile intravenous bag on the field. Cocking the spring activates the syringe suction, and once the syringe is full, pushing the plunger down again purges the lipoaspirate to the collection bag and cocks the spring again. The cycle is repeated until the bag is full, at which time the assistant replaces it with another empty bag. Fat is harvested in a completely closed system. There is no exposure to air and minimal chances of bacterial contamination. Excessive air exposure is known to be detrimental to adipocyte survival. This technique initially collects the fat into 100 cc intravenous bags, which is efficient for the next step in the process.

Machine Method (Del Vecchio)

Using a sterile “in-line” container, fat is aspirated at lower than 1 atm (500 mm Hg) suction by attaching a sterile, clear, collection canister to a standard vacuum machine off the sterile field. A 3 mm 9-hole cannula with a wide handle and ribbed connector end is used to attach to the liposuction tubing. Maximal negative machine pressures are avoided when using this technique, and vaporization of the fat in the

collection canister is to be avoided at all costs. This technique initially collects the fat into 1200 cc canisters and can be performed with existing equipment used in an operating room.



A 3 mm multihole cannula fused to an ergonomic handle reduces operator fatigue and reduces instrument breakdown at the handle-tubing interface.

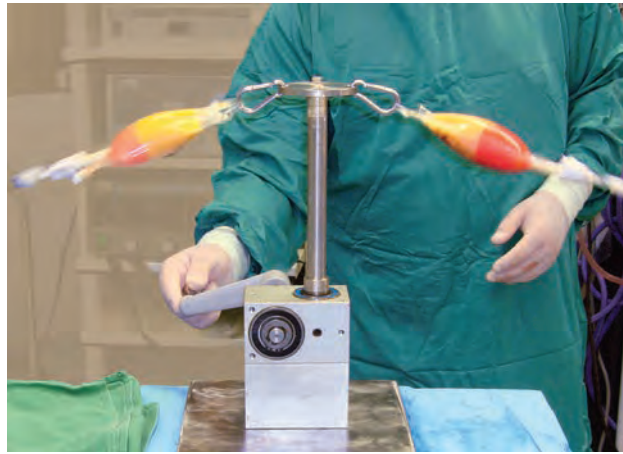


The in-line system is shown, with left-hand tubing going to the cannula and right-hand tubing headed off the field to a liposuction machine. The sterile canister on the field collects the fat.

Fat Preparation

Once the fat is collected, one of two general methods for removing unwanted crystalloid solution is employed: the bag centrifugation method advocated by Khouri and the large syringe method advocated by Del Vecchio.

Bag Centrifugation Method



With the bag centrifugation technique, 100 cc intravenous bags are hung on a hand-spun 5:1 gear-ratio spinner and centrifuged at low rpm (approximately 30 G) for several minutes. It takes minutes to prepare the 600 to 800 cc we often need for a bilateral augmentation, compared with hours for high-speed centrifugation. The infranatant crystalloid solution is tapped off, and the fat is ready for reinjection.

Large Syringe Method

By changing several in-line collection canisters during the machine liposuction, the canisters are allowed to stand for 10 minutes, allowing fat to separate from crystalloid. This fat is then drawn up into 60 cc syringes directly from the collection canister, and placed in a megavolume centrifuge. Additional low G force centrifugation of these 60 cc syringes is optional.



In the large syringe method, the passive use of 1 G separates the fat from the unwanted crystalloid solution by the use of stiff collimated containers—the canister and then the 60 cc syringes. This occurs passively and takes minimal additional time.



A number of 60 cc syringes are shown loaded onto the sterilized low G force bucket-handle centrifuge. Spinning decanted fat for 3 minutes at 40 to 50 G results in removal of 15% to 20% additional crystalloid solution, as demonstrated.

The greater the overexpansion of the recipient site space, the less important is production of ultraconcentrated fat. Overexpansion of the recipient site affords the opportunity to inject less-concentrated fat, which theoretically less traumatized, flows better, disperses better because it is less concentrated, and takes less operative time and manpower to process. The emphasis on *overcorrection* of fat grafting, with resultant overcrowding, interstitial hypertension, and fat necrosis, can now be applied to *overexpansion* of the recipient site before fat grafting.

Washing the cells with saline solution is avoided, because it is thought that this may remove essential components such as stem cells and growth factors from the fat slurry.

Placement

Once the fat is separated from unwanted crystalloid solution, injection into the breast begins. Injections are performed using a 15 cm Coleman side-hole needle.

The Mapping Technique (Khoury)

If a closed-system bag collection and centrifugation technique is used, the fat is simply drawn back out of the intravenous bags using small (3 to 5 cc) handheld syringes that are connected directly to a 14-gauge blunt, curved, side-hole cannula.



Markings for the mapping technique for fat injection in the expanded breasts are shown.

The markings are made in the recipient areas to aid in the systematic, diffuse, and even injection of the entire recipient site. Ten to 12 circummammary and 4 circum-areolar needle puncture entry sites are usually made with a 14-gauge hypodermic needle. Radially fanning tunnels from each site provide well-distributed, diffuse sites for insertion of the grafts.

Through each entry point the 15 to 25 cm long cannula makes multiple tunnels that fan out radially, and 2 to 4 cc of fat suspension is injected on withdrawal. The cannula is then inserted into another adjacent entry point and the process is repeated to yield a three-dimensional weave pattern that crisscrosses the recipient space to provide even coverage. The grafts are deposited at multiple levels, deep from the subpectoral plane, to the pectoralis muscle, to the base of the breast just above the pectoralis fascia, to the subcutaneous space immediately subjacent to the dermis.



Care is taken to disperse the graft as much as possible and *to inject on withdrawal of the needle* along an axial track. In a well-expanded breast, the superficial tissues from the skin to the breast parenchyma open up into three potential planes. Fat is first grafted in the most superficial subdermal plane, then in the middle subcutaneous plane, then in the deeper periglandular space. These are staggered along the multiple entrance needle holes. Grafts through the even-numbered holes are distributed most superficially, odd-numbered ones deeper, and periareolar deepest. We prefer to first fill up the preglandular recipient site, because it is more effective than filling the deeper subglandular layer when the same volume of fat is placed and survives. (Golf balls provide more contour projection when placed under the sheet compared with under the mattress).

In a well-expanded breast we can often graft over 200 cc in this superficial plane. Care must be taken, however, to avoid the “peau d’orange” effect of excessive grafting since this will cause total graft loss. Then, if there is more graft available, we graft

the deeper planes beginning under the muscle, progressing to inside the muscle, to above the fascia, to subglandular. Direct injection into dense breast tissue is not performed. This technique is more accurate and deliberate, requiring more time. It is recommended for those who are initially performing fat grafting to the breast. In addition, it requires that the operator deploy the plunger and withdraw the needle at the same time.

Reverse Liposuction Technique (Del Vecchio)

If fat has been harvested and collected using the machine and large syringe technique, the fat is already in 60 cc syringes. These syringes are simply loaded onto the Coleman cannula and injected into the breast. The reverse liposuction technique uses 6 to 8 insertions on the breast along the inframammary fold and spaced 4 to 5 cm laterally toward the axilla. The inframammary fold insertions are usually made 1 cm below the native inframammary fold, because this will descend 1 to 2 cm, similar to the effect seen in augmentation with breast prostheses.

Insertion holes are positioned in a pattern around the breast periphery. Insertions along the medial upper quadrant are generally avoided to reduce the possibility of pigmented large needle scars, as this is the part of the breast often seen in low cut clothing. Using a “reverse liposuction” technique, gentle pressure is placed on the plunger of the 60 cc syringe and the cannula is inserted and removed in a relatively rapid fashion along multiple axial directions.

A straight, 15 cm, blunt, side-hole, 16-gauge Coleman cannula loaded directly onto 60 cc syringes is used to inject the fat using a controlled “to and fro” liposuction movement with constant light depression on the plunger. With every pass of the cannula the direction is changed slightly to create a fanning vector pattern. This is repeated in each different insertion site and at multiple planar levels from the base of the breast. The axillary insertion is also used to place graft tissue in the submuscular position; this approach is thought to be the safest method of navigating the subpectoral space. An example of optimizing a technique versus maximizing a variable, the reverse liposuction technique strives to optimize graft insertion times with the potential for less exact dispersion of fat if not effectively performed. Another potential benefit of the reverse liposuction technique is that 60 cc syringes generate lower maximum pressures than do 5 cc syringes, which generate higher pressure. Therefore, if there is a blockage of flow along the insertion cannula because of clumping, this will occur at a lower pressure using a 60 cc syringe, with less potential damage to the grafted cells and less likelihood of pushing the blockage through, creating a bolus.

The maximum pressure generated in a 60 cc syringe is lower than that of a 3 or 5 cc syringe. There is thought to be less pressure and trauma on the adipocytes using the larger syringe. If the graft is placed at a rate of 1 cc of volume in 2 to 3 seconds, this results in 2 to 3 minutes per 60 cc syringe of fat, or 10 to 15 minutes to augment 300 cc of volume into each breast.

A summary of the two techniques is outlined in the table.

Comparison of Techniques for Harvest, Preparation, and Grafting of Fat

	Syringe Method	Mechanical Methods
Aspiration cannula	12-gauge Luer-Lok	3 mm ergonomic handle
Aspiration force	Handheld syringe	Machine assisted
Operator ease of use	Springloaded	Vacuum unit
Air exposure	Minimal to none	Mild to moderate
Negative pressure	Constant	Constant
Collection chamber	100 cc IV bag	1200 cc rigid canister
Crystalloid separation	Low G force centrifuge	Low G force centrifuge
Injection cannula	16-gauge blunt curved	16-gauge blunt straight
Injection force	3 cc syringe (high)	60 cc syringe (low)
Injection technique	Mapping	Reverse liposuction

Aesthetics of Breast Size and Shape Immediately After Grafting

There is a major paradigm shift between what a surgeon should expect from an aesthetic perspective after prosthetic breast augmentation and augmentation using megavolume fat grafting. Using breast implants, the “on-table” aesthetics can be critically examined for size, symmetry, and position and are more “WYSIWYG” (what you see is what you get). In contrast, the immediate on-table result with megavolume fat grafting represents the first stage of a dynamic process. First, there is a volume of interstitial fluid from the expansion itself and crystalloid solution in the donor fat; this will reabsorb in the first 3 to 5 days after grafting. The surgeon should not be too concerned with the appearance of breasts that look too large on the table but should focus on the volume of material that was grafted. Second, because the augmentation is intraparenchymal rather than the single-cavity volume enhancement achieved with implants, there are more on-table surface irregularities that will resolve in the early postoperative period; these require no additional manipulation.

When external negative pressure is placed on the breast, Brava preexpansion may accentuate breast contour irregularities that are caused by inframammary fold constrictions, tuberous breast constrictions, or internal scars in the breast. It is important to recognize these irregularities while the patient is still on the operating table. Breast shape can be addressed in augmentation patients, especially double-bubble contour deformities that occur along the inframammary fold.

***Shape Modification Using Three-Dimensional Meshing:
The Rigottomy Technique***

We use a technique first described by Gino Rigotti to release scars in breast reconstruction with fat grafting. He performs a three-dimensional mesh release of the scar. This is a very powerful way to release a contracture without making subcisions; it also avoids creating linear tissue planes that end up as loculated cavities with fat necrosis. Instead, the technique releases the contour deformities of the breast parenchyma and expands it in three dimensions like a skin graft is meshed to expand in two dimensions. This creates multiple microcavities where small deposits of fat can survive. We have named this technique the Rigottomy. The grafted fat fills the small cavities in the three-dimensional released structure and restores the attractive, round breast shape. By percutaneously releasing fibrous constrictions, the inframammary fold can be lowered, the constricted tuberous breast can expand in three dimensions, and the overall shape of the breast can be modified dramatically.



Immediately after fat grafting, the injected fat provides an internal traction effect to help identify specific areas of deforming scar or ligamentous bands, as seen in this patient (*left*). After insertion of an 18-gauge needle and release of the scar bands (*center*), the irregularity is released and the fat immediately fills the space created, changing the shape to a more aesthetic result (*right*).



In a dense breast that exhibits a double-bubble contour deformity at the inframammary fold (*right of nipple*) and upper pole (*left of nipple*), multiple needle band releases, or Rigottomies, may be required, as seen in this patient.

Postoperative Management

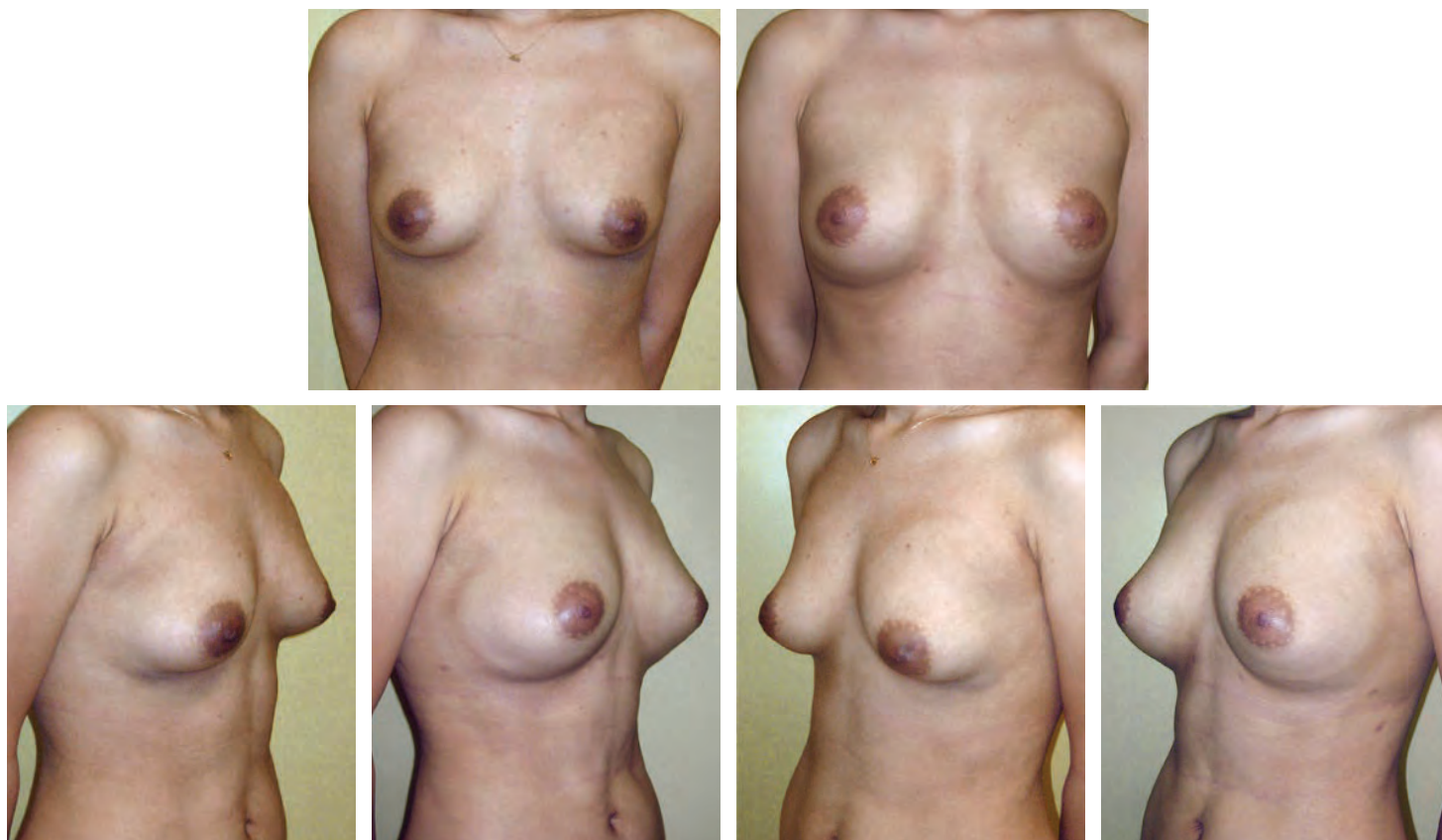
Postgraft care is a very important factor in graft survival. One would not expect a skin graft to survive if it were subjected to motion and shearing in the early postoperative period. Therefore, in the first 24 hours after grafting, no external compression or negative pressure should be applied. Beginning 24 hours after grafting, patients are placed in Brava domes that are set at a low constant pressure; the patient wears the Brava bra for the first 5 to 7 days after the grafting procedure.

The use of Brava in the postoperative period may act as a splint. As a fundamental principle of plastic surgery, it is crucial to maintain surgically released and grafted constrictions or scars open with a splint until the graft matures. The low negative pressure exerted by the expansion bra may help immobilize the fat cells and aid in neovascularization to the graft. It is also postulated that the lipoaspirate-filled slurry in the interstitial space held open with the Brava bra functions like a multitude of growth chambers to stimulate fat formation. In any event, application of the bra in the postoperative period certainly protects the breast from external trauma, which could serve to shift the grafts and potentially disturb neovascularization.

Our experience has shown that if the patient continues to wear the Brava bra after the first postoperative week for 10 hours per day for several months, she will tend to keep the early augmentation result as permanent tissue, with very little volume loss over the next year. In essence, this is the original expansion effect boosted by fat grafting. Therefore we currently recommend that the patient maintain the external tension on the tissue for 10 hours per day over the next 8 to 10 weeks; this in our experience greatly enhances the megavolume graft results. This creates a multitude of active growth chambers in which Morrison et al have shown stimulation of fat growth.

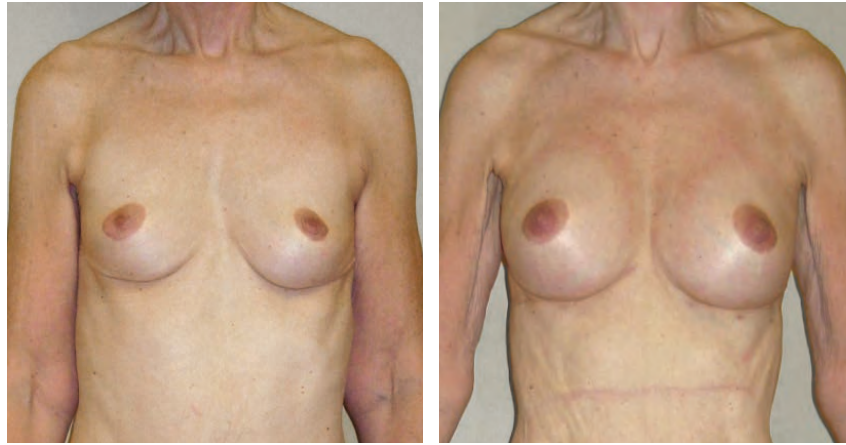
Results

One-Stage Breast Augmentation



This 24-year-old nulliparous woman desired increased breast size. She was concerned with size and requested a rounder shape. Her breasts were relatively symmetrical, with moderate inferior constriction in the lower poles. She did not want breast implants. She initially underwent expansion with a Brava handheld pump used 8 hours per day for 3 weeks. She was a very compliant patient, and her expansion proceeded well over serial office visits. After 3 weeks of expansion she underwent injection of 280 cc of fat into each breast, harvested by liposuction of the thighs. Six months after grafting, her result is stable. Even in patients in whom liposuction alone would not likely be considered, it is possible to obtain a sufficient amount of fat.

One-Stage Breast Augmentation for Deflated Breasts After Implant Removal



This 59-year-old woman had previously had silicone breast implants that were removed 15 years earlier because of implant complications. At the time of her implant removal, her breast tissue had atrophied and thinned, and her surgeon had performed a Wise pattern breast lift to remove excess skin. The patient was not happy with the size reduction and with the deflated appearance, but she did not wish to undergo reinsertion of breast implants.

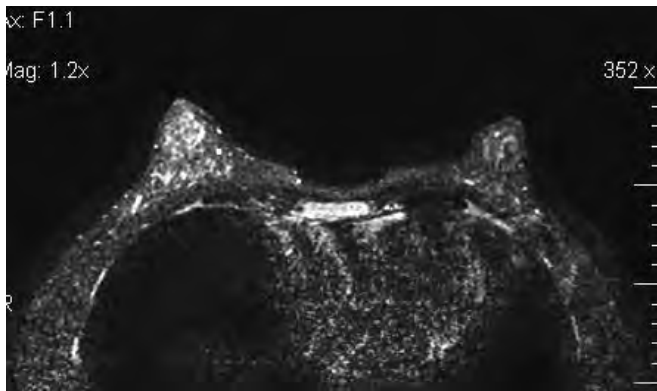
When she presented for a thighplasty involving initial thigh liposuction, to be followed 6 to 8 months later by a medial thigh lift, the possibility of using the liposuction fat for her breasts was discussed with her. The patient wore the Brava bra, using the higher-pressure hand pump, for 3 weeks preoperatively during the late afternoon/early evening for approximately 8 hours per day. This patient, a practicing physician, had a busy schedule, and compliance was a challenge. Despite her less than ideal compliance, she had enough parenchymal and skin laxity to expand well and to receive 600 cc of fat in each breast during her thigh liposuction. After 6 months she demonstrated a significant, sustained volume increase. Patients who have breast implants removed have already had significant skin expansion as well as subcutaneous parenchymal redundancy once the implants are removed. This is an opportunity to “backfill” this space with fat.

Two-Stage Breast Augmentation for Constricted Tuberous Breasts

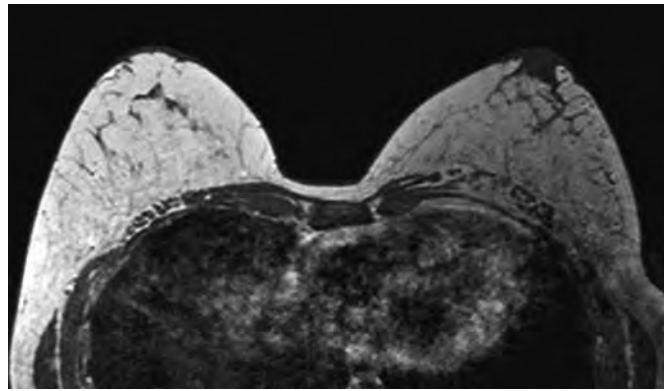
Constricted tuberous breasts can be augmented and reshaped with external expansion and megavolume fat grafting; usually two stages are required to achieve sufficient volume.



This 32-year-old patient with tuberous breast deformity desired increased breast size and improved shape. She had constricted inframammary folds and herniation of the nipple-areolar parenchyma. She did not want breast implants. She initially underwent expansion with a Brava Sport Pump, a low-pressure battery-operated pump, for 3 weeks before her first fat grafting procedure in which 300 cc of fat was injected into each breast, and she underwent three-dimensional mesh release and periareolar reduction. It was thought that the low negative pressure created by the Sport Pump was not optimal and that additional expansion could have been achieved with a handheld pump generating more negative pressure.



Preexpansion MRI of patient



MRI 6 months after second fat grafting

After 4 months she underwent a second round of preexpansion using a handheld pump and had a second round of grafting, with 350 cc of additional fat per breast. Her results after her first procedure and 8 months after her second injection series demonstrate a significant increase in volume and improved breast aesthetics.

Concluding Thoughts

Fat grafting to the breasts fell into disrepute 20 years ago because of a lack of efficacy in technique and the much-discussed potential for obscuring the detection of cancer. Over time, however, these concerns have been largely addressed as applications for fat grafting have expanded.

Today fat grafting to the breast is still controversial, but efficacy is no longer a question. To establish efficacy, each of us has conducted an independent prospective study with a total of 100 patients followed for 6 years. We have carefully monitored our patients with preoperative and postoperative MRIs and confirmed long-term fat graft survival after breast augmentation of 220 to 250 cc per grafting session. None of our patients had a suspicious lesion, and breast radiologists have identified no significant findings on the imaging.

There is no support in the literature for the theory that fat grafting might stimulate the growth of breast cancer. Plastic surgeons have routinely transferred large amounts of fat for breast reconstruction. That experience spans a few decades and hundreds of thousands of patients, with no suggestion whatsoever of increased cancer recurrence in a cancer-prone recipient site. Delay and Rigotti have reviewed their decade-long experience with more 1000 patients grafted after mastectomy and lumpectomy and found no evidence to suggest that the procedure promotes cancer growth or recurrence even in the cancer prone residual breast.

The potential but unproven benefits of stem cell–enriched fat and cell protectants are exciting new avenues for investigation; these must be evaluated through clinical studies, comparing these results to those using unadulterated adipocyte grafts as a benchmark. Over the next decade, these issues and the relative safety of the procedure will be better defined. Standardization, clinical improvements in technique, and protocols for preoperative and surveillance breast imaging are needed to define patient safety and the role of fat grafting as a viable alternative for breast augmentation.

Clinical Caveats

Successful fat grafting requires optimization of four components: (1) the grafted tissue with its viability and growth potential, (2) the size and quality of the recipient site, (3) the grafting technique, and (4) care after grafting. The outcome will be as good as the weakest link. There is no point in investing excessively in one factor if another step is neglected.

Preparation of the recipient breast with the Brava external expansion system requires a minimum of 2 weeks of expansion.

The more intensive the use of Brava, the faster the expansion; patient compliance is essential.

Expansion makes the recipient tissue compliant and allows the diffuse placement of large graft volumes with optimal preservation of the graft to the recipient interface.

For patients with constricted tuberous breasts, the Rigottomy technique is beneficial. It provides for the percutaneous release of fibrous constrictions in the inframammary fold so the constricted breast can be expanded in three dimensions, thereby facilitating the modification of the overall shape of the breasts.

Suggested Readings

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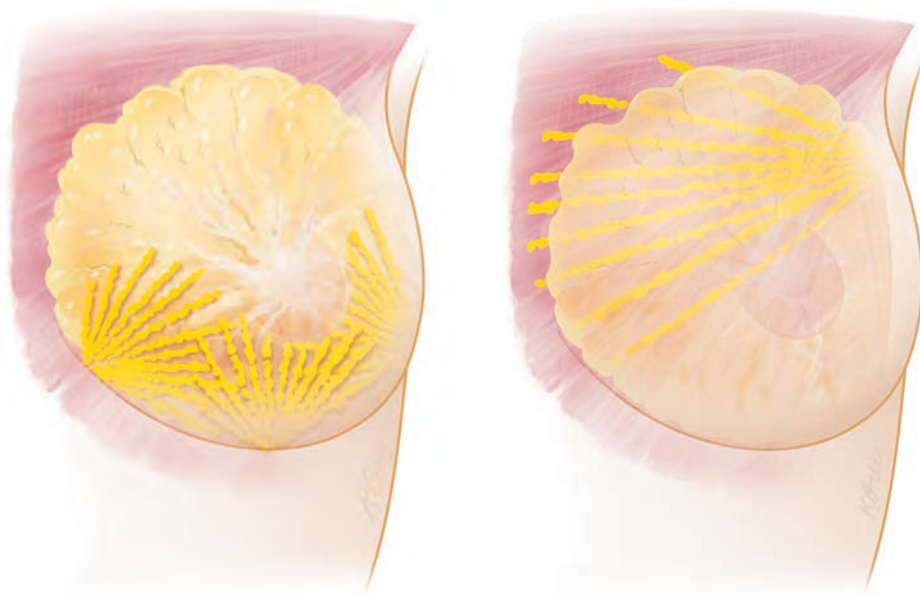
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CHAPTER 65



Fat Grafting to Treat Capsular Contracture

GINO RIGOTTI, ALESSANDRA MARCHI,
GUIDO BARONI, PAOLO PATETE, ANDREA SBARBATI

Capsular contracture is a postoperative complication following aesthetic and reconstructive surgery of the breast. Clinical studies report an incidence of 7% to 20%, without any specific correlation with the surgical procedure (augmentation or reconstruction).

From a clinical standpoint, capsular contracture results from a progressive fibrotic physiologic process that follows the insertion of a foreign body; the body attempts to wall off the object. After breast augmentation surgery in which implants are placed, normal capsule formation leads to a thin, soft layer of fibrotic tissue around the implant, with no evident morphologic modification of the breast. Capsular contracture is characterized by progressive hardening and thickening of the periprosthetic tissue layer, leading to retraction. The result is deformation of the implant, resulting in evident breast morphologic changes toward a hemispheric shape; the breast is drawn upward, causing pain and, in the worst cases, extrusion of the implant. Although the causes of capsular contracture have not been entirely elucidated, postoperative radiation therapy has been reported to significantly increase its incidence.

According to Baker's classification, capsular contracture is grouped into four categories:

Baker I capsular contracture is characterized by a soft breast without significant scar tissue.

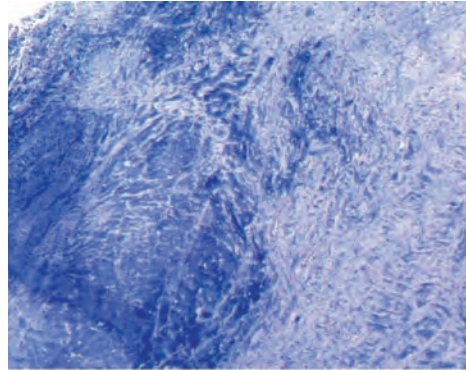
Baker II capsular contracture involves palpable scar tissue around the implant; however, the capsule is not visible.

Baker III capsular contracture is associated with visible and palpable hardening, leading to a deformed breast shape.

Baker IV capsular contracture, the most severe level, involves hardening and a palpable, visible capsular deformation and often a cold, hard breast that is very painful even to mild palpation.

Capsular contracture is conventionally treated with surgery (typically implant replacement) or capsulectomy in an attempt to restore normal breast morphology and reduce the clinical symptoms. However, in a high percentage of cases, the beneficial effects of surgical revision are not long lasting, and the contracture redevelops, requiring further surgical intervention.

The use of autologous fat grafting for the treatment of capsular contracture was first attempted after observation of the substantially fibrotic and avascular nature of the periprosthetic tissue.



This microscopic image of a periprosthetic capsule indicates the presence of contracture. This is typical of ischemic tissue, with no or few blood vessels present. Recent clinical studies demonstrate that transfer of lipoaspirate (autologous fat grafting) is an effective treatment for many of the pathologic conditions related to ischemia. Thus fat grafting is proving a reliable therapeutic strategy for the treatment of capsular contracture.

Although the mechanisms associated with the regenerative properties of lipoaspirate are not yet completely understood, they have been explained by the action of mesenchymal multipotent cells, *adipose-derived stem cells* (ADSCs or ASCs), which have been found in significant quantity in harvested lipoaspirate. The capability of these cells to produce angiogenic and growth factors appears to be enhanced when they are grafted in a biologic environment with altered microcirculation or when fat grafting is followed by mechanical stretching for volumetric enhancement.

The advantages of fat grafting in clinical practice include the ease and accessibility of harvesting lipoaspirate from different donor areas, the simplicity of the purification procedure, and the permanent nature of the results of fat transfer. The use of micrografts has led to improved “take” of the transferred lipoaspirate.



The advantages of fat grafting in the treatment of severe postradiation effects are demonstrated in this patient. On the left, she is seen following radiation therapy. On the right, after autologous fat grafting, a newly generated thick layer of fatty tissue is evident during reconstructive surgery.

Indications and Contraindications

Women who have had implant-based reconstruction or cosmetic breast augmentation and developed severe capsular contracture (Baker grades III or IV) are ideal patients for fat grafting. Many of these patients have undergone a conventional approach to the treatment of capsular contracture, and the condition has recurred.

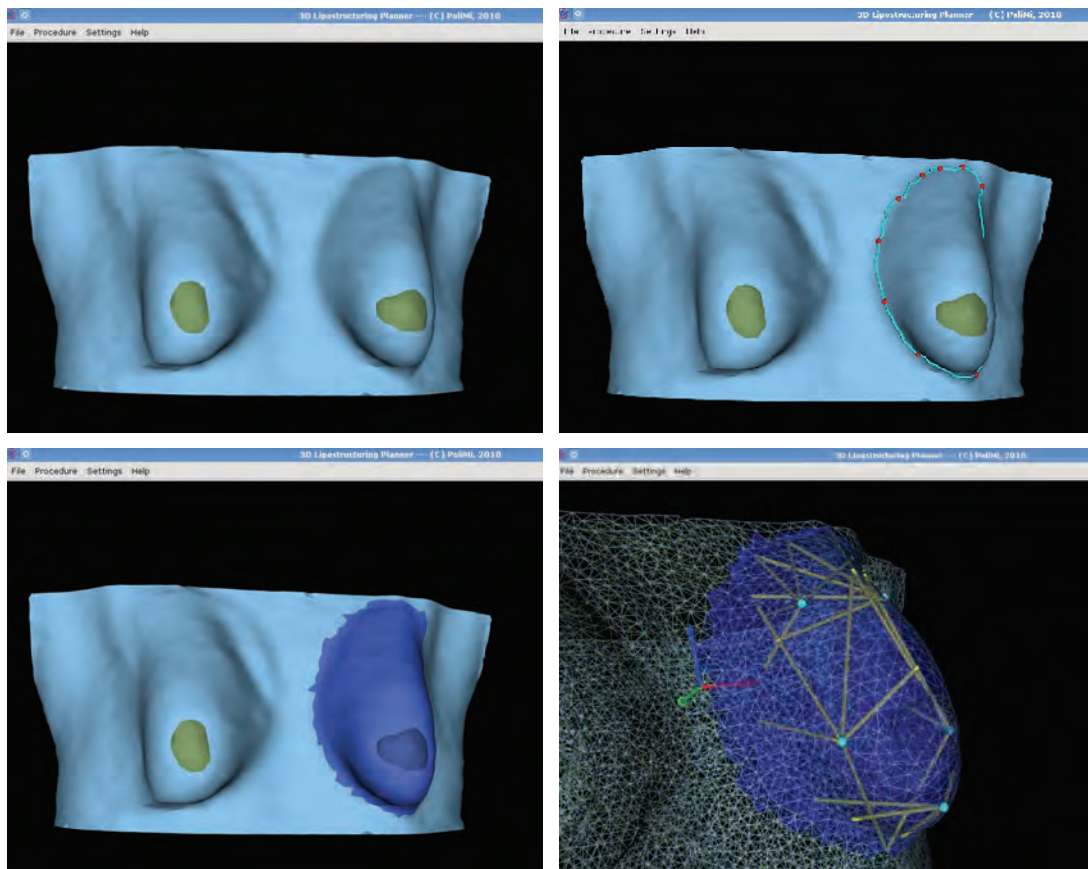
Patient suitability for fat grafting depends on whether the individual has a sufficient amount of fatty tissue to be harvested (70 to 200 cc for each grafting session; on average, three or four sessions are required). There are no specific contraindications to fat grafting, such as patient age or health issues, as long as the patient is able to tolerate the deep sedation required for tissue harvesting and grafting.

Preoperative Assessment and Planning

The severity of capsular contracture and its location must be carefully assessed so the surgeon can estimate the correct amount of fatty tissue required and make a preliminary comparison of the volume available at the donor site in relation to the requirements of the recipient site, without putting too much pressure on the infiltrated lipoaspirate. Generally, no additional fat is grafted to account for absorption; the effects of absorption are reduced by repeated lipoaspirate sessions. Grafting features fat deposition in a large area around the contracture site, plus localized deposition to treat the most evident signs of retraction and fibrosis.



Fat grafting is planned by establishing the number and location of the entry points and the direction of the injection tunnels; these parameters can be refined during surgery. The goal is to achieve optimal uniformity of distribution around and within the contracture area and to avoid significant overlaps and gaps. Lipoaspirate must be distributed all around the capsule with no perforation of the capsule or the prosthesis. The purified fat is grafted between the skin and the capsule.



Surgical planning can be enhanced with computer-assisted planning tools. These provide volumetric anatomic models of the target area based on MR scans (with the patient prone), or they register an MR atlas on the patient's surface data acquired by laser surface scanning. An example of the targeted volume and graphic feedback of optimized tissue deposition pathways is shown above. The computer tool allows the surgeon to visualize and segment the target structures, to establish the initial graft geometry by defining preliminary entry point positions and insertion angles, and to define forbidden areas and/or volumes that must be avoided, such as the implant. The tool features automatic procedures that optimize the grafting sequences by means of volumetric algorithms that optimize the uniformity of tissue distribution.

The operative plan created with these computer tools can be viewed during the procedure to guide the surgeon through the sequence of deposition paths. A further step toward the highest possible accuracy of fat grafting is represented by the use of intraoperative surgical navigation devices based on real-time, three-dimensional localization technologies (infrared optical tracking systems and electromagnetic localizers) that are registered with the individual patient's surgical plan.

The surgeon must thoroughly discuss the procedure with the patient, particularly the fact that the technique requires multiple surgical sessions at monthly intervals and that the entire treatment cycle can be as long as 12 months.

Operative Technique

The operative technique is organized in three phases.

Phase I: Harvesting the Lipoaspirate

The patient is given a local anesthetic and deep sedation for harvest of fatty tissue. Twenty minutes before surgery begins, antibiotics are administered. Typically, lipoaspirate is harvested from the medial area of the knee, the abdomen, or the trochanteric regions and the flanks. The identified donor area is infiltrated with a cold saline solution of 1:400,000 epinephrine and 20 ml lidocaine 0.5% for every 500 ml. Harvesting is performed by means of a 2 mm diameter blunt-tip cannula with a dull distal opening that is connected to a 50 cc Luer-Lok syringe. Aspiration must be performed without applying excessive negative pressure. It is important to begin harvesting with superficial liposuction, extending this to the deeper layers.

Phase II: Purifying the Lipoaspirate

The harvested fatty tissue is purified to remove a large part of the triglycerides stored in the tissue to facilitate their rapid clearance after injection. At the end of harvesting, the cannula is removed from the syringe and replaced with a plug. The plunger is removed and the syringe is placed directly into a centrifuge (IEC Medispin-6). The syringes are centrifuged at 1000 rpm for 1 minute; this produces three layers within the syringe: the upper level contains oil from ruptured adipocytes; the middle level contains the purified lipoaspirate; and the lowest level contains blood, saline solution, debris, and residual drugs. The upper and lower levels are discarded by using neuropads for absorption and opening the plug, respectively. The purified lipoaspirate is transferred to a 2 cc syringe and is ready for injection.

Phase III: Injecting the Lipoaspirate

The same local anesthetic that is employed for harvesting is injected at the recipient site with the patient under deep sedation; blunt needles are used to avoid vessel damage. Coleman type III and V cannulas are used for lipoaspirate deposition (especially effective in irradiated tissue).

There are two main issues to be considered in lipoaspirate deposition:

1. The quantity of lipoaspirate to be administered
2. The homogeneity of the deposition

The quantity of lipoaspirate to be injected is crucial. Several issues need to be considered: stiffness of the subcutaneous tissue and skin retraction (*peau d'orange*) are highly critical. The quantity of lipoaspirate is decided on a patient-specific basis. It

is important to avoid too much pressure on the infiltrated lipoaspirate; at the end of the procedure, some elasticity within the treated area must be preserved. It is crucial that fatty tissue be placed with the highest homogeneity within and around the targeted area. Anecdotally, this homogeneity is believed to increase the regenerative effects of the treatment. Graft homogeneity is the rationale for using computer-assisted planning and surgical navigation for lipoaspirate grafting.

As a general rule, the placement of very small aliquots of lipoaspirate for each insertion path is the key to obtaining remarkable, lasting results. Injection of bulky quantities will usually result in the development of oil cysts and/or macrocalcifications. *NOTE: The thread of lipoaspirate must be placed while withdrawing the cannula to minimize the risk of arterial or venous embolization.*

The number of treatments depends on the patient's initial clinical picture and on the patient's response to the therapy. In our experience, three to six treatments are sufficient to obtain the desired results. Capsular contracture following radiation therapy is much more severe and requires more fat grafting procedures. There is no evidence of any contraindication to additional fat grafting sessions.

Postoperative Care

DONOR AREAS Immediately after the procedure, ice packs should be placed for 4 to 6 hours over any areas from which fat was harvested. The patient wears an elastic pressure garment for about 2 weeks.

TREATED AREA As in the donor area, ice packs are positioned over the treated area immediately after the procedure and kept in place for 4 to 6 hours.

Immediate and Late Complications

Donor Areas

In the postoperative period, ecchymosis and small hematomas are often present but normally disappear within 2 to 3 weeks. Local administration of epinephrine is extremely important to avoid this problem. Irregularities can be avoided by using the techniques recommended for liposuction.

Infection

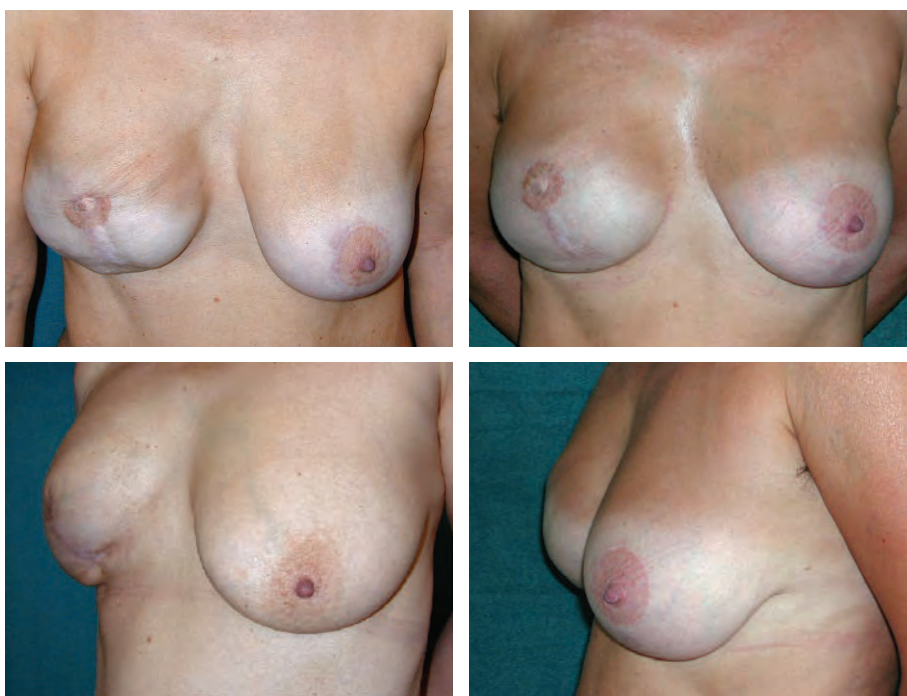
Infection is a very uncommon complication—the incidence is normally much less than 0.5%. This probably is associated with antiinflammatory properties of the lipo-

aspirate as a result of T lymphocyte inhibition. Nevertheless, we strongly advise giving a single prophylactic dose of an intravenous antibiotic before the procedure.

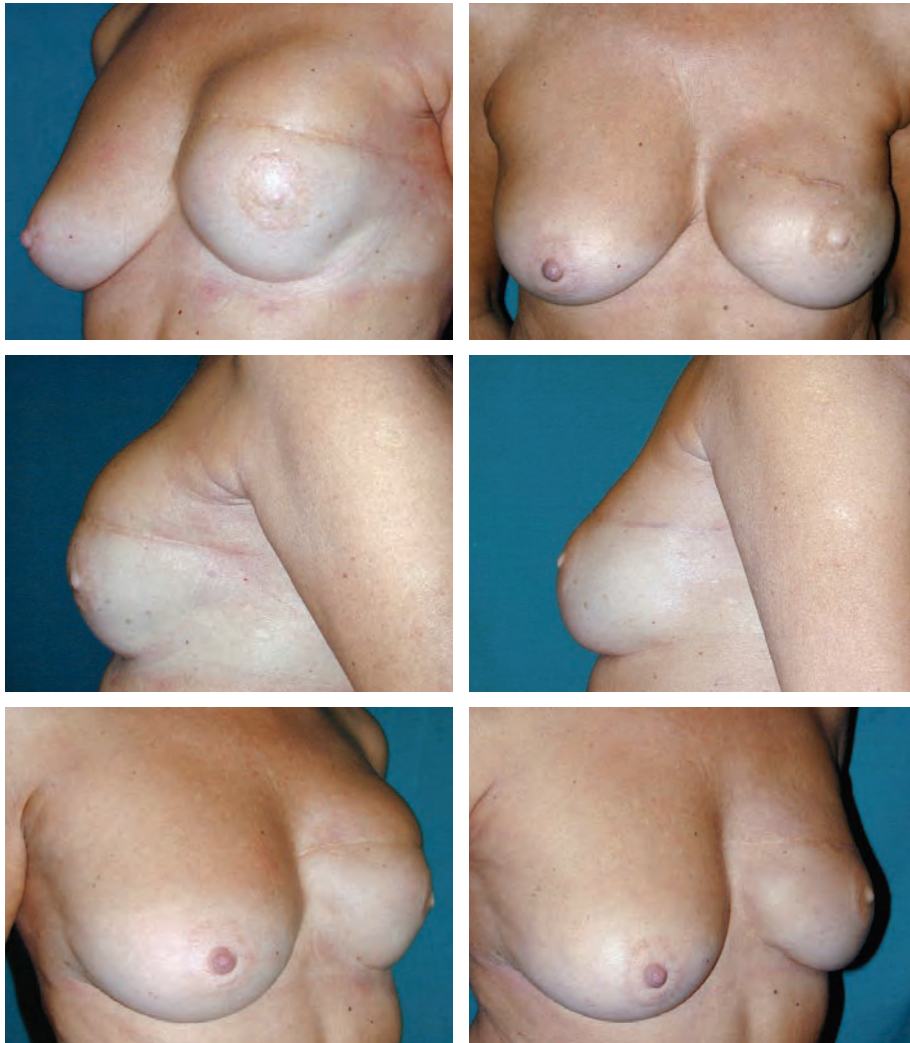
Venous and Arterial Injuries

The most common problem associated with fat grafting is damage to veins or small arteries, resulting in ecchymosis, and occasionally hematomas. To avoid these problems, sharp needles should not be used, even for injection of a local anesthetic. Peripheral arterial occlusion has never occurred in any of our patients after the procedure.

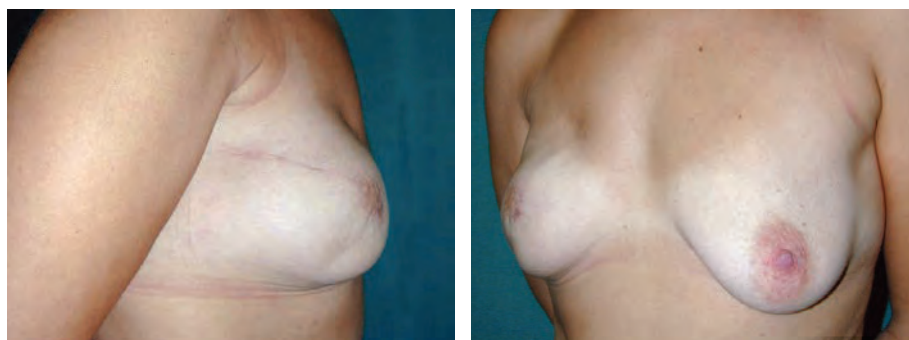
Results



In this patient, total reconstruction of the right breast with an implant was complicated by moderate capsular contracture. There were wrinkles that were more evident in the upper quadrants and flattening of the lower pole, as well as upper prosthesis dislocation and a volumetric deficit. Four fat grafting sessions were sufficient to resolve the scar retraction and contour waviness and to produce new adipose tissue in the targeted areas; this led to restoration of breast morphology comparable with that of contralateral breast.



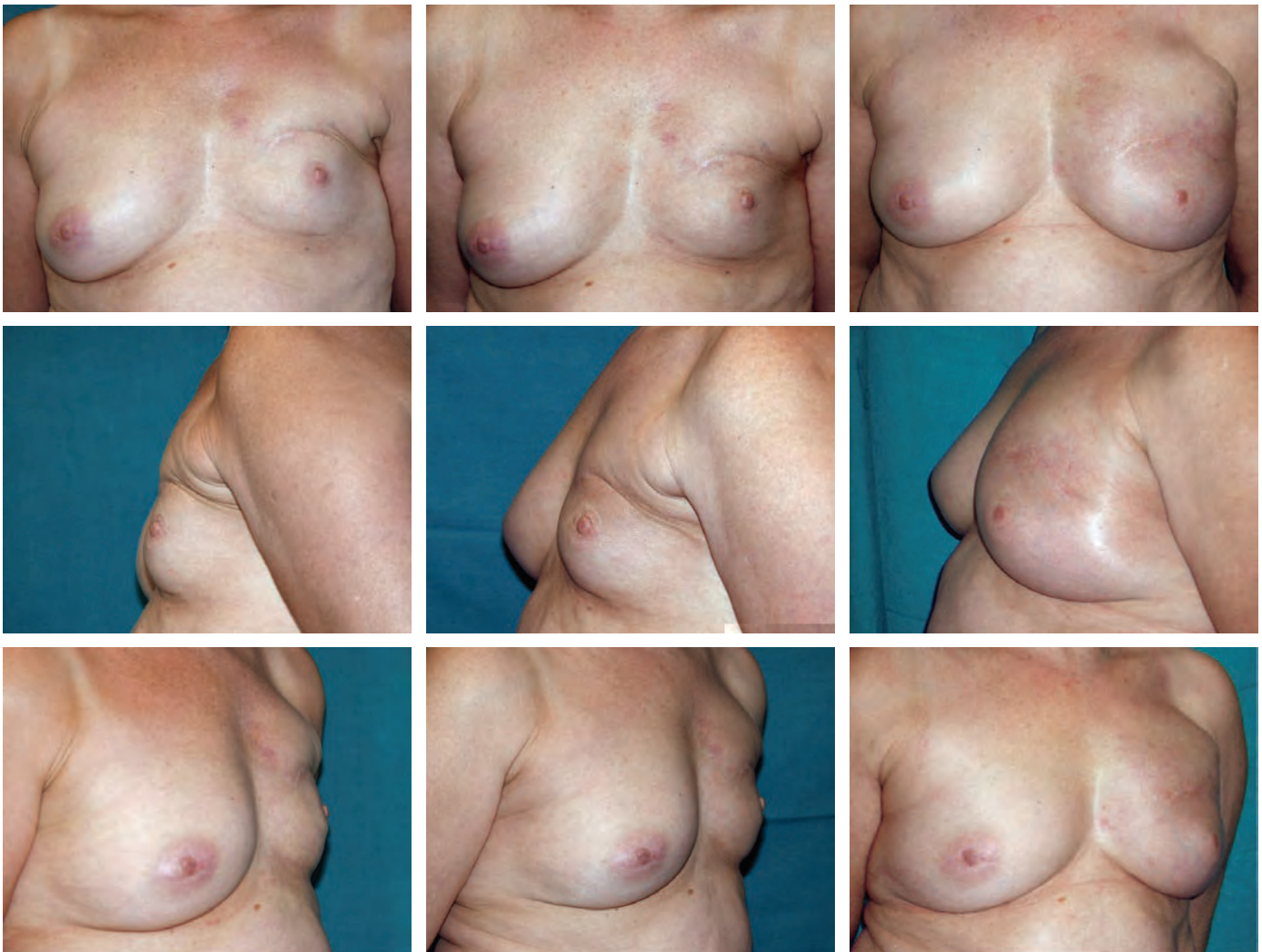
This patient underwent implant-based breast reconstruction, which resulted in a significant Baker III capsular contracture. Retraction had led to upward dislocation of the implant, with excessive bulging in the superior quadrants and deformation of the inferolateral contour. Marked scar retraction was also evident. At her 5-year follow-up, we modified the capsular fibrotic tissue through fat grafting into a softer tissue, which led to complete morphologic and clinical recovery.



In this patient, breast reconstruction with a prosthesis after a quadrantectomy resulted in severe capsular contracture after radiation therapy, with a significant reduction in breast volume, severe retraction of the residual gland in the upper quadrants, and scar adherence to the chest wall. The patient also had pain and restraint of movement.



Three sessions of fat grafting, every 4 months, led to a marked reduction of the general retraction, and restoration of the volume deficit and natural ptosis. The reconstructed breast became soft and pain free. The implant was not replaced.

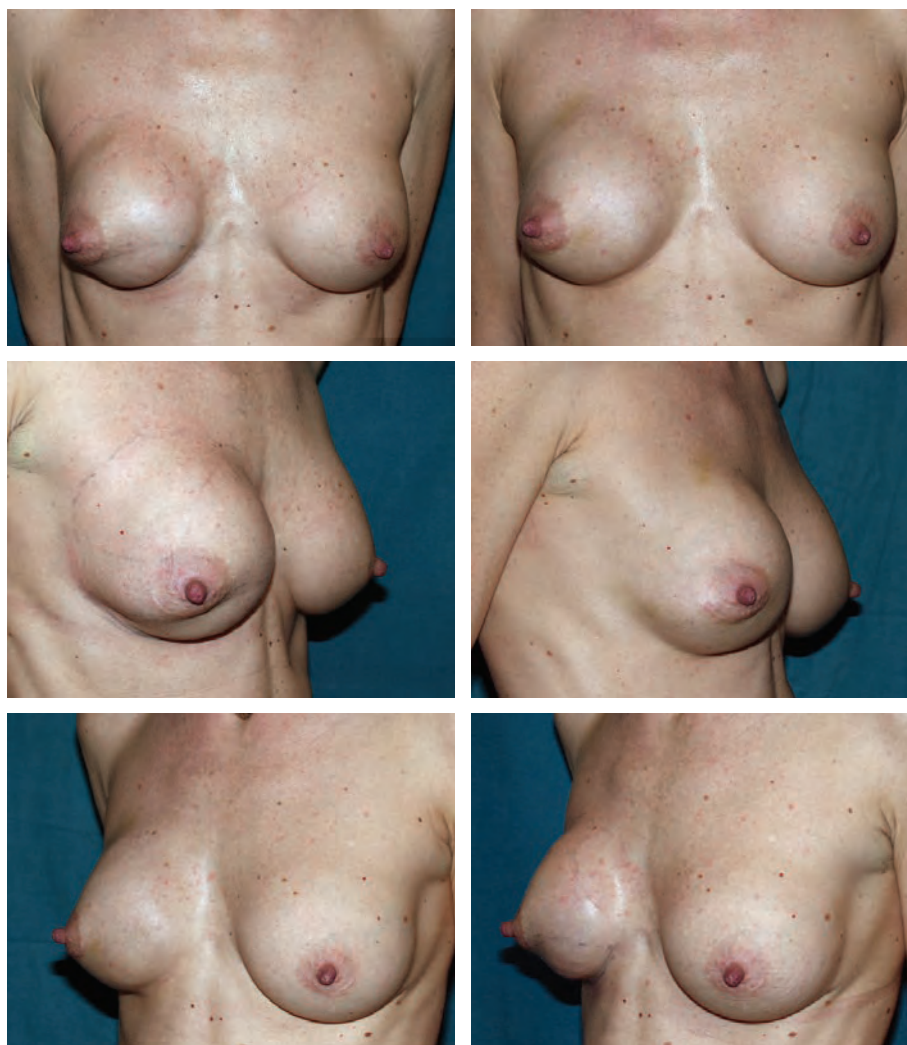


Before fat grafting

After session 1

After session 2

This young woman underwent total breast reconstruction with a breast implant. No radiation therapy was performed. Localized capsular contracture in the superomedial and inferolateral quadrants affected the cosmetic result. Two fat grafting sessions (80 cc and 120 cc, respectively) were performed to correct gaps and restore contours. The antifibrotic effects of fat grafting allowed resolution of the initial marked capsular contracture, scar retraction, and volumetric deficit.



Before fat grafting

After session 1

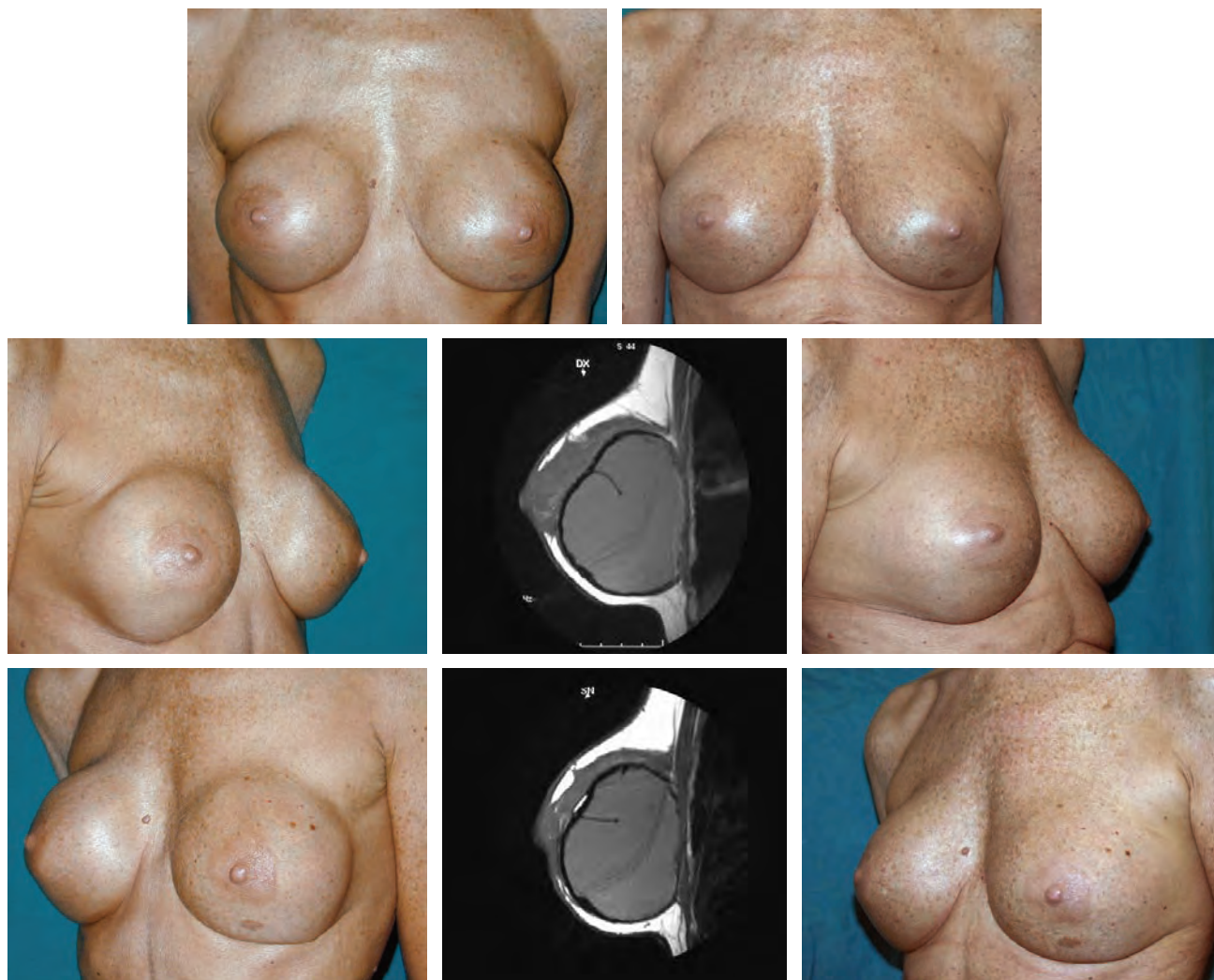
This patient had undergone bilateral augmentation and developed significant capsular contracture in the right breast, with a round constriction of the breast and retraction most evident in the inferior pole. Selected capsulotomies and capsulectomies had not improved the clinical picture. Three fat grafting sessions with 4 months between each session were necessary to restore shape, volume, and symmetry with the contralateral breast.



After session 2

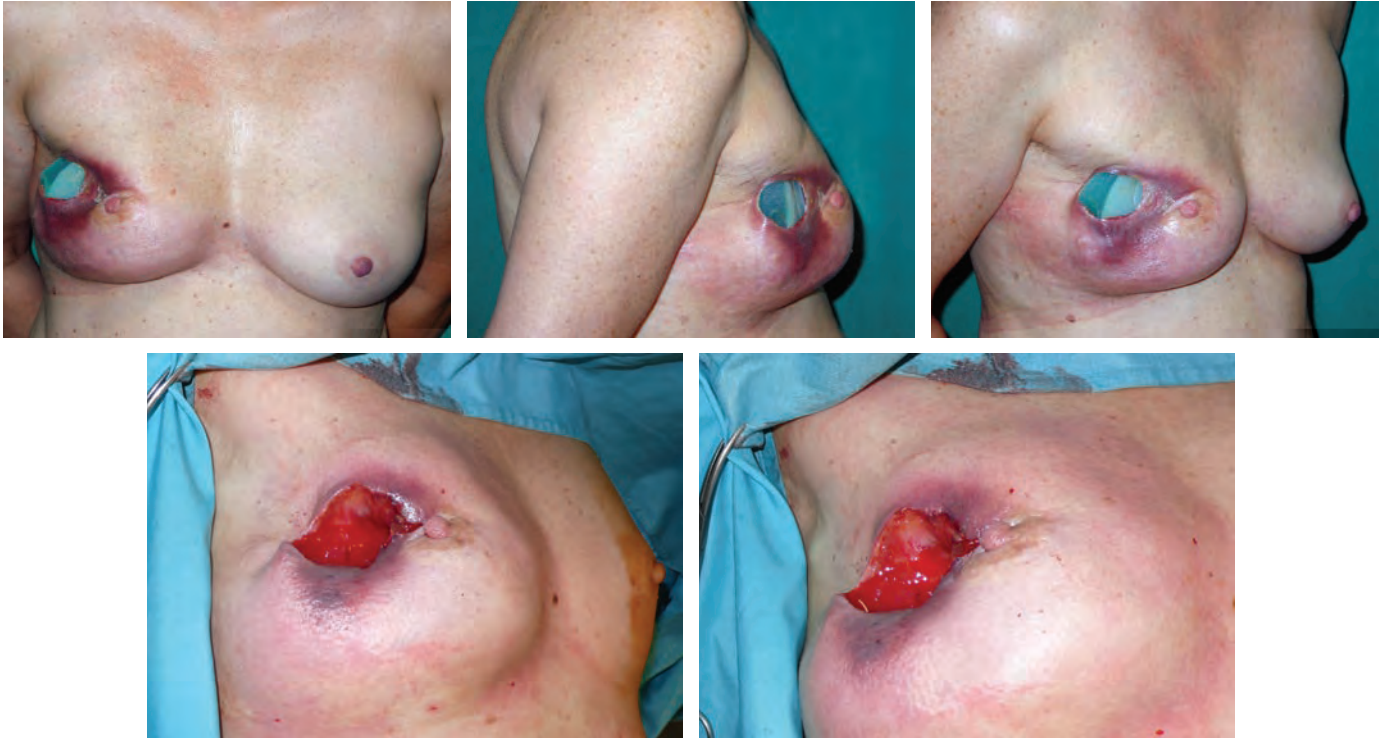
After session 3

Fat grafting progressively improves the softness of the breast; the contracture, particularly evident in the upper quadrants, became a wider, rounder shape, and ptosis was increased, allowing the breast to shift downward with a much more natural look.

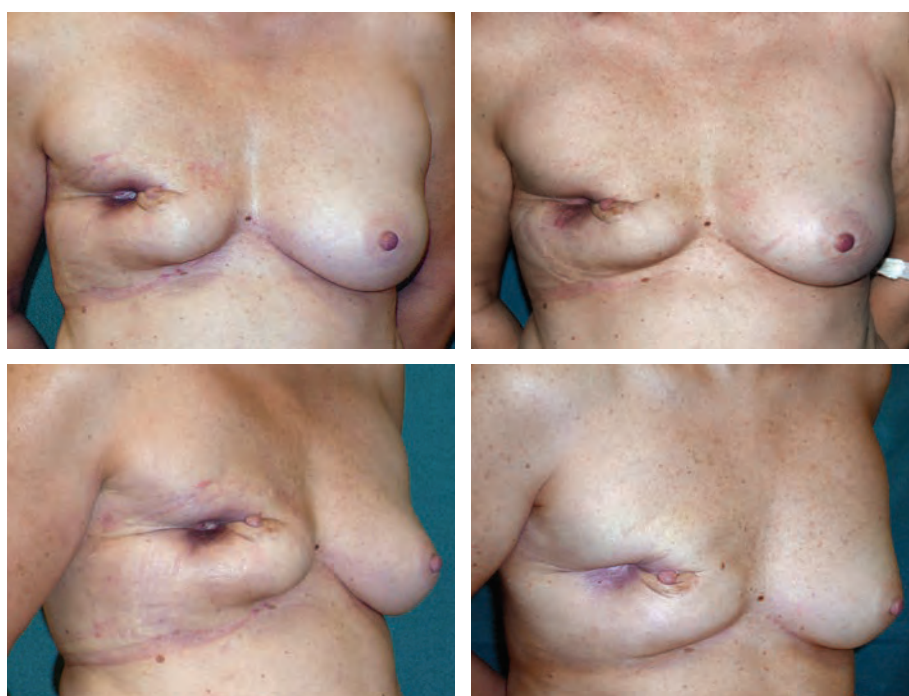


In cosmetic surgery, capsular contracture is a distressing complication after breast augmentation. This patient developed severe capsular contracture after a bilateral submuscular augmentation in which monolumen cohesive silicone gel textured implants were placed. The patient underwent surgery twice for capsulectomy and replacement of the implants, with no favorable result and a subsequent recurrence. The MR scans indicate the clinical picture before fat grafting.

The patient underwent three fat grafting sessions to reduce contractures and restore normal, stable breast contours. Her long-term results are shown 7 years after the third fat grafting session.



The therapeutic efficacy of fat grafting is based on the regenerative potential of mesenchymal adipose-derived stem cells and has proved to be extremely effective and reliable in the treatment of many different problems, exhibiting a common etiopathogenesis of chronic ischemia. Nevertheless, in some clinical cases characterized by initial major damage, particularly the severe adverse effects of radiation therapy, fat grafting does not correct the problem and implant removal is necessary, as can be seen in this patient who had implant extrusion after a nipple-sparing mastectomy and intraoperative radiation therapy (IORT). Surgical removal of the implant was accompanied by a first fat grafting session.



After removal of implant and session 1

After session 2

Even in unfavorable cases, fat grafting offers alternative solutions, such as total autologous implant-free breast reconstruction. The patient is shown 45 days after implant removal and her first and second fat grafting sessions.



After session 3

After session 4

The same patient's results are seen after her third and final fourth sessions of fat grafting.

Clinical Caveats

The adipose-derived stem cells (ASCs) contained in lipoaspirates modify the fibrotic and ischemic tissue of capsular contracture into soft tissue with restored micro-circulation.

Tissue regeneration induced by fat grafting leads to a restoration of normal breast morphology.

Uniformity of tissue deposition can be optimized by using preoperative computer-assisted planning tools and intraoperative navigation systems.

Harvesting and purification of fatty tissue (centrifugation) are straightforward processes.

Fat tissue deposition is performed between the skin and the capsule in multiple sessions with a 3- to 4-month interval.

Three to six sessions are generally required to obtain stable, long-lasting results.

Annotated Bibliography

Embrey M, Adams EE, Cunningham B, et al. A review of the literature on the etiology of capsular contracture and a pilot study to determine the outcome of capsular contracture interventions. *Aesthetic Plast Surg* 23:197-206, 1999.

This review covers the literature on several proposed contracture factors, including filler material, implant placement, surface texture, and bacterial infection. The pilot study's goal was to test the feasibility of a data collection form that could be used in a scaled-up study to analyze multiple surgeons' records. The goal of the expanded version of this study will be to determine the efficacy of available interventions for capsular contracture, including surveillance.

Kronowitz SJ, Robb GL. Radiation therapy and breast reconstruction: a critical review of the literature. *Plast Reconstr Surg* 124:395-408, 2009.

The optimal timing and technique of breast reconstruction in patients who may require postmastectomy radiation therapy are controversial. Even with the latest prosthetic materials and modern radiation delivery techniques, the complication rate for implant-based breast reconstruction in patients undergoing postmastectomy radiation therapy is more than 40%, and the extrusion rate is 15%. They conclude that in patients who will receive or have already received postmastectomy radiation therapy, the optimal approach is delayed autologous tissue reconstruction after postmastectomy radiation therapy. If postmastectomy radiation therapy appears likely but may not be required, delayed-immediate reconstruction may be considered.

Patete M, Riboldi M, Spadea MF, et al. Motion compensation in hand-held laser scanning for surface modeling in plastic and reconstructive surgery. *Ann Biomed Eng* 37:1877-1885, 2009.

The authors report on the development of a new integrated method for breast morphology assessment in plastic and reconstructive surgery comprising hand-held laser scanning with active compensation of breathing motion and involuntary movements to obtain a thorough, artifact-free representation of patient breast shape. This was obtained by tracking surface motion with a configuration of passive markers fitted on the patient's thoracoabdominal region. The proposed method, based on a mapping procedure, has been compared with respiratory gating, which is commonly used in radiation therapy and biomedical imaging applications. The results show that the implemented procedure is able to compensate for motion, resulting in quantitative surface description to be used for clinical evaluation.

Rigotti G, Marchi A, Galiè M, et al. Clinical treatment of radiotherapy tissue damage by lipoaspirate transplant: a healing process mediated by adipose-derived adult stem cells. *Plast Reconstr Surg* 119:1409-1422, 2007.

The objective of this study was to assess the presence of adipose-derived adult stem cells left in their natural scaffold in the purified lipoaspirate and to assess the clinical effectiveness of lipoaspirate transplantation in the treatment of radiation side effects. This study was designed beginning with surgical procedures in 2002 and envisaging a continuous patient follow-up to 31 months. Twenty consecutive patients undergoing therapy for side effects of radiation treatment with severe symptoms or irreversible function damage (LENT-SOMA scale grade 3 and 4) were enrolled. Purified autologous lipoaspirates (60 to 120 cc) taken from a healthy donor site were administered by repeated minimally invasive computer-assisted injections. This study demonstrates that this surgical procedure is an effective therapeutic approach for resolving the late side effects of radiation therapy. According to the proposed hypothesis of the ischemic nature of radiolesions, treatment with lipoaspirate transplantation is potentially extended to other forms of microangiopathies.

Rigotti G, Marchi A, Sbarbati A. Adipose-derived mesenchymal stem cells: past, present, and future. *Aesthetic Plast Surg* 33:271-273, 2009.

The authors report on the history, current use, and expected future developments of adipose-derived mesenchymal stem cells technology in fat grafting.

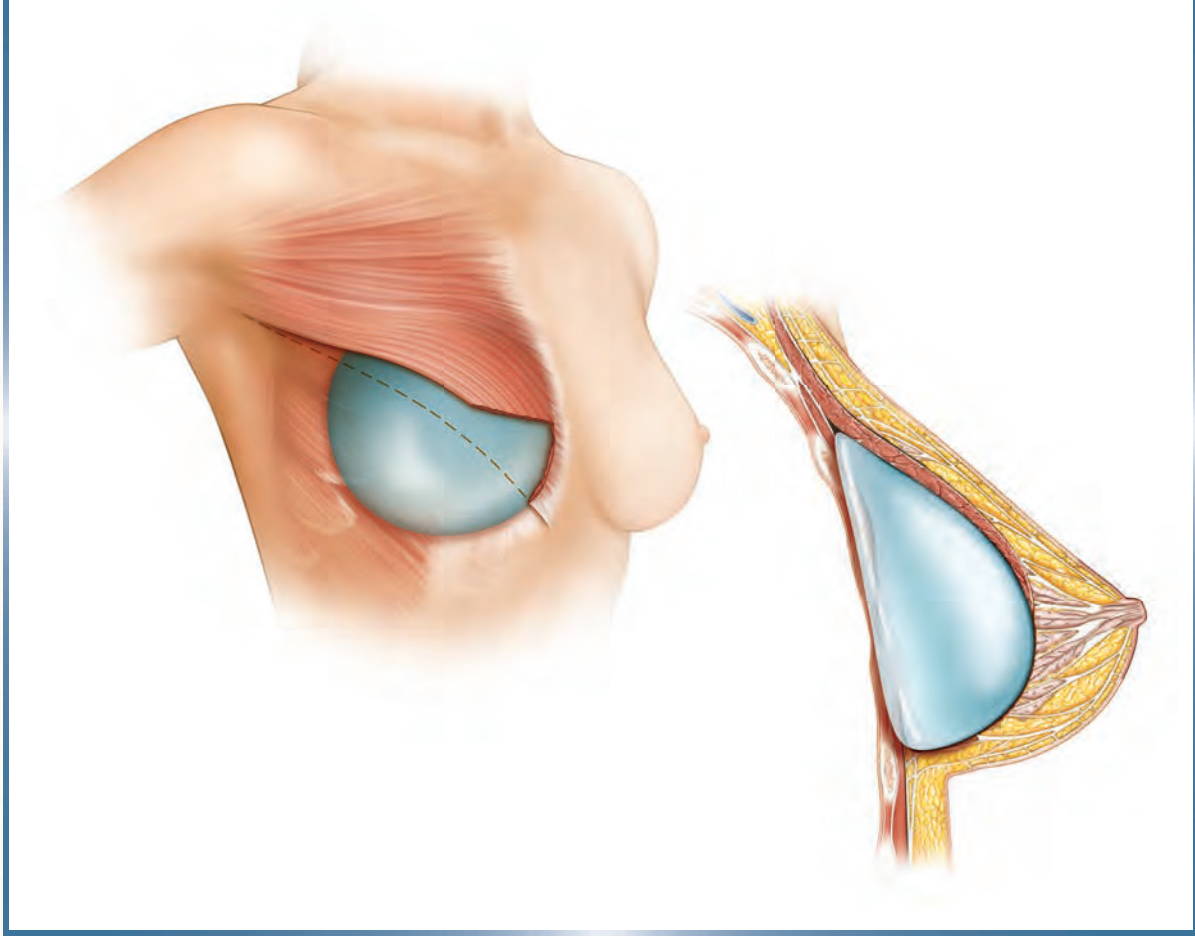
Suggested Readings

Marques M, Brown SA, Oliveira I, et al. Long-term follow-up of breast capsule contracture rates in cosmetic and reconstructive cases. *Plast Reconstr Surg* 126:769-778, 2010.

Whitfield G, Horan G, Irwin M, et al. Incidence of severe capsular contracture following implant-based immediate breast reconstruction with or without postoperative chest wall radiotherapy using 40 Gray in 15 fractions. *Radiother Oncol* 90:141-147, 2009.

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CHAPTER 66



Augmentation Mastopexy

DENNIS C. HAMMOND

Augmentation mastopexy is generally regarded as one of the most challenging of all the aesthetic procedures performed on the breast. This reputation is well deserved because of the thoughtfulness required in designing an appropriate operative strategy and the technical expertise required to perform the procedure. For many patients presenting with ptosis and volume loss, operative correction is more of a reconstructive endeavor than a purely aesthetic one. Thus revisions are often required to obtain an optimal result. This does not indicate that the overall procedure is a failure, but rather is a consequence of handling multiple surgical variables at once. It is with this philosophy in mind that I will outline the principles that govern the design of a successful operative strategy and describe the factors that influence specific implant choice as well as the technique of skin envelope management.

Indications

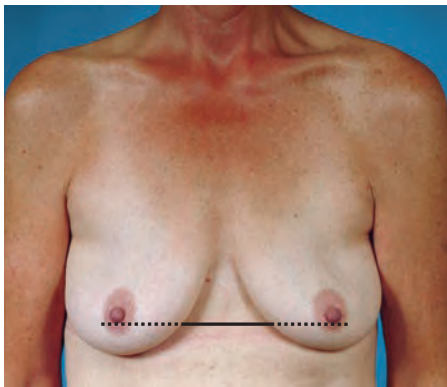
An aesthetic breast represents a harmonious positional relationship between the footprint of the breast and the location of the nipple-areola complex. When the nipple-areola complex is located in any inferiorly displaced position other than at or slightly above the point of maximal projection of the breast mound, it is considered ptotic. This is not the appearance of an aesthetic youthful breast, the artistic ideal that we strive for. In this context it must be recognized that ptosis of the nipple-areola complex is not an all-or-none phenomenon; varying degrees of nipple-areola complex ptosis can occur. Other variables can affect how the nipple-areola complex position is perceived, including the location of the breast footprint on the chest wall and the presence of pseudoptosis or ptosis of the breast parenchyma and skin envelope in association with a normally positioned nipple-areola complex.

With this in mind, one strategy that can be used to guide a ptosis correction procedure is the location of the nipple in relation to the location of the inframammary fold. When viewed from directly in front, a line can be drawn across the chest connecting the inframammary fold from side to side. If the nipple is located 2 cm or more above this line, simple breast augmentation will provide enough lift to properly position the nipple-areola complex at the apex of the breast mound.



This is an example of a patient who presented for breast augmentation with a normal nipple position. For this woman, a simple breast augmentation can be performed, and the implant and the nipple will be positionally in phase, creating a pleasing result.

In these cases, if the nipple-areola complex position is still a bit low, the inframammary fold can be lowered slightly to reposition the implant below the nipple-areola complex to create the proper nipple-areola complex-to-breast mound relationship and optimize the aesthetic result. Between 0 and 2 cm above the fold, a periareolar mastopexy may be required to create the best result.



This is an example of a patient whose nipples are located just above the level of the inframammary fold. For this woman, the optimal result will be obtained by using a periareolar lift in conjunction with placement of an implant.

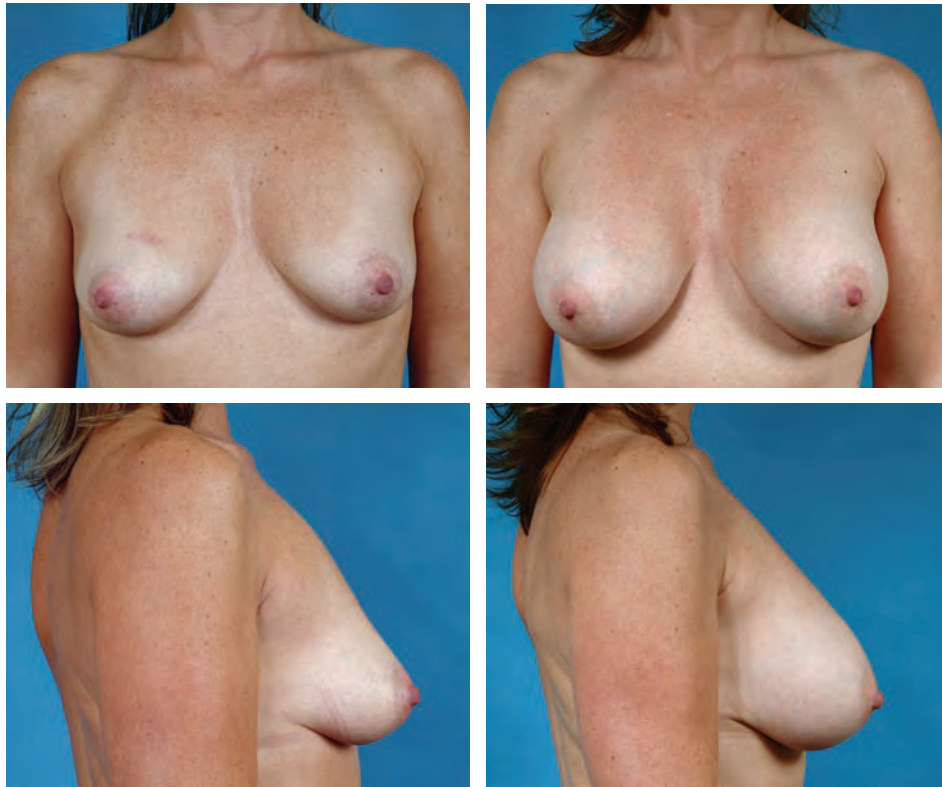
Again, lowering the fold may be helpful in bringing all the elements of breast shape and proportion into harmony to create the best result. For patients with nipples that fall below the inframammary fold line, in addition to a periareolar technique, a vertical extension will likely be needed to completely correct the ptosis.



This is an example of a patient whose nipples are located well below the inframammary fold. The skin envelope is loose and redundant. For this woman, a circumvertical mastopexy pattern can effectively lift the nipple-areola complex the required amount and help to manage the redundant skin envelope.

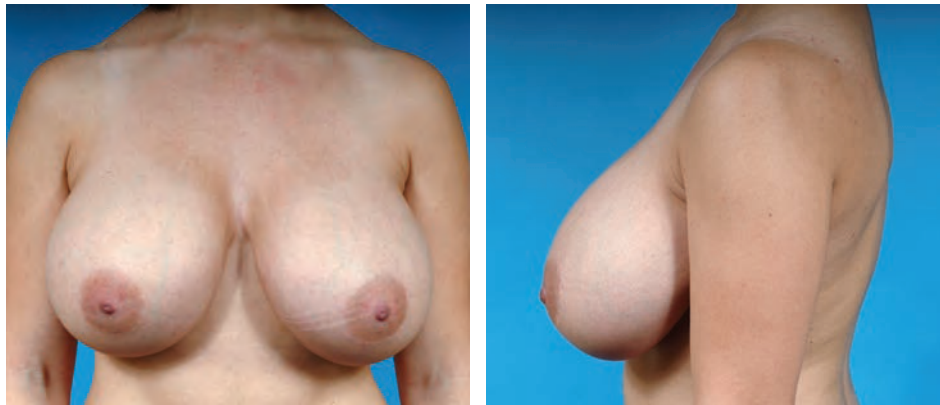
Contraindications

Aside from the purely technical aspects of treating breast ptosis are the concerns patients have regarding the scars that are produced. In particular, for patients who are on the borderline of requiring a periareolar procedure to optimize the aesthetic result, concerns about the periareolar scar may prompt the surgeon to try a different approach. In these patients lowering the fold slightly may allow a reasonable result without the need for a periareolar procedure. It may also be helpful to use an anatomically shaped cohesive gel implant that concentrates more of the volume in the inferior pole of the breast.



This 40-year-old woman requested breast augmentation. She was unwilling to accept the scars associated with a periareolar mastopexy; therefore an anatomically shaped cohesive gel implant was used to concentrate more of the implant volume in the lower pole of the breast and limit the likelihood of any excess upper pole fullness. She is shown 4 years after the placement of a 375 cc anatomically shaped cohesive textured silicone gel implant; the skin envelope has been filled without any excess upper pole distortion. The shape of the breast is acceptable; however, the position of the nipple falls just below the point of maximal projection of the breast mound. For this patient, this was an acceptable compromise, given the fact that there was no periareolar scar.

If patients are advised preoperatively that the nipple-areola complex may still appear a bit low after surgery, this may be an acceptable option if the goal is to avoid the periareolar scar. One maneuver that carries a significant potential for postoperative dissatisfaction is an attempt to lift the nipple-areola complex by using an overly large implant.



This 24-year-old woman is shown 1 year after an 800 cc smooth round silicone gel implant was placed in an attempt to avoid the need for a mastopexy. Although the larger volume device was placed in an attempt to “lift” the breast, all that has been accomplished is the creation of an overly large and out-of-proportion breast that still has a nipple-areola complex that is too low.

This strategy is often unsuccessful in lifting the nipple-areola complex the needed amount and leaves the patient with a breast that is too large, with sharp, unnatural contours. The negative effects of such large devices on the patient’s soft tissues over time make this an unattractive option in nearly every circumstance. For these reasons, the strategy of using a large device in an attempt to lift the nipple-areola complex and avoid the need for a formal mastopexy should be avoided.

Operative Strategy: To Stage or Not to Stage

It has been suggested that one technique that can be used to improve the outcome of an augmentation mastopexy is to stage the procedure by breaking it up into its two component parts. Generally speaking, this involves performing the mastopexy first, followed later by the addition of an implant. The advantage of this approach is that the control the surgeon has over the final result is enhanced by dealing with only one set of variables at a time. By successfully reducing the surface area of the redundant skin envelope, normalizing the position and size of the nipple-areola complex, and letting the final result stabilize over time, more reliable decisions can be made about

the size, shape, and position of the subsequent implant. The disadvantage of this approach is that two procedures are required to achieve the end result, and if any complications develop, a third or even a fourth procedure could be required to achieve an acceptable endpoint. In addition, the financial strain placed on patients using this approach can be significant, leading many patients to abandon the idea altogether. To achieve a reasonable result after the first-stage mastopexy, a significant skin tightening will likely be required that can restrict the size of the implant that is chosen during the augmentation. To perform the procedure in the reverse—that is, to place the implant first and then perform the mastopexy later—is an even less attractive option, since it is very likely that a properly placed implant will ride high compared with the ptotic breast during healing after the augmentation procedure. Thus a temporary but potentially distressing deformity can be created that must be tolerated until the mastopexy is completed.

To avoid these disadvantages, many surgeons perform the augmentation mastopexy as one procedure at the first operation. By intelligently adding an appropriate-sized implant and then tightening the skin envelope around this newly created breast, excellent results can be obtained. If a revisionary procedure is required in the future, it is usually of less magnitude and complexity than would generally be required when using a staged approach. For this reason many surgeons prefer to combine the augmentation with the mastopexy in one operation, accepting the possibility that a revisionary procedure may be necessary in the future.

It has been suggested that one of the reasons that augmentation mastopexy is so difficult is that the technical details of the operative strategy work against one another. In other words, adding an implant enlarges the breast volume and performing the mastopexy reduces the skin envelope, two factors that when taken to excess can compete with each other. It is perhaps more accurate to think of the procedure as enlarging the breast volume the correct amount to allow the still-redundant skin envelope to be reduced to match the new breast volume, thus creating a situation in which the implant and the breast work together to just the proper degree to create an aesthetic breast shape. To achieve such a result requires technical skill and artistry, which for the surgeon is one of the most compelling aspects of the procedure.

Implant Selection

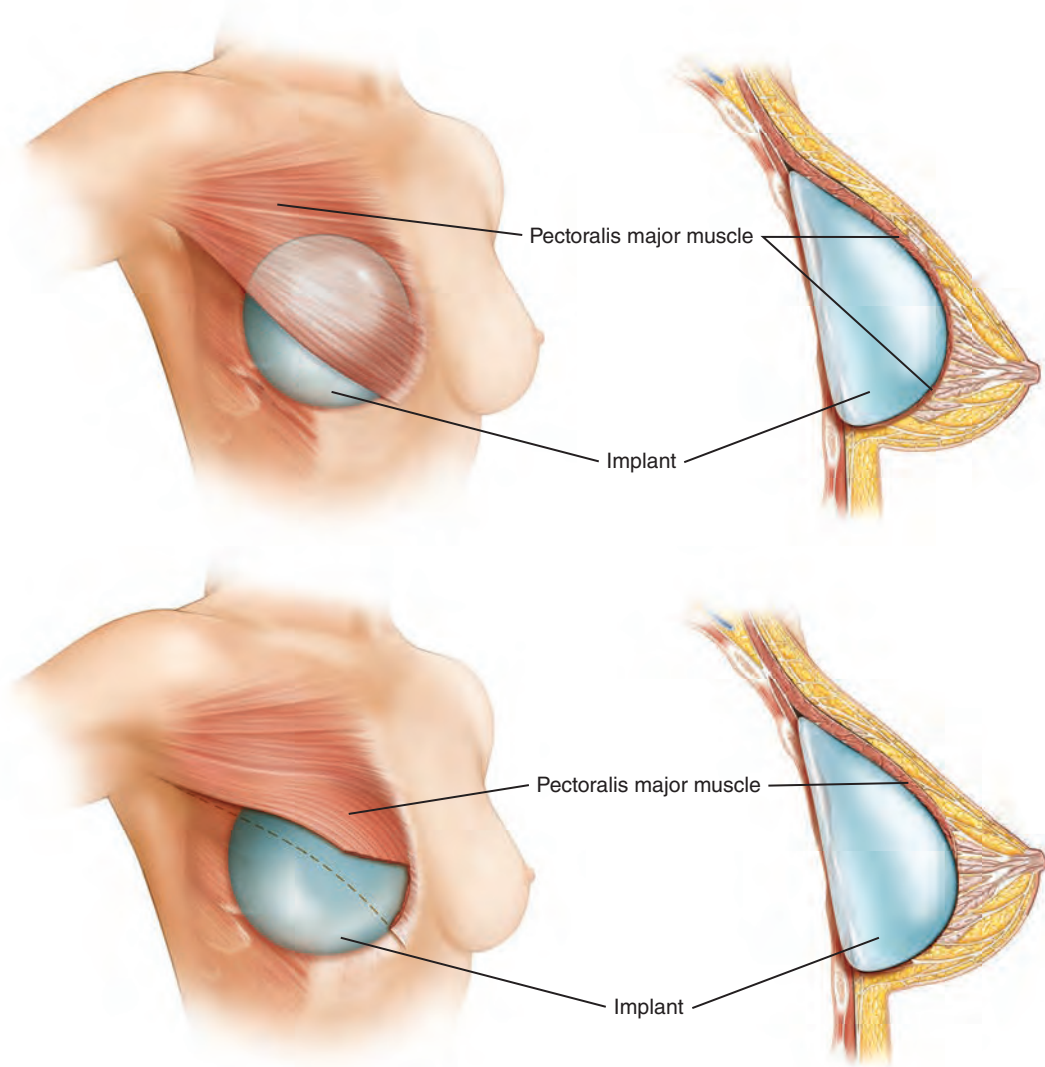
When selecting an implant for an augmentation mastopexy patient, there are slightly different variables involved than those for a simple breast augmentation. First, for many patients with breast ptosis, the skin envelope has been compromised to the point that it has little normal “rebound” under stretch, even after it has been tightened by removing the redundant skin. As a result, the implant is not held in position as tightly as in a breast augmentation patient, where the surrounding soft tissues can

often snugly secure the implant in place. For this reason, *round* smooth or textured implants hold an advantage over anatomically shaped gel devices, because the inherent symmetry of the round device can tolerate a certain amount of implant mobility without risking breast distortion from implant rotation. If an anatomically shaped implant is used, any element of implant rotation in this inherently asymmetrical device can adversely affect the shape of the breast. Such rotation becomes a greater possibility with a looser overlying skin envelope, even when the pocket has seemingly been accurately dissected to match the dimensions of the implant. In addition, augmentation mastopexy patients typically have a greater starting breast volume than primary augmentation patients do, and this inherent volume must be considered when planning the operation and selecting an implant volume. It is common for the average implant volume used in augmentation mastopexy to be slightly less than that used in breast augmentation to achieve an equal result. In fact, it is not at all uncommon for an augmentation mastopexy patient to feel that her breasts are too big after the procedure, because many surgeons apply the augmentation mindset to the preoperative planning process and ignore the preexisting volume of the breast. Therefore, when selecting implant volumes in breast augmentation mastopexy, it is prudent to be conservative to optimize patient satisfaction with the overall result.

Whether or not textured implants provide any advantage in augmentation mastopexy remains unclear (see Chapter 61). Basically, all of the arguments guiding implant selection in primary breast augmentation also apply to augmentation mastopexy. Although the effect of textured surfaces on capsular contracture remains somewhat controversial, many surgeons think that a textured surface will assist in holding the implant in position and perhaps limit the development of recurrent ptosis postoperatively. Such an effect is conjectural at this point, and the use of textured versus smooth devices remains a matter of personal preference.

Pocket Plane Selection

One very important aspect of the preoperative planning process relates to the pocket plane used to place the implant. For augmentation mastopexy patients, this decision can be profoundly influenced by simple anatomic relationships. Quite simply, one of the elements of the overall ptotic appearance of the breast is often a somewhat low breast footprint or a breast position that is low on the chest wall. Even with tightening of the skin envelope, the overall position of the breast in relation to the pectoralis major muscle remains low, and to properly position the implant under the breast, a significant release of the pectoralis major muscle is often required. Failure to do so can create a disharmonious positional relationship between the breast and the implant. As a result, most of a properly positioned implant will in fact extend well below the lower border of the muscle, often with only the upper 25% or less of the implant being covered by muscle.



When a breast implant is placed under the pectoralis major muscle with little or no release in an attempt to provide maximal muscle coverage to reduce the potential of capsular contracture, the implant can be located too high in relation to the position of both the breast and the nipple-areola complex. The result is an unaesthetic breast contour with a rounded upper pole and a nipple-areola complex position that is too low. When the pectoralis muscle is released along the inferomedial border, the implant can then be positioned lower on the chest wall under the ptotic breast mound to create a more pleasing contour with a properly positioned nipple-areola complex. However, in these cases, the muscle may then only cover a small portion of the implant, leaving the device in a space that is mostly subglandular.

Thus it is reasonable to question the utility of placing the implant in the submuscular pocket at all in an attempt to reduce the rate of capsular contracture, since most of the implant is in fact in contact with the gland. Therefore, in patients with adequate thickness of soft tissue in the upper pole of the breast, generally regarded as 2 cm or more, the subglandular pocket can be used to good effect. In fact, subglandular implant placement can have a slightly more prominent nipple-areola complex

elevating effect than even partial subpectoral placement, because all of the projection of the implant is applied in an unrestricted fashion to the overlying soft tissue, with a mild lifting effect on the nipple position. Many surgeons favor the subglandular pocket as a means of providing maximal lift in augmentation mastopexy, because placing the implant under the muscle can limit the projection of the device somewhat, resulting in less elevation of the nipple-areola complex. However, in patients with a thinner soft tissue thickness in the upper pole of the breast (less than 2 cm), the lifting effect of subglandular placement must be weighed against the creation of a sharp step-off in the upper pole. In these patients, the breast-implant interface in the upper pole can be softened by placing the implant in the subpectoral pocket to create a more natural contour, even though the muscle covers only a small portion of the implant. For such patients, shaping the upper pole takes precedence over concerns regarding the lift effect of the implant, and the partial subpectoral space is the preferred pocket for implant placement in thinner patients.

Operative Technique

Periareolar Approach

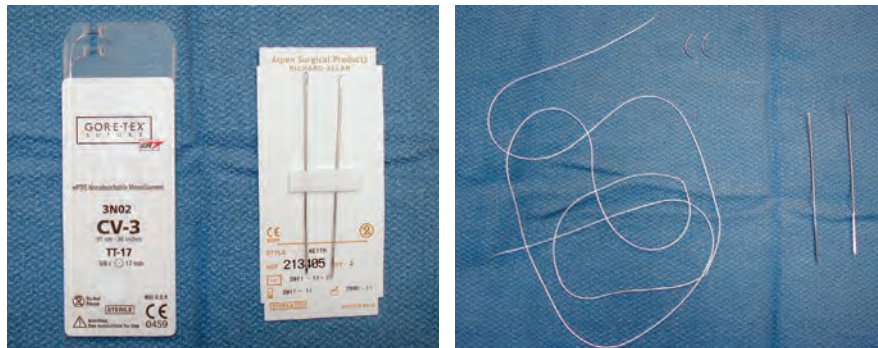
When contemplating periareolar techniques to assist in the management of the patient with breast ptosis, one must realize that periareolar approaches are excellent techniques for lifting the position of the nipple-areola complex, but they are much less successful for reducing a redundant skin envelope. When a periareolar approach is used to try to reduce the skin envelope while lifting the position of the nipple-areola complex, because of the size of the resulting periareolar defect it is likely that complications will develop, such as wound healing, distortion of areolar shape or size, flattening of breast projection, and/or unaesthetic scar formation. For this reason, performing a periareolar nipple-areola complex lifting procedure in conjunction with an augmentation is limited to patients who generally need 3 cm or less of nipple-areola complex lifting. Such patients can be treated quite consistently and successfully using a periareolar approach. In fact, this subset of patients probably falls out of the augmentation mastopexy category, typically recognized as being technically challenging and prone to complications, because adding a small periareolar lift to a breast augmentation using a periareolar incision is not a technically challenging procedure and is easily done. With that in mind, there are several technical maneuvers that can be applied to periareolar surgery that can help ensure success.

Periareolar Purse-String Suture

One of the recognized complications related to periareolar surgery is postoperative areolar spreading. This tendency of the areola to spread can be minimized in two ways. First, it must be recognized that the areolar dermis is quite elastic, and a given areolar diameter diagrammed into a relaxed native areola will stretch many millimeters once it is placed under tension by an unsupported periareolar closure. For

this reason, any time an areolar diameter is diagrammed as part of an areolar reduction or lifting procedure, the intended diameter must be measured with the areola under maximal stretch to limit the effect of immediate stretch on the resulting postoperative areolar diameter. In a related fashion, any time a periareolar manipulation is attempted, it is advisable to make the periareolar defect completely periareolar to minimize asymmetrical forces from distorting the shape of the areola. One example of this is the use of a crescent-shaped superior areolar resection in an attempt to lift the areola without creating a completely periareolar scar. The unfortunate result of such a procedure can be lifting of the areola at the expense of creating a distorted and vertically oblong areolar shape.

Second, once the periareolar defect has been created, it must be supported with a permanent purse-string suture. By supporting the outer periareolar defect with a purse-string suture, the stress of the closure is absorbed by the purse-string, thus relieving the tension on the areola as it rests within the defect defined by the purse-string as it is closed down. Although many types of sutures can be used for this purpose, two design attributes of the suture become important in providing long-term success. First, a permanent suture material is much more reliable; the long-term support provided by a permanent suture allows the new soft tissue relationships created in the postoperative breast to stabilize over time, reducing the tension on the areola. Therefore, even if the suture fails after a year or more, the likelihood of areolar spreading is minimized because of scar support of the closure, in addition to whatever soft tissue accommodation has taken place over time. If an absorbable suture is used for this purpose, disintegration of the suture with loss of support can occur before the defect has stabilized, possibly leading to areolar spreading. Second, a monofilament suture offers technical advantage when the suture is cinched down, since it slides through the outer dermal diameter more easily without catching or bunching. Perhaps the best material currently available that satisfies both of these concerns is suture made of a polytetrafluoroethylene (PTFE) material, otherwise known as Teflon.



PTFE or Teflon suture is commonly used in cardiovascular and dental surgery because of its handling characteristics and nonreactivity. It is a permanent, strong, monofilament suture with little “memory” and smooth handling characteristics, all

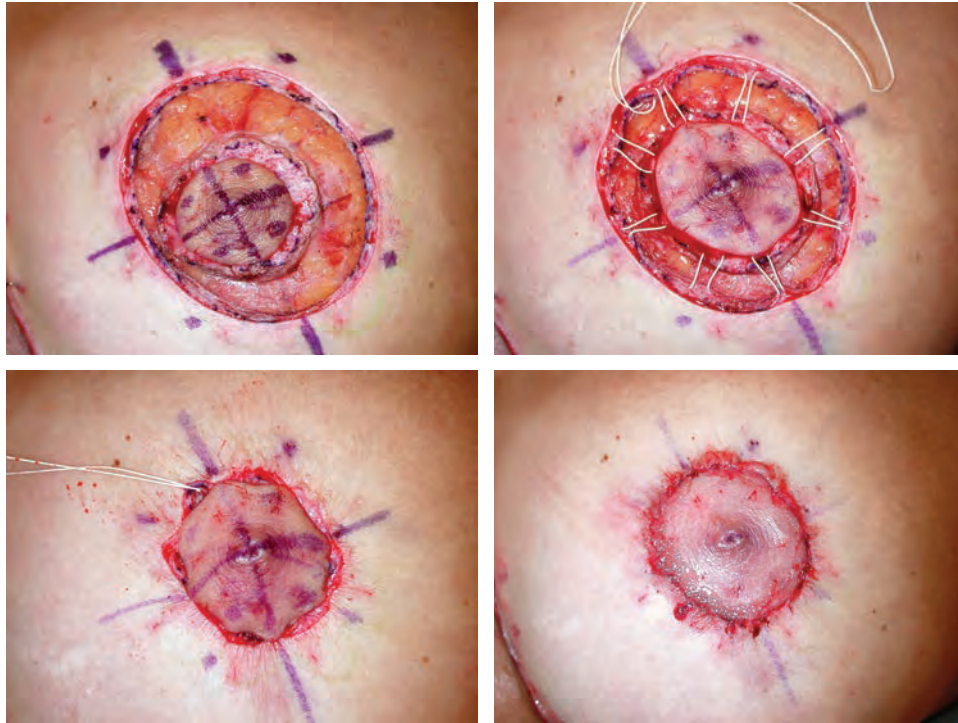
of which makes it the ideal material to use as a purse-string suture. It slides through the tissue matrix of an outer periareolar incision smoothly, allowing precise control of the size of the periareolar defect. By cutting the curved needles of a standard cardiovascular suture strand and threading the suture onto a Keith needle, passage of the suture can be facilitated, allowing the strand to be placed in the fewest number of passes possible. Currently PTFE suture is available from several manufacturers in several different sizes. There is an advantage to using a suture strand that is roughly the size of a standard 3-0 suture attached to a straight (Keith) needle.

Interlocking Purse-String Suture

In an attempt to further stabilize the periareolar defect and minimize postoperative areolar spreading, an interlocking purse-string suture can be used.



This patient presented for revision after a previous periareolar augmentation mastopexy. The interlocking suture technique is planned to control the size and shape of the areola. A 40 mm areolar diameter is diagrammed with the areola under maximal tension and the inner and outer incisions are made. The intervening skin is deepithelialized and the location for the dermal incision designed to leave behind a small dermal cuff is made. After release of the dermis, the defect can be seen to enlarge slightly.



Eight matching and evenly spaced points are marked on the areolar and periareolar incision lines. The PTFE suture is woven into the defect connecting the outer dermal cuff with small bites of the areolar dermis at eight evenly spaced points. The PTFE interlocking purse-string suture is cinched down to the desired diameter. Final closure is performed with a subcuticular absorbable monofilament.

In this technique, the same PTFE suture used in a standard purse-string technique is chosen; however, at eight evenly spaced locations around the periareolar defect, a small bite of the areolar dermis is incorporated into the placement of the suture. When the purse-string is cinched down, the areolar dermis is “locked” into the periareolar closure in a way that further stabilizes the dimensions of the defect and therefore the dimensions and shape of the areola. This technique has proved a very useful adjunct to periareolar surgery and provides secure, consistent control over the size and shape of the areola.

Markings

In preparation for periareolar mastopexy, the patient is marked in the upright position. The most important decision to be made is where to position the top of the areola. Quite simply, this becomes an artistic determination. By grasping the areola with the index finger and the thumb at the point at which the superior areolar incision will be made, the areola can be lifted in relation to the remainder of the breast. The areola is lifted just to the point where it is positioned at the point of maximum projection in relation to the breast mound, and this point is marked. The areola is then allowed to fall and the magnitude of the areolar lift can then be seen. By gently curving an oval around the medial, inferior, and lateral extent of the existing areola, the

dimensions of the periareolar pattern can then be determined. The marks are applied on each breast with care to ensure that the top of each pattern is symmetrically located from side to side.



To determine the top of the periareolar pattern, the superior aspect of the proposed periareolar incision is grasped and manually lifted up to the desired location. After marking the top of the periareolar pattern, the remainder of the incision is curved around the medial, inferior, and lateral extent of the existing areola to set the final pattern. It typically assumes the shape of an elongated oval.

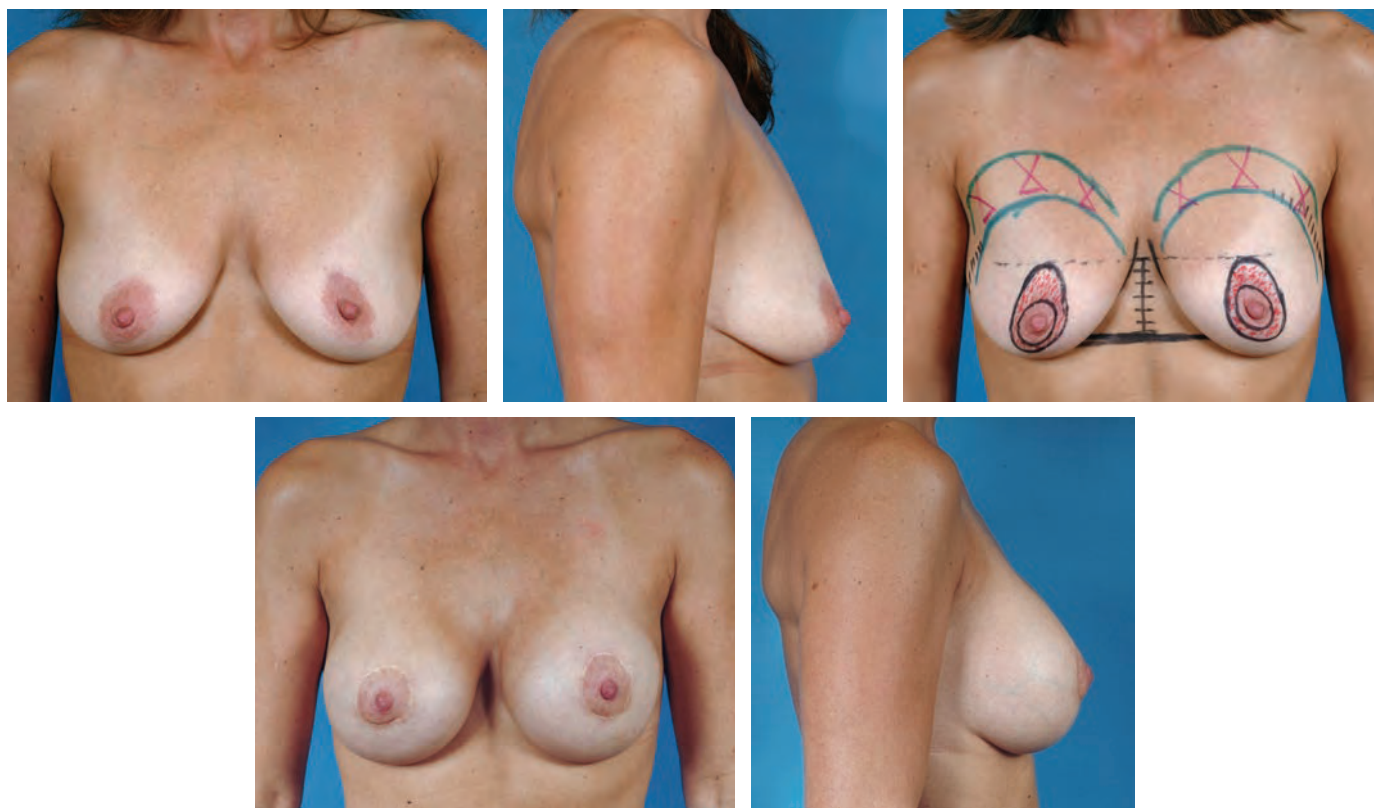
Surgery

At surgery, the proposed areas of deepithelialization are infiltrated with a dilute solution of lidocaine with epinephrine to provide a vasoconstrictive effect and minimize bleeding. The areola is maximally and evenly stretched out to allow a 40 to 44 mm areolar diameter to be marked with the aid of a multidiameter areolar marker. The inferior half of the proposed areolar defect is incised and a small strip of dermis along the inner aspect of the incision is deepithelialized. The exposed dermis along the inside rim of the periareolar incision is then divided with Bovie cautery in such a way as to create a 5 mm dermal shelf. This shelf will serve as a very strong architectural framework to support the eventual purse-string suture. Access to the breast is obtained either by dissecting directly through the breast or by following the breast fascia inferiorly and curving down and around the breast to the level of the inframammary fold. There is theoretical advantage to using the inferior approach, since dissecting directly through the breast may expose the prosthesis to bacterial contamination from divided breast ducts, which potentially predisposes the breast to capsular contracture formation. Once the underside of the breast had been reached, any desired breast pocket can be developed. Care must be taken to ensure that the inframammary fold is properly positioned and the pocket is developed to the desired limits.

At this point, either the final implant or a sizer is inserted into the breast pocket and the proposed periareolar closure is temporarily stapled into position. With the patient placed in the upright position, adjustments in the elevation of the nipple-

areola complex can be made as needed to create the desired result. Once the final pattern is determined, the remainder of the periareolar defect is deepithelialized and the dermal shelf is created around the entire defect. An interlocking PTFE suture is placed and the areola is inset, with final closure with a subcuticular 4-0 absorbable monofilament suture.

Thus the volume of the augmented breast is set first, then the degree of final lift is determined. By sequencing the procedure in this fashion, the ability to adjust not only the volume of the implant, but also the final position of the nipple-areola complex is maximized, and miscalculations in either variable can be minimized. This approach is particularly useful in cases of preoperative asymmetry of the nipple-areola complex. By adjusting the position of each nipple-areola with the pocket dissected and the implant in place, the final position of the nipple-areola complex can be set in a controlled, predictable fashion.

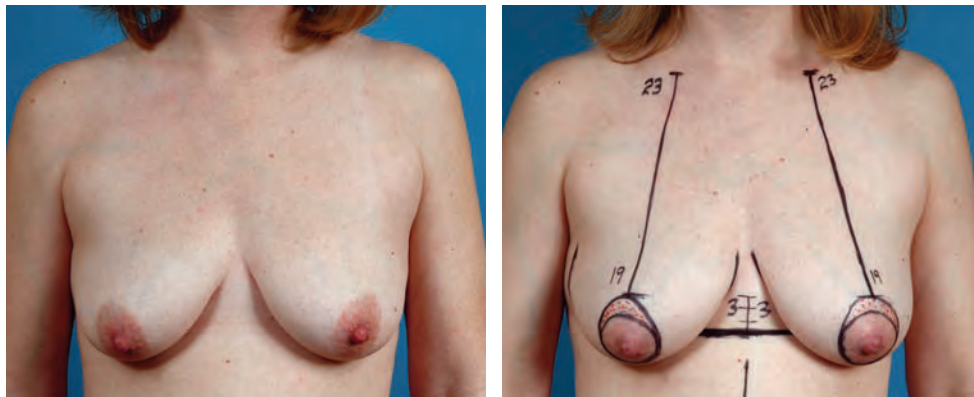


This 35-year-old woman requested a periareolar augmentation mastopexy. Her preoperative markings show that the top of the areola will be lifted 3 cm to a point estimated to be 6 cm above the inframammary fold. This marking pattern is common for patients who present for augmentation mastopexy. The existing nipple position is 1 to 2 cm above the inframammary fold line. I placed 350 cc high profile smooth round silicone gel implants in the subglandular plane. Her 1-year postoperative result is shown.

Circumvertical Approach

When a periareolar approach will not be sufficient to provide the desired result, a circumvertical pattern is required. In these cases, a tailor-tacked vertically oriented inferior pole skin takeout is added to the periareolar pattern. This technique allows lifting of the nipple-areola complex, narrowing of the breast base diameter, and restoration of breast projection. Compared with the periareolar technique alone, the circumvertical pattern is a very effective method that can be used to not only lift the nipple-areola complex but also to reduce an excessive and ptotic skin envelope. This technique is so powerful that the need to resort to the use of an inverted-T pattern to manage the skin envelope is greatly reduced.

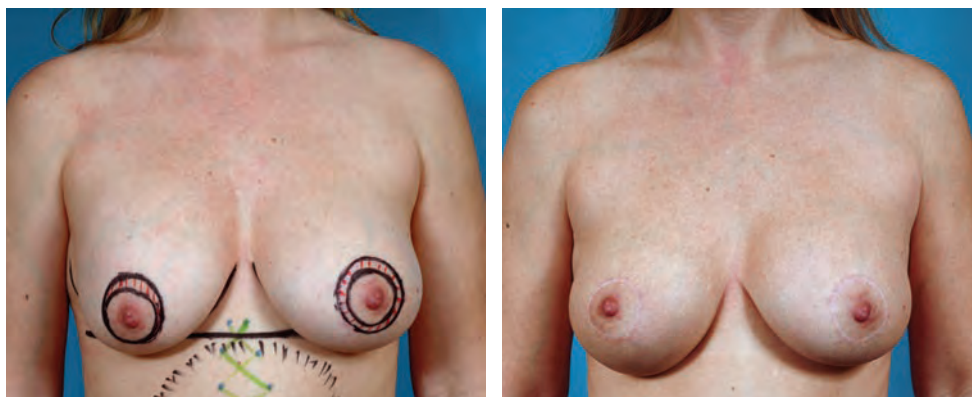
At times it can be difficult to predict preoperatively when a periareolar pattern will be sufficient to provide the desired result as opposed to when the addition of a vertical segment will be required. Simply put, whenever a vertical inferior pole skin tightening results in improvement of the breast contour, it is wise to add it. This school of thought values shape over scar and it must be recognized that the vertical scar more often than not heals in an imperceptible fashion when evaluated over time. In most instances, the improvement in the shape of the breast and the reduction in stress that is placed on the periareolar closure more than make up for the disadvantage of having to add the vertical scar. Familiarity with the CV pattern is one of the most powerful skills an aesthetic and reconstructive breast surgeon can acquire.



This 36-year-old woman presented for periareolar augmentation mastopexy with a smooth round silicone gel implant. The preoperative marks are shown; note that both nipples lie below the level of the inframammary fold.



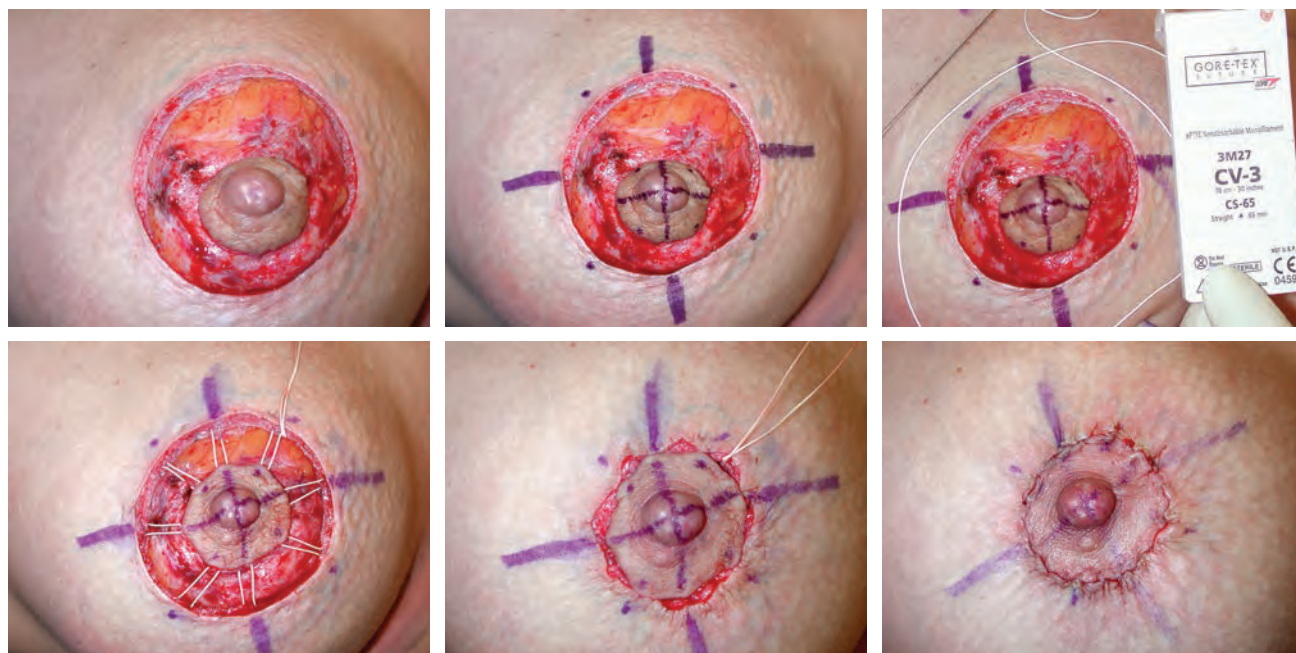
The 1-year postoperative result shows mild widening of each areola, along with a mild capsular contracture on the right.



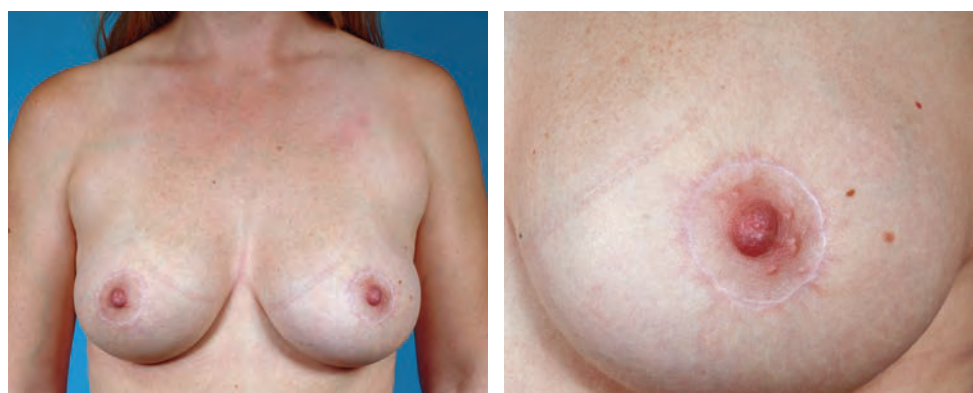
A right capsulectomy and a bilateral periareolar revision were performed. The 9-month postoperative result shows persistent mild periareolar distortion.



A bilateral periareolar scar revision was planned using the interlocking PTFE suture technique.



The areola was incised at 40 mm and the dermal shelf created. The interlocking suture was marked, and the PTFE suture was attached to a Keith needle. The interlocking suture is shown in place, cinched down to the desired diameter. The final closure is shown.



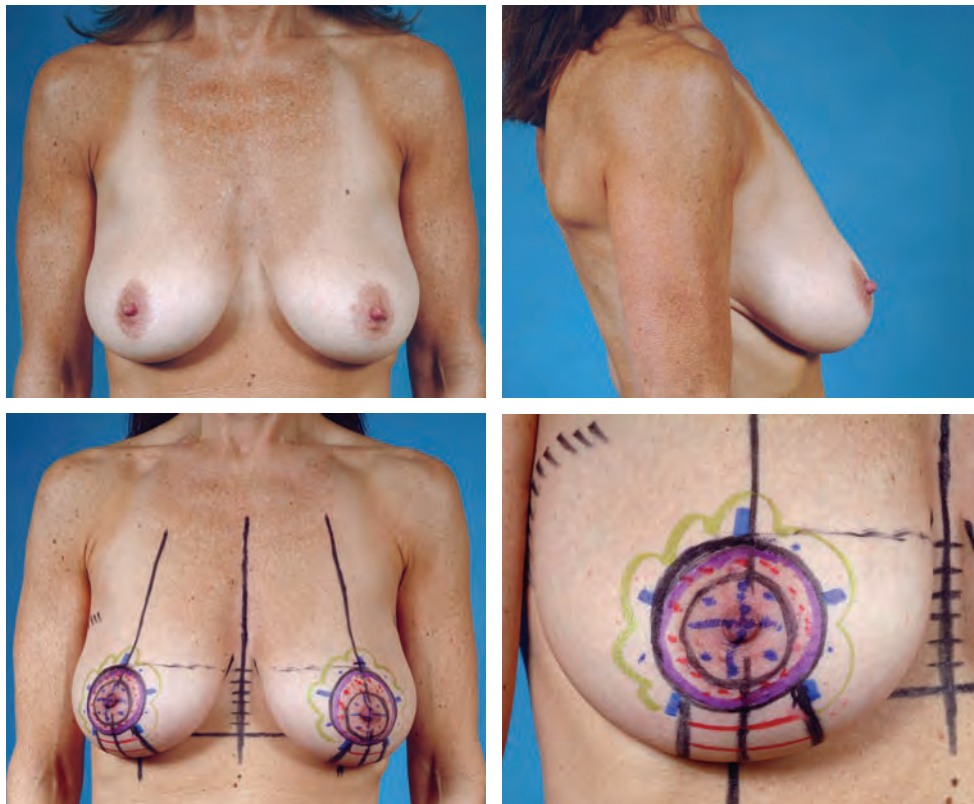
The final result at 7 months is shown, with correction of the periareolar distortion.



The patient's original lateral pre-operative appearance and her final 7-month postoperative appearance are shown.

Markings

As with the periareolar pattern, the patient is marked in the upright position. The top of the periareolar pattern is determined as before, and implant size and location is estimated based on the patient's wishes. The vertical segment is added by simultaneously lifting the position of the nipple-areola complex to the desired location, then pinching the skin of the lower pole together in a vertical line extending directly down from the bottom of the areola to the inframammary fold until a pleasing shape is created.



This 47-year-old woman presented for bilateral augmentation mastopexy; the circumvertical technique was planned. Circumvertical marks are shown. Note that the top of the periareolar pattern is positioned 6 cm above the inframammary fold line.

By drawing in the medial and lateral extent of this proposed skin excision, the general position of the vertical segment is estimated. The final vertical pattern will be determined intraoperatively once the implant is in place. However, identifying the general location of the vertical segment in this fashion allows an access incision to the breast to be drawn that will ultimately fall within the segment of skin that will be removed. Using this strategy allows free access to the breast for developing the pocket and positioning the implant without any concern about creating an addi-

tional cutaneous scar. With this in mind, a line is drawn within the center of the proposed skin excision, and it is this incision that will serve as the access portal to the breast to develop the pocket and place the implant. For more excessive skin envelopes, the inferior aspect of the vertical excision will curve out laterally along the inframammary fold rather than extend down below the fold. In these patients, the pattern assumes more of a canted V or a tornado-funnel shape, as opposed to a symmetrical V extending straight down the meridian of the breast. By curving the incision out laterally, more skin can be removed for a better breast shape without any of the wound-healing difficulties associated with traditional vertical skin patterns.

Surgery

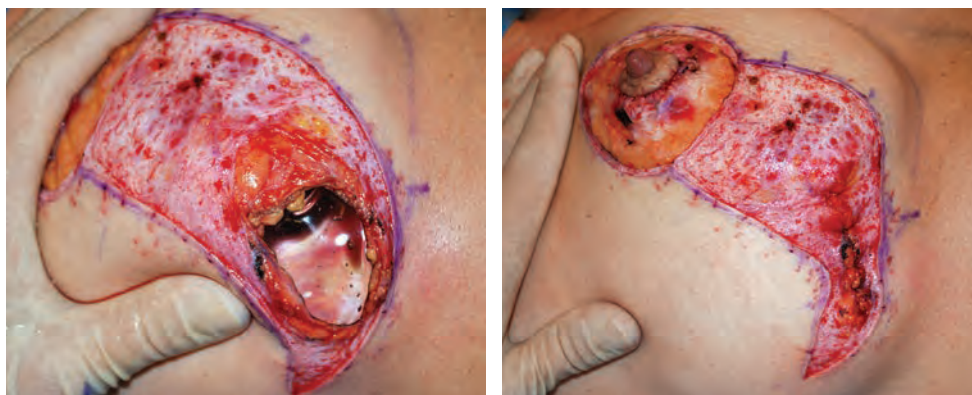
As with the periareolar approach, all of the areas that will either be incised or deepithelialized are infiltrated with a dilute solution of lidocaine with epinephrine. The procedure is begun by first incising through the previously marked vertical skin incision. The desired pocket is created with care to preserve the location of the inframammary fold. The implant can then be inserted or, perhaps more preferably, a sizer can be used to add the desired volume to the breast. With the sizer or implant in place, the skin pattern as it was drawn preoperatively is tailor-tacked into place with staples and the patient is placed in the upright position, preferably all the way up to 90 degrees, if possible. This maneuver provides a very accurate assessment of the shape of the breast and the position of the nipple-areola complex. At this point, any alteration that is required to optimize the result can be made. Changes in the volume or projection of the implant, further defining of the pocket, or alteration of the position of the nipple-areola complex can all be made to provide the most shapely and aesthetic result possible.

As with a periareolar augmentation mastopexy, the operative strategy is to finalize the volume addition first and then tailor the skin envelope to fit this new breast size. Sequencing the procedure in this fashion provides a controlled and highly reproducible procedure that will minimize the likelihood of complications. Once these decisions have been finalized, the borders of the proposed skin takeout are marked with a surgical marker and the staples are removed after returning the patient to the supine position. The borders of the skin pattern, including the periareolar as well as the vertical components, are incised and the redundant skin deepithelialized. The same 5 mm dermal shelf used in periareolar procedures is created and the final implant is inserted. The vertical incision is closed in layers using an absorbable 4-0 monofilament suture. The patient is then returned to the upright position and the shape of the resulting periareolar defect is assessed. If it is not circular at this point, the opening is redrawn to approximate a perfect circle, and additional skin is deepithelialized as needed. Finally, an interlocking PTFE suture is placed to control the periareolar defect, and the areola is inset with a running subcuticular 4-0 absorbable monofilament suture to complete the closure. The wounds are dressed with tissue adhesive (Dermabond) and covered with an occlusive dressing (Opsite).



Once the pocket has been developed and the sizer or implant has been placed, the skin pattern is tailor-tacked into position to assess the shape and size of the breast (*left*).

After assessing the desired result, the edges of the plicated skin envelope are marked with a surgical marker and the staples removed (*right*). Here, the pattern can be seen to curve laterally along the inframammary fold just slightly because of the excess of the skin envelope. At the base of the pattern, the access incision used to create the pocket can be seen. Note that this incision falls within the confines of the vertical pattern that will be removed.



The redundant skin is deepithelialized and the final implant inserted into the pocket. The access incision is securely closed to prevent implant herniation as well as inadvertent lowering of the inframammary fold.



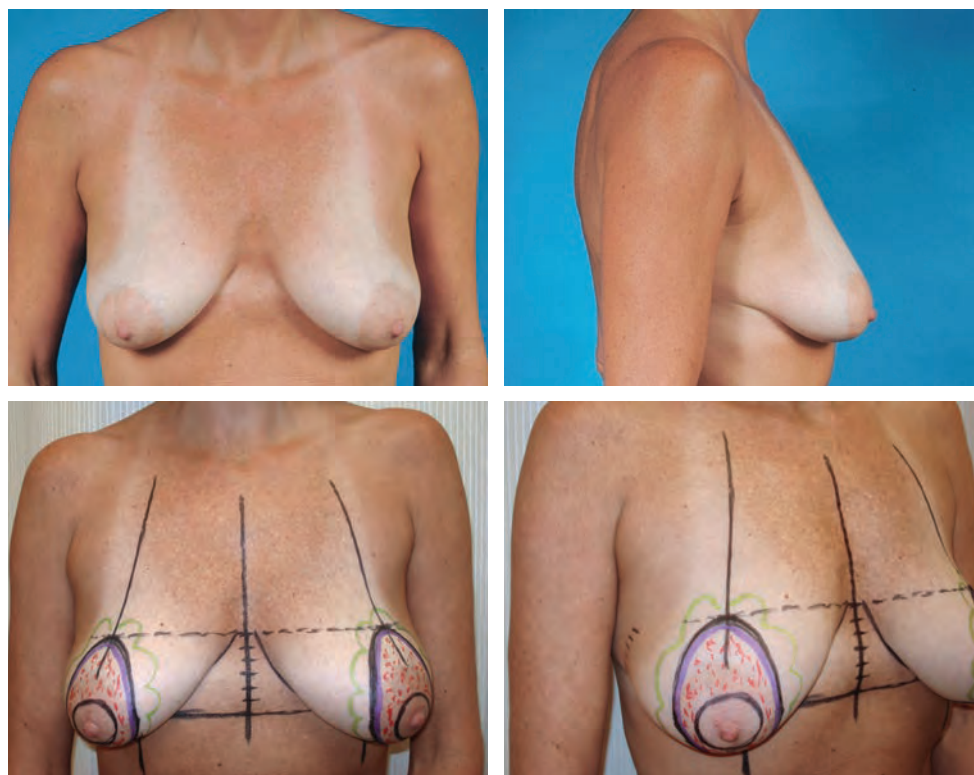
The areolar and periareolar margins are marked in preparation for placement of the interlocking PTFE suture. The PTFE suture is woven into the defect in an interlocking fashion, aligning the eight fixation points as accurately as possible. The final closure is completed.



The appearance of the right breast is shown after a 200 cc round smooth silicone gel implant was placed in the partial subpectoral pocket in conjunction with a circumvertical skin tightening. The difference in the appearance of each breast is readily apparent. The immediate appearance after operative correction of both breasts is also shown.



The early postoperative appearance reveals an aesthetic breast shape with good symmetry; the nipple is positioned at the apex of the breast mound created by proper positioning of the implant beneath the breast.



A bilateral circumvertical augmentation mastopexy was planned for this 44-year-old woman. Preoperative marks are shown; note that the top of the periareolar pattern is marked 6 cm above the inframammary fold line.



Her results are shown 1 year postoperatively.

Postoperative Care

The patient dons a support brassiere after surgery and is advised to wear the garment for at least the first week. When anatomically shaped implants are used, the support garment takes on greater importance, because the external support can help to hold the asymmetrical implant in the proper position while the pocket matures. In these cases, the patient is advised to wear the garment continuously for 6 weeks. No special straps, bands, or other external breast-shaping devices are required, since proper execution of a sound surgical plan will provide the desired result. Patients are seen 1 week postoperatively, when sutures are removed, and then at 6 weeks, 6 months, and 1 year. Typically the result will have matured by 6 months; however, full scar maturation can take a year or longer.

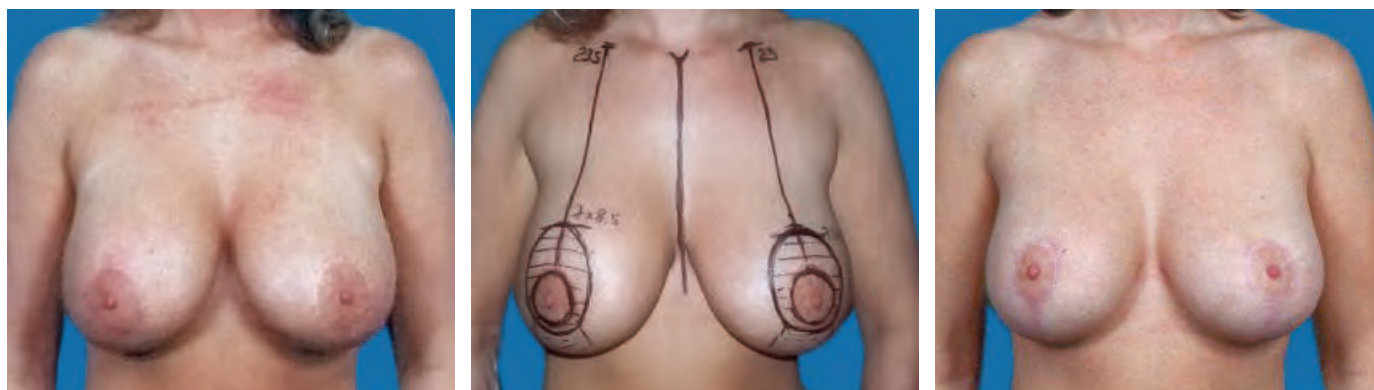
Complications

Using the described approach will afford the operating surgeon the maximal control over the final result and complications should be few. However, it is the nature of the procedure that complications may develop. As noted previously, it is useful to view augmentation mastopexy as more of a reconstructive procedure rather than a strictly controlled and focused aesthetic procedure such as primary breast augmentation. As a result of the increased number of variables that are being manipulated, the complexity of the procedure is greater and it is unavoidable that complications will develop. By doing the two components of the procedure together, however, the majority of the work is accomplished at the first procedure. Therefore, when problems do develop postoperatively, they are typically of less magnitude and are easier to treat than when the operation is staged. Although common complications inherent in any breast procedure such as infection, hematoma, delayed healing, capsular contracture and unattractive scarring may develop, there are several complications that are unique to augmentation mastopexy that merit specific mention.

Loss of Shape

Patients with breast ptosis severe enough to require mastopexy are a self-selected group of patients who are prone to postoperative settling of the skin envelope. In particular, patients who have undergone a large (more than 50-pound) weight loss are particularly prone to this problem. As well, simple aging or postoperative changes in weight, either up or down, can affect how the skin envelope complements the underlying volume of the implant. In each instance, ptosis of the breast parenchyma, the skin envelope, or the nipple-areola complex can become progressively worse over

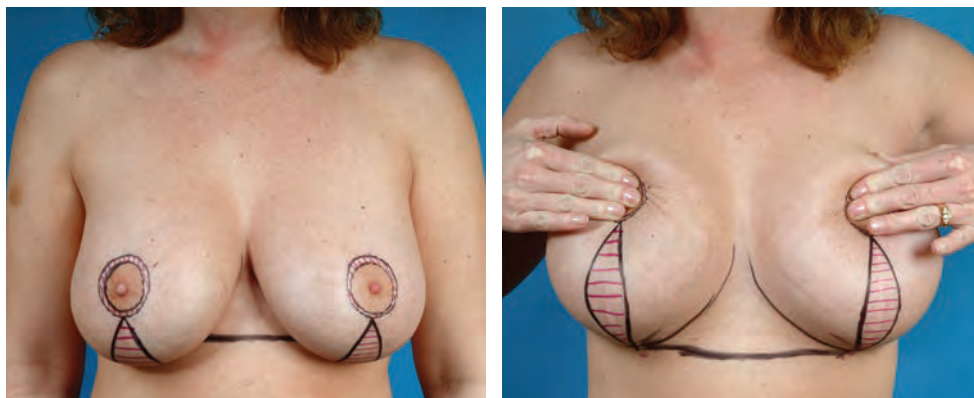
time to the point where the shape of the breast is adversely affected. Typically, the implant will appear superiorly malpositioned on the chest wall with the soft tissue of the breast variably falling off the bottom of the inferior pole. It should be noted that these changes can occur whether the procedure is performed as a combined procedure or is done using a staged approach. Whatever the circumstance, typically all that is required to correct the deformity is to reapply the skin pattern using a tailor tack approach. Often the procedure can be performed using only local anesthesia. By retightening the skin envelope, the harmony of the breast with the breast implant can be restored creating a pleasing breast shape. It should be noted that mild capsular contracture can often contribute to an altered breast shape postoperatively. In these cases, it is important to treat the capsular contracture first and then retailor the skin envelope to provide the optimal result. Typically the amount of skin retailoring required to reshape the breast is minimal and easily done compared to the initial procedure and retightening the skin envelope is a straightforward operation. It is the unusual patient who requires a third skin tightening although such a procedure would be easily performed. The advantage of using the circumvertical pattern for these patients is that the pattern used to retighten the skin envelope is the same as was used initially, therefore no new scar is created. Such patients serve as an example of how powerful the C-V pattern is when used as a breast-shaping technique.



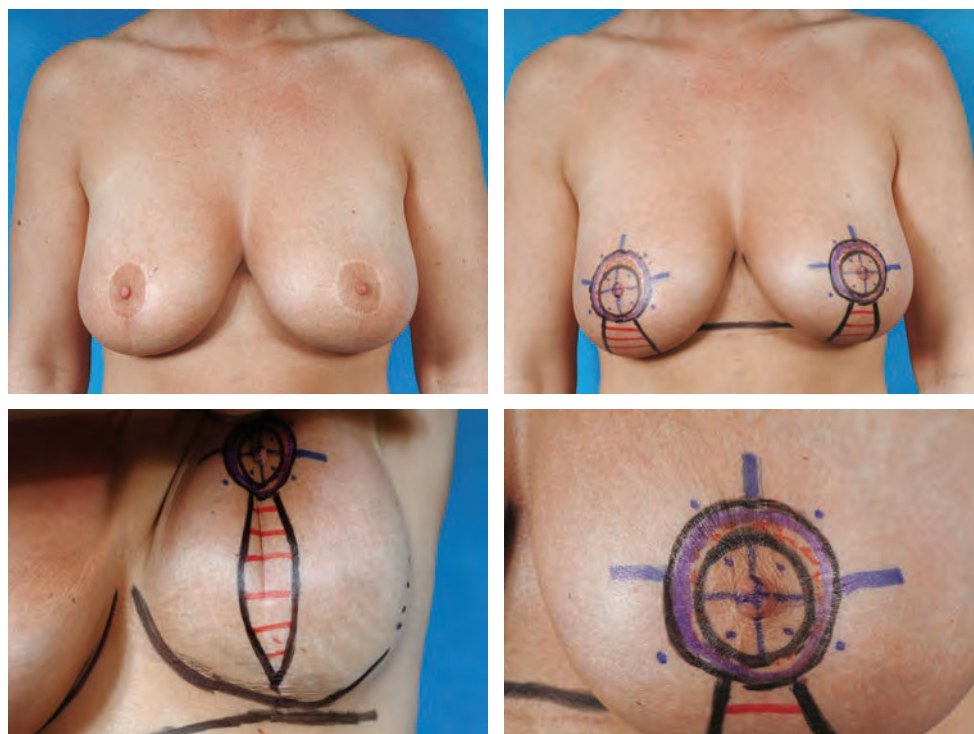
This 34-year-old woman is shown several years after undergoing a periareolar augmentation mastopexy. The position of her nipple-areola complex is low, and much of the breast has descended inferiorly off the lower pole of the implant. Preoperative marks show the plan for circumvertical tightening of the skin envelope without manipulating the implant. The 1-year postoperative result demonstrates an aesthetic improvement in the appearance of the breast.



Over several years, the patient had a mild weight gain and seemed to develop a disproportionate increase in the size of her breasts. Although the shape of her breasts was acceptable and the position of the nipple-areola complex was correct, she wanted a smaller breast size.



Preoperative marks are shown in preparation for an implant exchange; a mild circumvertical skin tightening was planned in anticipation of the creation of a mildly redundant skin envelope as a result of placing a smaller implant.



The 1-year postoperative result shows mild areolar asymmetry. A repeat circumvertical skin tightening was planned using the interlocking PTFE technique.



The 1-year postoperative result is shown. This case demonstrates the utility of the circumvertical pattern in managing several different postoperative concerns without the need to create additional scarring, yet it provides exacting control over the final result.

Asymmetry

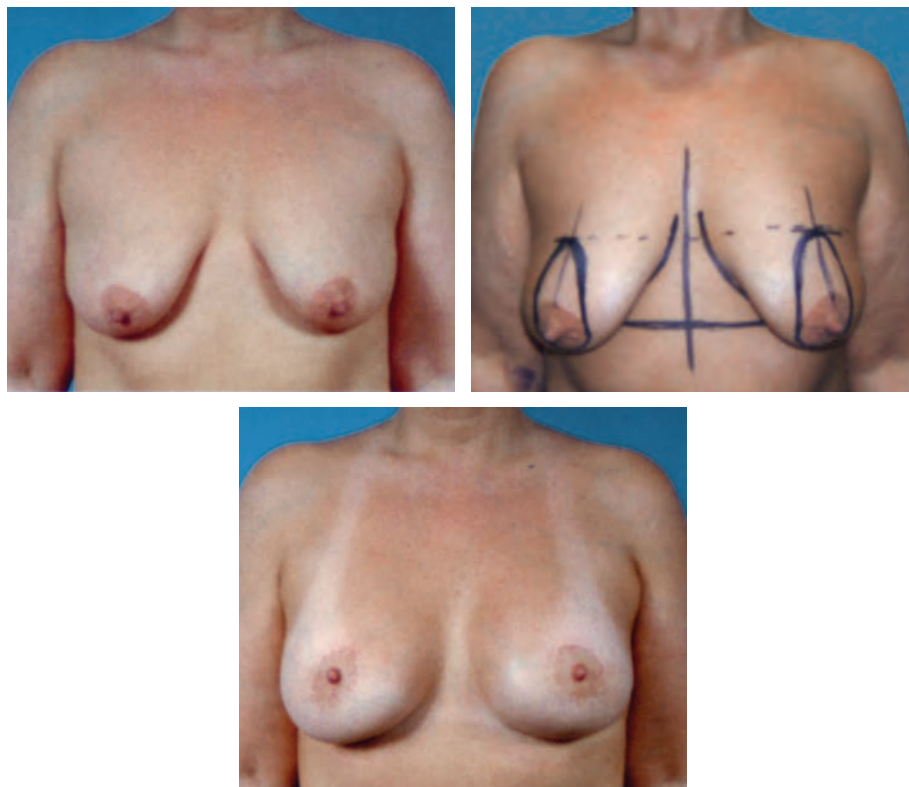
For the same reasons noted for the loss of breast shape, it should not be a surprise that a small asymmetry in the shape or size of the breast or nipple-areola complex can develop postoperatively. Fortunately, correction of these asymmetries is just as straightforward. Because most of the work was done at the first procedure, the general relationship between the skin envelope and the implant can be seen directly once the result has stabilized. It then becomes a straightforward procedure to exchange an implant as needed, to lift or tighten the skin envelope, or reposition the nipple-areola complex using the interlocking PTFE technique. Such procedures are easily performed individually or together, and restoration of an aesthetic, symmetrical breast shape is usually easily performed.

Areolar Distortion or Widening

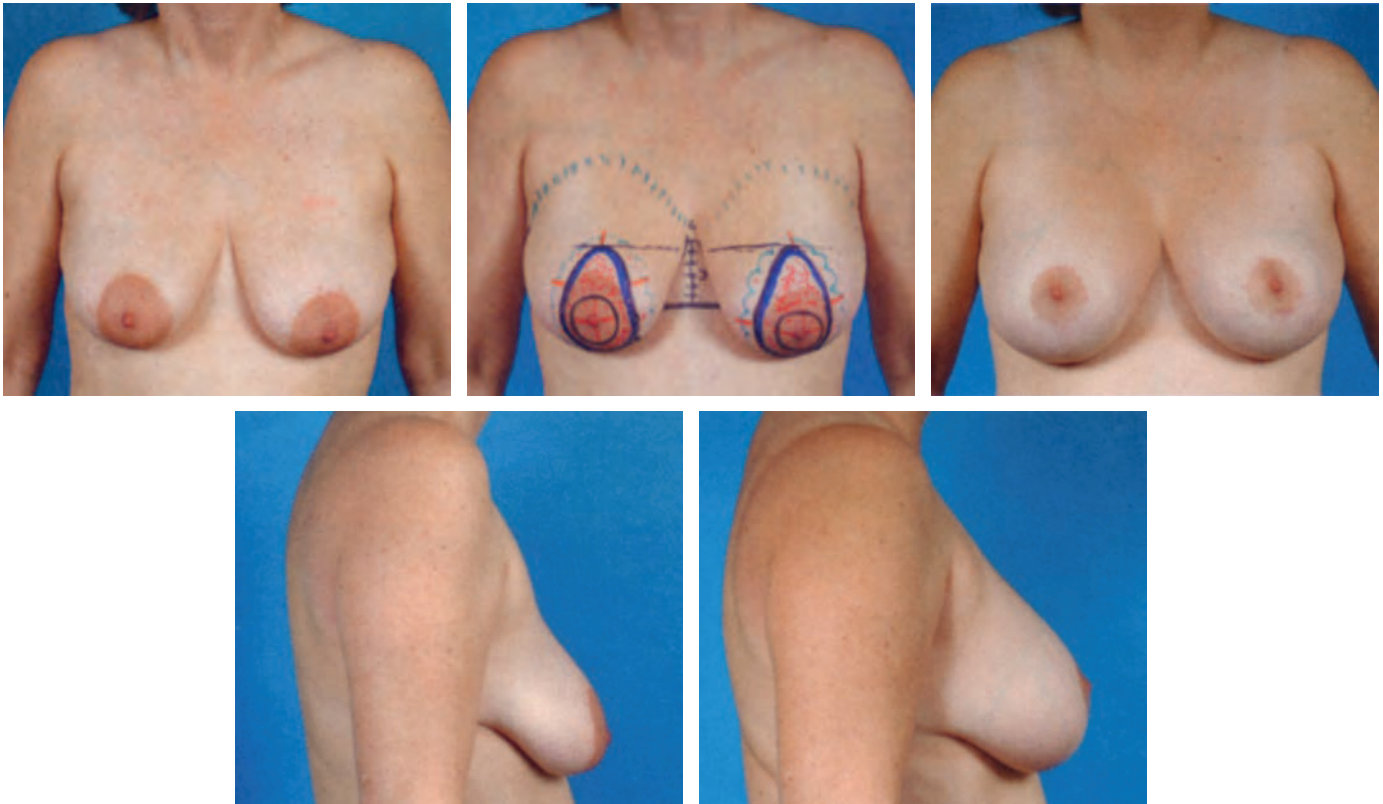
Problems with the size, shape, or position of the nipple-areola complex are complications specific to augmentation mastopexy. Fortunately, the interlocking technique has a particular advantage in these cases. Because scar has formed around the periareolar closure, the elasticity of the surrounding tissues is typically reduced. As a result, redoing the periareolar closure with or without a reduction in the size of the areola is facilitated, since the scar tends to hold the PTFE suture with a greater security than the dermal shelf created at the initial procedure. Also, the magnitude of the change in the diameter of the areola is usually less significant in a revision procedure; therefore less stress is placed on the periareolar closure.

One caveat to redoing an areolar closure relates to the shape of the breast. If the projection of the breast is flattened as a result of the periareolar incision or the dimensions of the periareolar defect are greater than 8 to 10 cm, it may be wise to add a vertical component to the skin pattern. This maneuver will tend to counteract the propensity of the breast to flatten and will help restore projection. The dimensions of the periareolar defect will become less significant, and stress on the periareolar closure will be reduced. As with other skin envelope complications, such revisions are easily performed and can often be done with a local anesthetic with a high degree of control and predictability.

Results



This 43-year-old woman sought augmentation mastopexy. She had ptosis of the nipple-areola complex but did not want any type of vertical scar. The preoperative marks for periareolar augmentation mastopexy represent the limit to what can be done successfully using only a periareolar approach. The patient is shown 6 months after placement of 300 cc round smooth silicone gel implants in the subglandular plane. The size and shape of the breasts are acceptable, and the nipple-areola complex is at the point of maximal projection. However, the aesthetics of the periareolar scar have been compromised because of the magnitude of the periareolar lift. To avoid such areolar distortion would have required the use of a vertical segment in addition to the periareolar component.



This 41-year-old woman requested an augmentation mastopexy. Not only did her nipple-areola complex require lifting, but also the skin envelope needed to be reduced. Therefore a circumvertical pattern was planned to manage the skin envelope. The preoperative marks show the degree of lift for the nipple-areola complex. On the right, a 275 cc smooth round silicone gel implant was placed subglandularly, and a 250 cc implant was placed on the left. She is shown 2 years postoperatively; a full, rounded breast has been created, with the nipple located at the apex of the breast mound.

Concluding Thoughts

Augmentation mastopexy is one of the most challenging of all aesthetic breast procedures. However, with careful planning and judicious management of the redundant skin envelope, excellent results can be obtained in one operation.

Clinical Caveats

Periareolar mastopexy should be limited to patients who predominantly need lifting of the nipple position, preferably a lift of 3 cm or less.

The circumvertical approach is appropriate for patients who require reduction of an excess skin envelope in addition to lifting of the nipple.

The interlocking suture technique provides extra control over the position, size, and shape of the areola.

Tailor-tacking can be used to predetermine final breast shape before actual incisions are made.

Ideally the augmentation is performed first, then the mastopexy, to be certain that the two maneuvers optimally complement each other.

Overaugmentation in an augmentation mastopexy patient may lead to dissatisfaction because the breasts are too large.

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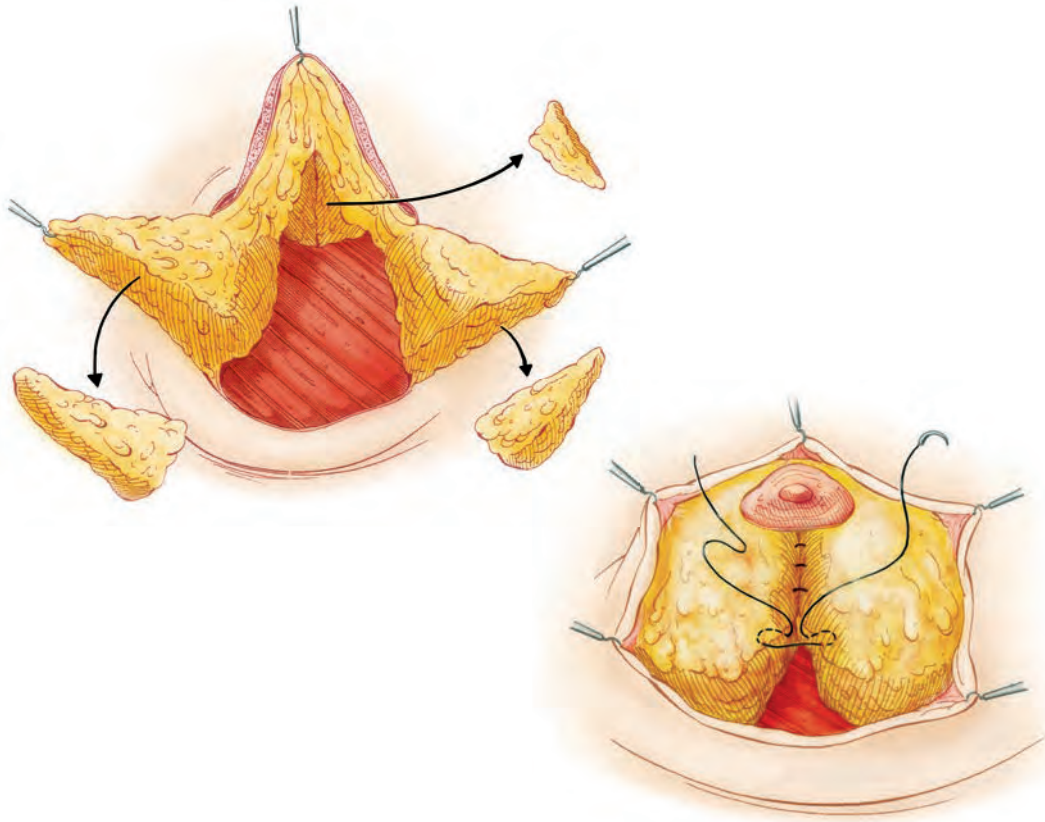
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CHAPTER 67



Control and Precision in Mastopexy

JAMES C. GROTTING, STEPHEN M. CHEN

Perhaps no other aesthetic procedure is characterized by as much anticipation by the patient—and long-term potential for dissatisfaction—as mastopexy, the procedure for treating ptosis. The problem with this aesthetic breast deformity is that all the forces that lead to its occurrence continue postoperatively to strongly influence the end result. This is the reason that mastopexy has traditionally been viewed as a semipermanent procedure.

The goal of mastopexy is well understood by both patients and surgeons—that is, to construct a breast that is beautifully shaped, has long-term stability, and is appropriately sized. Nipple positioning must be precise, with preserved sensibility, shape, and size. Preservation of lactation and minimal visible scarring are essential.

Sometimes patients have a breast shape in mind that they had earlier in life or before pregnancy or weight loss. Other patients, as a result of genetics or constriction, may have developed a “droopy” breast shape, even in adolescence, that has long been a source of dissatisfaction or embarrassment. Patient education is essential; many women enter the plastic surgeon’s office with the misconception that ptosis can be corrected simply by the addition of a breast implant.



It is interesting that most patients indicate the shape they desire by lifting (pulling) the gland above the nipple-areola complex to lift and tighten the lower pole. However, most of the procedures that we have to offer to treat ptosis consist of tightening the lower pole to push the gland up from below. In this chapter we will focus on procedures that have produced the most reliable results and on recent trends toward reduction of scar length.

Common Causes of Breast Shape Deformities

Clearly, understanding the forces that have produced a certain breast shape is important so that one can design a strategy to correct it. Most women who have had one or more pregnancies experience an adverse effect on breast shape. The processes of lactation and hormonal influences produce breast enlargement that stretches skin, supporting ligaments, and even the ductal and glandular structure itself. Once these changes overtax the ability of the elastic tissues to recover, the result is a loss of the ability of the breast to maintain its position on the chest wall. The smaller the breast to begin with, the more likely it is that the breast will not become overly ptotic; women with large breasts invariably become more ptotic after pregnancy. Ptosis resulting from weight gain and subsequent weight loss produces similar damage to breast shape. This etiologic factor is fast becoming one of the most common reasons patients seek mastopexy as weight-loss surgery becomes more and more prevalent.

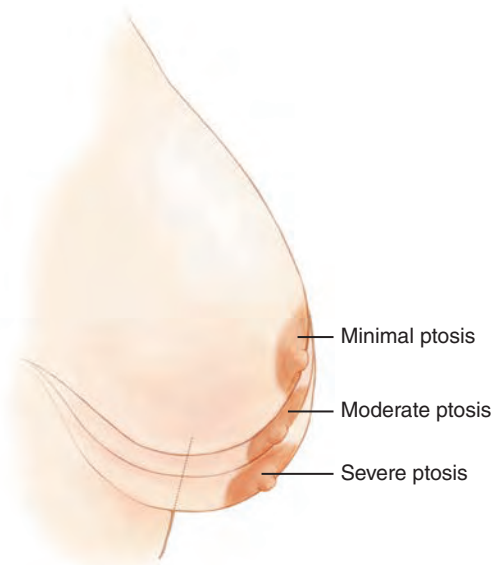
Changes in the breast caused by aging can also produce symptoms similar to macromastia. As women try to counteract drooping breasts by tightening their bra straps, more pressure is placed across the shoulders, resulting in neck and shoulder pain. Furthermore, the moisture in the inframammary fold area caused by skin-on-skin contact can produce intertrigo or fungal dermatitis.

One other common category of breast ptosis is seen long term after a breast augmentation procedure. Not uncommonly, these patients were originally treated (and, it could be argued, inappropriately) with breast implants to correct minor ptosis. Often the surgeon may place a larger implant in the subglandular position to attempt to improve the droop. The long-term price paid for this approach is greater stress on all elements of the breast architecture and “rock-in-a-sock” deformities of the breast.

Common Causes of Breast-Shape Deformities

- Changes after pregnancy
- Weight gain and subsequent loss
- Aging
- Long-term changes after breast augmentation
- Developmental deformities during adolescence

Classification of Breast Ptosis



Regnault's classification of breast ptosis remains a helpful way to communicate or record the severity of a deformity. By this classification, minimal or first-degree breast ptosis is present when the nipple position is within 1 cm of the anterior reflection of the inframammary fold and above the lower contour of the gland, whereas moderate or second-degree breast ptosis is defined as a nipple position 1 to 3 cm below the fold but still above the lower contour of the gland. In severe or third-degree breast ptosis, the nipple position is more than 3 cm below the fold and below the lower contour of the skin and gland.

Pseudoptosis is another variant of breast shape in which the nipple is actually at or above the level of the fold but the majority of the gland is below, producing the impression that ptosis is present. It is important to recognize this deformity so that the corrective plan does not result in positioning the nipple too high.

Patient Evaluation

In one sense, many of the patients who complain of breast ptosis can be viewed as having “too much skin” for the amount of breast tissue they have. However, equally important is the quality of the skin and breast parenchyma in designing an appropriate procedure for them. Some patients with breast ptosis also have an element of macromastia, which exacerbates the shape problem. Although the goals of some patients may be to retain a large size with a perfect shape, these two elements often be-

come mutually exclusive with time. In other words, the effect of gravity alone on a large mass of breast tissue will invariably result in recurrence of ptosis. Therefore a reduction of some breast parenchyma may be an important component of the treatment plan. Conversely, adding mass with a breast implant can potentially expedite the recurrence of ptosis by the same mechanism.

Preoperative Physical Characteristics to Observe During Initial Evaluation

Skin quality: Thickness, color, striae, and amount of excess skin

Fat: Quality and content

Fibrous tissue: Quality and content

Nipple: Size and shape

Areola: Size, shape, and color

The primary question that must be addressed is whether the patient would benefit from the use of an implant. A good question to ask the patient is, “Can you make your breasts look the way you want them to look in a bra?” If the answer is “Yes,” then the patient can usually be treated with a mastopexy alone. If she is doing something to enhance volume (for example, wearing a padded bra or using an insert), she may also benefit from an implant. Of course, the problem with a combination of mastopexy and implants is that, in a sense, the two operations are working against each other. The natural tendency after an augmentation is for the tissues to eventually move down and out—exactly the opposite of what the mastopexy is designed to do. Therefore we prefer to delay implant placement in patients who are ambivalent about being larger. Persoff has chosen to solve this dilemma by using a postoperatively adjustable Spectrum (Mentor) implant. Obviously, there are patients in whom good shape or adequate size cannot be achieved without the addition of an implant, and in these individuals the plan must include an implant. Further, practical considerations such as cost and time away from work or family may dictate that an augmentation and mastopexy be combined in one procedure.

Once the decision has been made regarding placement of an implant, the evaluation continues with a few helpful measurements. Specifically, the distance from sternal notch to nipple on each side identifies asymmetry. Photographs are also indispensable for this judgment. The distance between the nipple and the inframammary fold will also help determine whether a periareolar, vertical, or inverted-T approach is necessary. As the distance shortens, it is more likely that only a periareolar approach will be required. If the areola is large and the distance short, the situation is ideal for

the periareolar approach. Conversely, as striae increase in number, it is more likely that additional skin will need to be excised because of the unpredictability of skin retraction in these patients. The need for additional volume must be balanced by the quality of support from the parenchyma and skin. If the quality is poor to begin with, it is foolish to assume that the long-term result will remain good, and the surgeon must augment the supporting structures.



With the patient standing, the surgeon gathers the lower pole with the hand to simulate the upper pole fullness and medial cleavage desired. This movement allows the surgeon to see the patient's reaction to the new shape. Some patients will view this and agree that that appearance is what they want; others will offer additional information that will help define their goals. The surgeon can make a mental note of how far the nipple must be elevated. If minor elevations are necessary, one might consider a periareolar technique (or even a semicircular skin excision). Only the most severe cases require an inferior pedicle or a medial or lateral pedicle so that the nipple-areola complex can be rotated without tension. The pedicle will also influence the position of the implant above or below the muscle. For example, an inferior pedicle would preclude use of a subglandular implant in most cases.

Operative Technique

Selection of Technique

Mastopexy techniques generally fall into the simple skin-tightening-only procedures, or the parenchymal remodeling methods. Because skin is elastic, skin-only techniques tend to produce a shorter-lasting correction and are appropriate if less elevation is required or if one does not wish to violate the parenchyma at all (for example, op-

posite breast corrections with breast reconstruction). This can be likened to procedures of the face, where we now recognize that tightening only the skin will not yield a natural, long-lasting result. With patients who have both hypomastia and ptosis, the surgeon must decide whether to try to correct ptosis with an implant alone. In general, correcting ptosis with large subglandular implants ultimately leads to a lower breast position, a short distance from the lowered inframammary fold to the iliac crest, and difficulty in fitting clothing. Although patients may initially accept the appearance, in time many return to the plastic surgeon's office seeking correction. Improved nipple position on a lowered glandular profile is not an adequate tradeoff for the original problem of shape and size. Correction, of course, requires some type of mastopexy and usually smaller implants.

The differences between skin-only mastopexy techniques and parenchymal remodeling techniques can be summarized as follows:

Skin-only techniques: Less permanent

Parenchymal remodeling: Longer-lasting correction of ptosis techniques

The issue of implant size must be considered if implants are to be used. Mastopexy patients already have stretched-out skin, and large devices very likely cannot be supported long term by the tissues, so it is generally safer and more predictable to place a smaller base-width implant with less volume. Because patients often confuse size with shape, a reasonable strategy for the patient with larger volumes of native tissue is for her to live with the lift alone for the first year and consider tweaking the result with an implant if she really desires more size at the 1-year mark. Many of these patients will realize that the shape is what they desire more than just increased cup size. When the breast parenchyma is very thin, soft, and fatty, it generally will not hold shape well, and therefore we prefer skin-only tightening in this group of patients and virtually always include an implant.

Skin Incision and Ultimate Scar Shape Versus Dermoglandular Pedicle

Many surgeons confuse skin incision and pedicle location as being interchangeable when in fact they are two independent variables. Skin incisions are based on the amount of excess skin that needs to be removed to produce a more pleasing breast shape, whether it be smaller and rounder or larger and rounder. Pedicles about the breast are numerous, whether they are located superiorly, inferiorly, superomedially, laterally, are bipedicled, and so on. The important concept is that the nipple must be given a base to survive and the underlying gland must be shaped so that it will aid in a long-lasting correction of a deflated breast.

Periareolar Techniques

No mastopexy technique is as seductive as the periareolar technique. By this we mean that as tempting as it is to confine incisions to the areola-skin interface, the method can lead to poor results if applied to the wrong patient. Clearly, all patients and surgeons would prefer to keep scars concealed and as short as possible, as long as a beautiful shape can be produced. When the proper technique is executed in a properly selected patient, the periareolar technique confines incisions and therefore potential scars to the areola-skin interface. Resulting scars in this area are usually almost unnoticeable if the surgeon diligently makes the incision precisely where the areola and breast skin meet. If the incision extends either onto the areola or the skin, more noticeable and less satisfactory scars can result, and the primary benefit of this technique is lost. Subsequent correction of these poorly positioned scars may lead to further spreading of the areola and poor aesthetic results.

The periareolar approach is most appropriate in cases of mild to moderate breast ptosis where there is adequate, firm glandular parenchyma. If a patient has mild to moderate breast ptosis but a small or atrophic gland, a small implant may be added in certain periareolar techniques to achieve a pleasing breast shape.

The simplest periareolar technique involves excising or deepithelializing skin around the areola. Depending on the degree of ptosis and the location of the nipple, the skin excisions can be designed in a doughnut or crescent shape.

Small, mildly ptotic breasts with adequate breast parenchyma respond best to this technique. However, this technique can be modified to accommodate moderate degrees of ptosis and for patients who lack adequate breast parenchyma. The usual modification in such a case is the addition of a small implant to take the place of breast tissue and to fill the skin envelope. Usually nipple position remains low after this augmentation, and simultaneous removal of skin around the areola allows elevation of the nipple-areola complex to a more anatomically desirable position. It is difficult to achieve more than 2 to 3 cm of nipple elevation using these simple skin-only designs.

As with all periareolar techniques, the main advantage is a minimal incision with placement where the resulting scar can best be camouflaged. Even if an implant is needed, this can be placed through the same periareolar incision used to excise the excess skin.

The primary disadvantages have to do with the requirement for meticulous precision in the placement of the incision and the amount of skin excised. Even with precision, the resulting scar can widen because of excessive tension on the closure,

either as a result of overaggressive skin excision or trying to use this procedure to treat significant breast ptosis. If a patient requires more than 3 cm of nipple elevation, we usually opt for a vertical incision. Sometimes the weight of the implant can put too much tension on the closure. In addition, the patient's skin quality (thickness and elasticity) can be a major factor in the quality of the final scar. It is not a coincidence that women with poor skin quality are most likely to present with complaints of ptosis.

Excessive tension on the closure may also cause the breast to assume a flattened shape with poor projection. This must be avoided, because a good scar loses its value if placed on a misshapen breast.

Periareolar Mastopexy Without Parenchymal Reshaping

Technique

The position of the nipple-areola complex determines the amount of skin to be excised. It is critical to resect only the amount of skin necessary to raise the nipple to correct the ptosis. Additional consideration must be made for any excess areola that is to be removed.

The lines of excision are marked on the breast with the patient in a sitting or standing position in the preoperative area. Symmetry is ascertained using the sternal notch-to-nipple distance and the sternum-to-nipple distance. In the operating room, the amount of the areola that is to remain is marked under tension using an areolar marker. According to Spear et al, the amount of nonpigmented skin excised should be less than the amount of pigmented skin excised. The skin between these two marks is infiltrated with 0.5% lidocaine with 1:200,000 epinephrine to facilitate deepithelialization. Once the epidermis is removed, the edge of the dermis can be elevated. The skin around the outer edge of the exposed dermis is elevated off the gland for a short distance superiorly. The freed dermis can then be tacked to the gland under the elevated skin for additional support for the new nipple position. A purse-string suture of 4-0 Gore-Tex or Mersilene is then placed in the deep dermis of the skin edge. This is then cinched to the approximate size of the areola and tied. The areola is tacked to the skin with half-buried horizontal mattress sutures, followed by a running Monocryl or PDS subcuticular stitch.

The Benelli Periareolar Mastopexy Technique

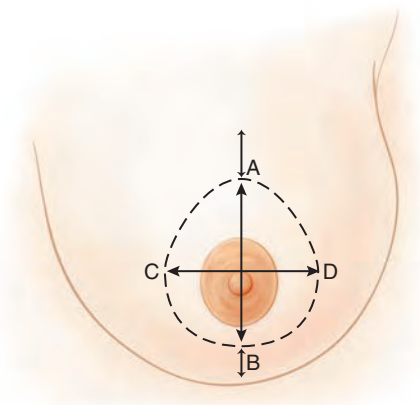
Dissatisfied with the limits of simple periareolar techniques, Benelli devised modifications of periareolar mastopexy so that the periareolar technique could be applied to larger breasts with increasing degrees of ptosis. In addition, Benelli's technique could be applied in cases of breast hypertrophy as well as tumor excision, with the main goal of limiting the scar.

Benelli's technique treats the skin and gland as two separate components. The periareolar approach affords access to the underlying gland, which is then separated from the overlying skin. A vertical dermatoglandular flap is created with lateral and medial extensions that are subsequently crisscrossed to make the glandular mound cone shaped. The tissue contiguous with the vertical flap inferiorly can either be excised or imbricated, depending on the volume needed for good breast shape. The end result is a narrower breast with a tightened inferior pole. The skin envelope is then redraped over this newly formed glandular scaffold. A "round block" cerclage stitch is used as in the doughnut mastopexy to help control tension at the areola-skin junction. As can be seen, this technique allows a more precise shaping of the breast with the inverted-T incision through the gland, while requiring no additional incisions to the skin.

This technique expands the range of periareolar mastopexy to incorporate greater degrees of ptosis as well as the ability to treat glandular excess. As with the skin-only techniques, an implant can be used to provide superior pole fill.

The Benelli technique is not beneficial for women who have severe degrees of ptosis and/or very poor skin quality. Potential pitfalls of this technique include its steep learning curve as well as the temptation to apply this technique when it is not indicated. The usual complications that arise when attempting this are a flattened appearance of the breast and a widened areola as a result of overresection of the skin and/or improper glandular support. The unwary surgeon may produce a very unsatisfactory outcome using this concept.

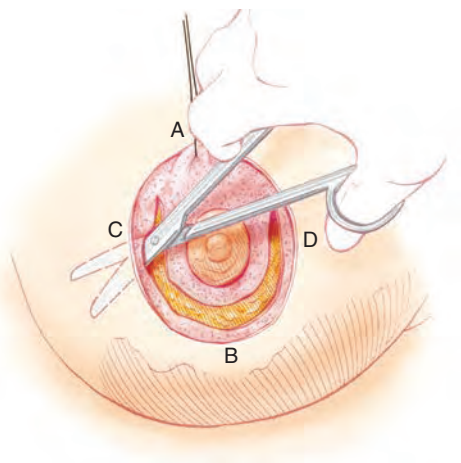
Technique



Preoperative markings are performed with the patient upright by first marking the midline and estimated meridian of the newly shaped breast (usually located 6 cm from the midline in a position medial to the original breast meridian). Point A, the future superior border of the areola, is marked 2 cm above the anterior projection

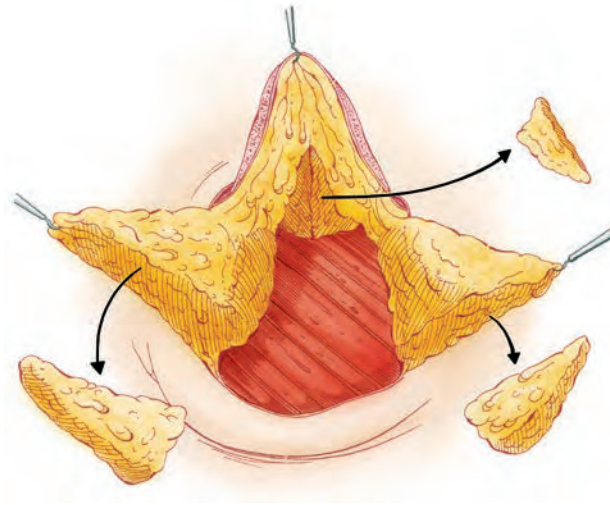
of the inframammary fold in line with the new breast meridian. Point *B*, the future inferior border, is marked with the patient recumbent and is located 5 to 12 cm above the inframammary fold after taking the final estimated volume and the amount of skin resection into consideration. Points *C* and *D* (the medial and lateral limits of the new nipple) are equidistant from the meridian. Point *C* averages 8 to 12 cm from the midline. Like point *B*, these marks are based on the anticipated final volume. Point *S* is the point at which the breast meridian intersects the inframammary fold.

The opposite breast is marked in a similar manner, depending on the degree of asymmetry inherently present. The resection margins are simulated by pinching together points *A* and *B* and then *C* and *D* to verify adequate skin coverage without tension. A wetting solution consisting of saline solution (1000 ml), epinephrine (0.25 mg), and 2% lidocaine (20 ml) is infiltrated subcutaneously in the area that will be detached. The ellipse and surrounding 3 cm are not infiltrated to preserve the vascularity of the skin edges. The prepectoral area is also infiltrated.



The desired areolar diameter is marked and the periareolar ellipse deepithelialized. The deepithelialized dermis is incised from the 2 o'clock to the 10 o'clock positions. The dissection is extended toward the inframammary fold in the subcutaneous plane.

The dissection continues to the upper-outer quadrant of the breast, with the dissection becoming more superficial to preserve the vessels coming from the lateral thoracic artery. Next glandular dissection is initiated with a semicircular incision approximately 3 cm from the inferior areolar edge to preserve innervation and the blood supply to the areola. Dissection is continued to the prepectoral space in the avascular central space, preserving the peripheral blood supply.

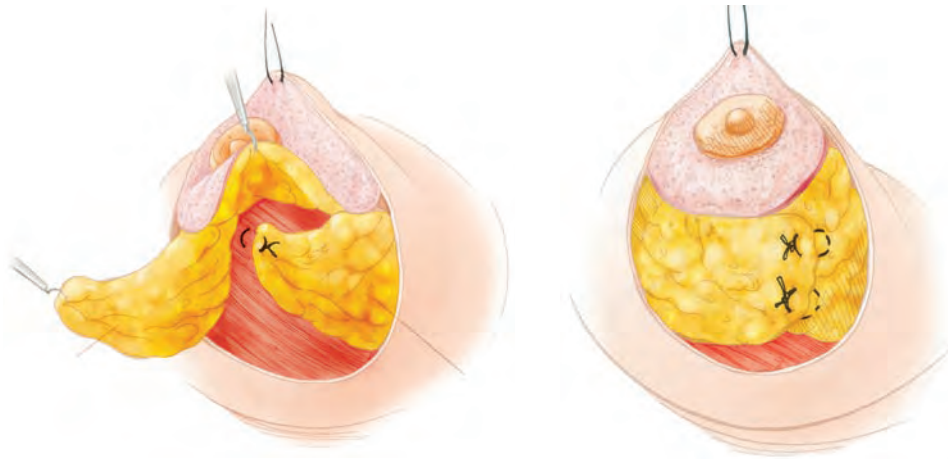


The inferior glandular flap is then cut vertically beyond the breast meridian up to the fascia. Four flaps will thus have been elevated: (1) a superior dermoglandular flap supporting the areola, (2) a glandular medial flap, (3) a glandular lateral flap, and (4) a detached skin flap.

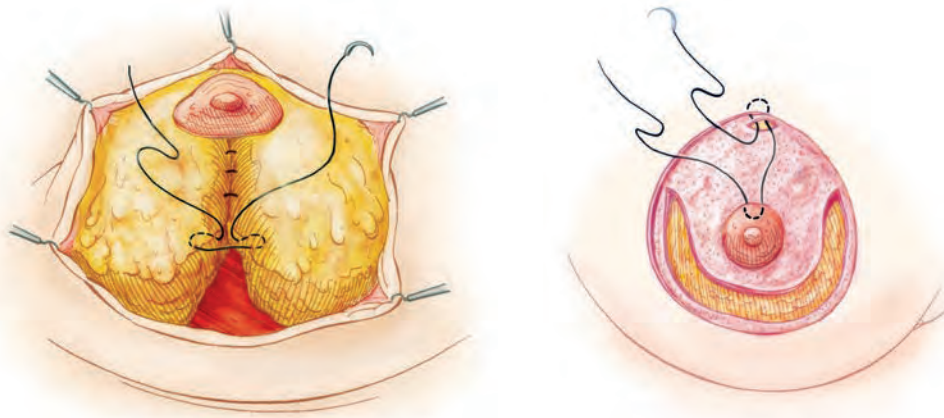
These glandular flaps will be reassembled and repositioned to decrease the base of the breast, thus promoting the lifted appearance. If necessary, these flaps can be trimmed to reduce unwanted fullness. Volume reduction at the distal ends of the flaps will limit their length.



On completion of the gland resection, the gland is lifted by stitching the superior flap high up on the pectoralis fascia to produce an exaggerated bulge in the superior pole of the breast. The nipple should be raised by this maneuver as well. Over the next few weeks, the superior roundness will flatten from the effects of gravity.

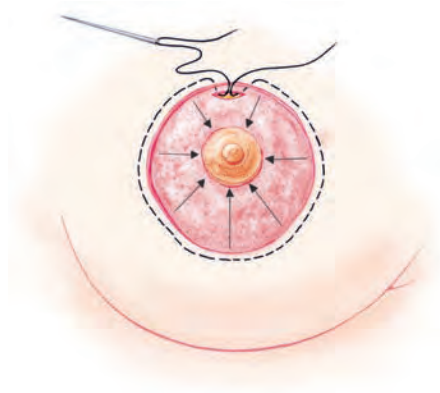


Next the medial and lateral flaps are folded over one another and sutured in place by rotating and folding the medial flap behind the areola, fixing its distal portion to the pectoralis muscle with superficial stitches. Then the lateral flap is crossed over and fixed to the medial flap. The movement of these flaps reduces the base of the breast, forming a glandular cone on which to place the areola.

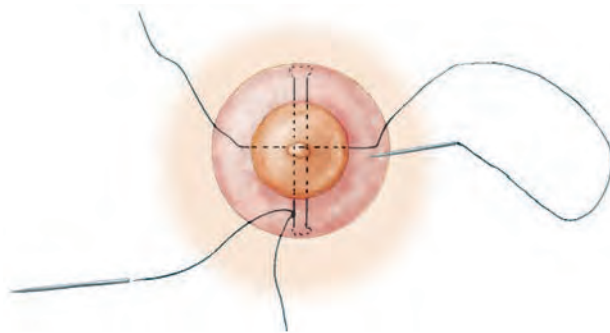


If the gland requires no resection, a plication invagination can be performed to achieve conization and elevation of breast shape.

The areola is fixed to the superior border of the ellipse through a 1 cm dermal window made near the superior skin edge (the 12 o'clock position). This allows the knot to be buried and the areola to be supported without tension on the skin. Support for the breast shape is achieved by full-breast lacing. Braided polyester suture material on a long straight needle is used to create large inverted sutures along the underside of the gland. The superior stitch should pass through the superior dermoglandular flap, allowing control of the anterior projection of the nipple-areola complex. These full-breast lacing sutures should be applied without tension, their goal being to provide passive support of the newly created conical breast. Tying these lacing sutures too tight can result in glandular necrosis.



The skin is redraped over the breast. A round block cerclage stitch is passed in the deep dermis in purse-string fashion. It is then cinched around an areolar template of the desired diameter, ensuring even distribution of the skin pleats. The block stitch is then tied, burying the knot in the previously created dermal window. Further regulation of the projection of the areola is accomplished by an inverted dermoareolar stitch, which takes a large vertical bite in the areola and a large horizontal bite in the dermal ellipse. This helps to evenly distribute any remaining deep pleats around the areola.



A diametrical transareolar U suture (point) is placed to serve as a barrier and to help prevent areolar protrusion. It also can be used to give a circular shape to the areola in cases in which the areola tends to be ovoid. A 4-0 Vicryl intradermal suture around the areola completes the procedure.

The site is dressed with a wet compress on the areola and dry compresses on the detached skin, held in place by an adhesive bandage of moderate compression to prevent hematoma. These are removed on postoperative day 2, along with any drains, and are replaced with a sterile, ultrathin, semiocclusive polyurethane foam adhesive pad. This dressing covers the areola and scar and maintains all of the detached skin in place. This pad will be changed weekly. The patient wears a mammary support bra day and night for 2 months.

Góes Periareolar Technique With Mesh Support

João Carlos Sampaio Góes of Brazil expanded the use of periareolar techniques by introducing his *double-skin technique* whereby a resistant lining of the breast is created with the use of a layer of prosthetic mesh. The “double skin” refers to the use of a doughnut-shaped, periareolar, deepithelialized dermal flap that is used to support the gland under the remaining normal skin, which will be closed around the reshaped gland. The mesh provides increased support of the new breast shape during the healing and skin contraction processes rather than depending on stretched-out breast parenchyma and skin.

Sampaio Góes treats the glandular unit separate from the overlying skin. He creates an internal brassiere by using the anterior pectoral fascia, inframammary connective ligaments, a periareolar dermal flap that is used as an internal lining, and a mixed mesh originally composed of Vicryl and Prolene (Ultrapro by Ethicon). This is enveloped by the external skin.

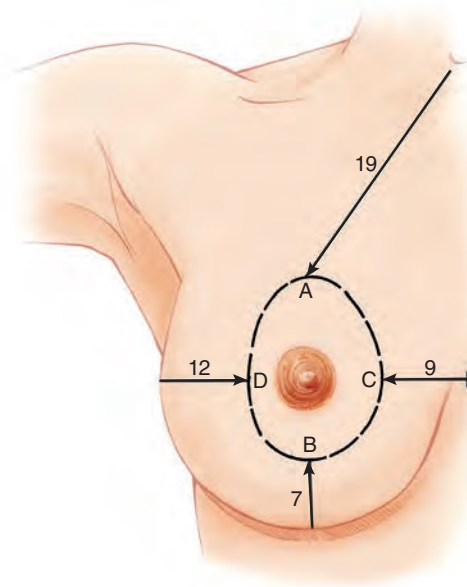
This method is very useful for correcting ptosis or for small reductions of mammary hypertrophy with or without ptosis. The reduction volume should ideally be less than 500 g. As with all breast surgery, better aesthetic results are obtained in younger patients who have firm tissues, more elastic skin, and little fatty tissue.

In addition to limiting the scar to the periareolar region, the main advantage of this technique is the use of the mixed mesh to create a long-lasting correction for the ptotic breast. The mechanism is an intense fibrosis around the mesh, which causes scarring. This results in an initially rigid breast for the first few months, which then softens as the scar matures. However, despite the fact that internal scarring occurs, the mesh that remains is integral to maintaining the correction. Ultimately, the breast feels normal on palpation—the mesh is not palpable, and it does not interfere with mammographic evaluation.

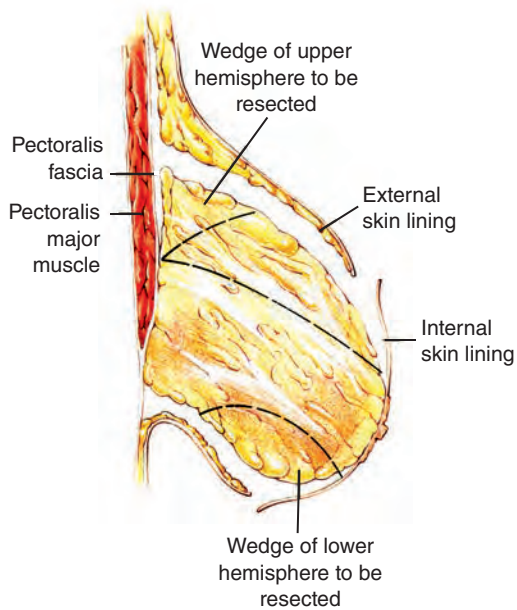
The drawbacks of this technique lie in the steep learning curve associated with this technically difficult operation. In addition, there are the theoretical problems of mesh extrusion, infection, or skin necrosis. It is imperative to carefully dissect the skin flaps and to place the mesh meticulously to avoid suboptimal results and/or disastrous outcomes.

There has also been considerable resistance to placing permanent foreign bodies within the breast parenchyma among U.S. surgeons because of concerns about mammographic artifacts or palpability; de Bruijn and colleagues in Belgium have addressed this with the use of a three-dimensional polyester mesh that does not cause artifacts on mammography and is not palpable. Histologically, there is minimal scarring and a deposition of a thin layer of collagen about the mesh that results in increased firmness of the breast parenchyma to provide a long-lasting correction.

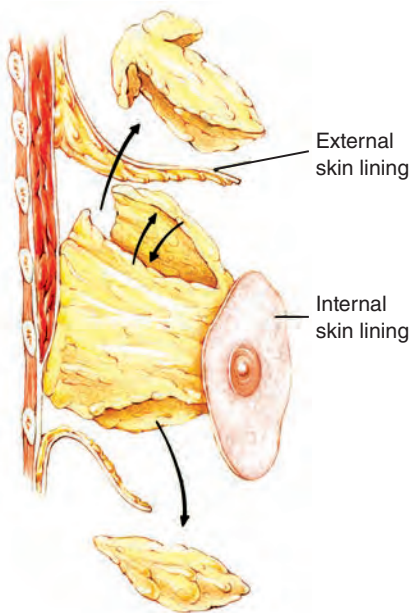
Technique



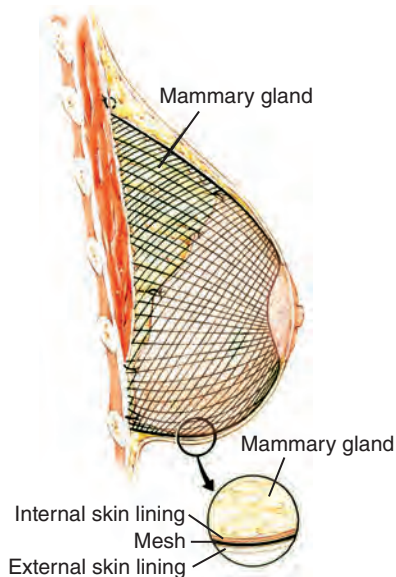
The technique begins with the preoperative marking. The most important concept is to leave adequate skin to cover the new breast mound. With that in mind, four cardinal points are marked. Point A is the level of the top of the new areola; point B is the distance from the inframammary fold (on average, 7 cm); point C is the distance from the midline to the medial margin at the level of the nipple (usually 9 cm); and point D is the distance from the anterior axillary line to the lateral margin at the level of the nipple (usually 12 cm).



The marked area is deepithelialized to the nipple. The outer border is incised and a skin flap is developed superiorly, with progressive thickening of this flap as one approaches the chest wall. The undermining continues for another 5 cm once the pectoralis fascia is reached. The direction is then changed inferiorly under the gland to approximately a third of the retromammary space. Perforators will be encountered and should be preserved. Inferiorly, a thin flap is developed down to the inframammary fold.



After the skin and breast parenchyma are separated into components, any excess tissue can be resected in a wedge shape at the superior and inferior poles of the breast mound. None of the tissue at the base of the mound should be excised. The gland is then shaped by suturing the gland together superiorly and affixing it to the chest wall to provide fill of the upper pole of the breast. Likewise, the inferior resection is sutured together and then fixed to the inframammary connective ligaments and the anterior pectoral fascia. The deepithelialized flap is stretched out over the new breast mound, attaching it superiorly to the connective ligaments of the breast and inferiorly to the anterior pectoral fascia. This creates the internal skin lining.



The next step places the mesh over the newly created mound and internal skin lining to function as a brassiere that will elevate the breast and provide a stable base for achieving a conical shape. The mesh is affixed to the anterior pectoral fascia at the base of the breast mound.

The external skin lining is brought up over the breast mound and closed around the areola with a circular, continuous, deep intradermal suture of Mersiline 2-0 on a straight needle. A continuous intradermal Monocryl 4-0 suture is used to fix the areola skin to the external skin lining. Dressing consists of triangular pieces of Micropore tape covering the whole gland, which is left in place for 20 days. Tegaderm also works well for this purpose. Suction drains are removed after approximately 5 days.

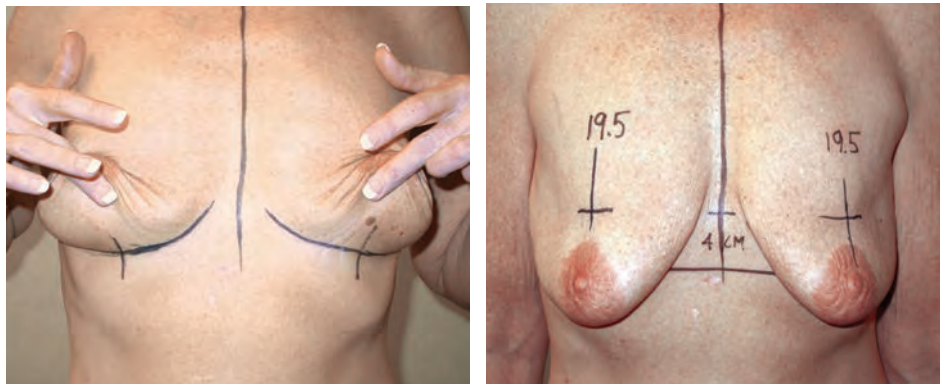
Excessive tension on the closure can also result in the breast assuming a flattened shape with poor projection. This must be guarded against, because a good scar loses its value if placed on a misshapen breast.

Vertical Mastopexy Without Implants

We believe that some type of parenchymal remodeling is essential to produce a longer-lasting lift effect in a mastopexy without implants. As mentioned previously, a vertical or inverted-T deepithelialization with skin tightening alone is appropriate only in certain patients. These are the women for whom the surgeon deliberately chooses not to violate the parenchyma for follow-up imaging considerations, such as opposite breast mastopexy for matching a reconstructed breast. Otherwise, it is my view that rearrangement of the parenchyma gives a more satisfactory long-term lift. The way that we most commonly way accomplish this is with a superiorly based flap from the midline of the lower pole turned underneath to provide fill to the upper pole. The medial and lateral pillars developed by the flap are approximated to tighten the lower pole and narrow the breast if it is too wide.

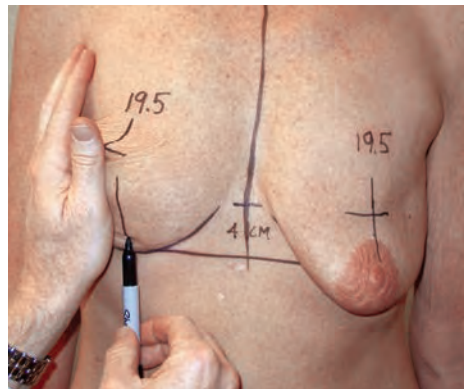
Marking

The breast is marked with the patient standing with her arms at her sides. We prefer to sit in front of her on a stool, which can be raised and lowered so that the surgeon always views the patient from the same perspective, regardless of how tall she is. By doing that, the surgeon can learn from past errors with nipple position and so forth, and the line of sight will be very similar on the next patient so markings can be adjusted.



The inframammary fold is marked on each side. The new nipple position is assessed. This is determined by a combination of data points. First the inframammary fold is transposed to the anterior surface of the breast and marked. Then the lower pole breast tissue is gathered to simulate the pexy to see if the nipple seems to elevate to the marked point. The point is checked against the midhumeral horizontal line and the distance between the sternal notch and the new nipple position is measured, usually 20 to 23 cm. Symmetry and distance from the sternal notch are checked. If any of

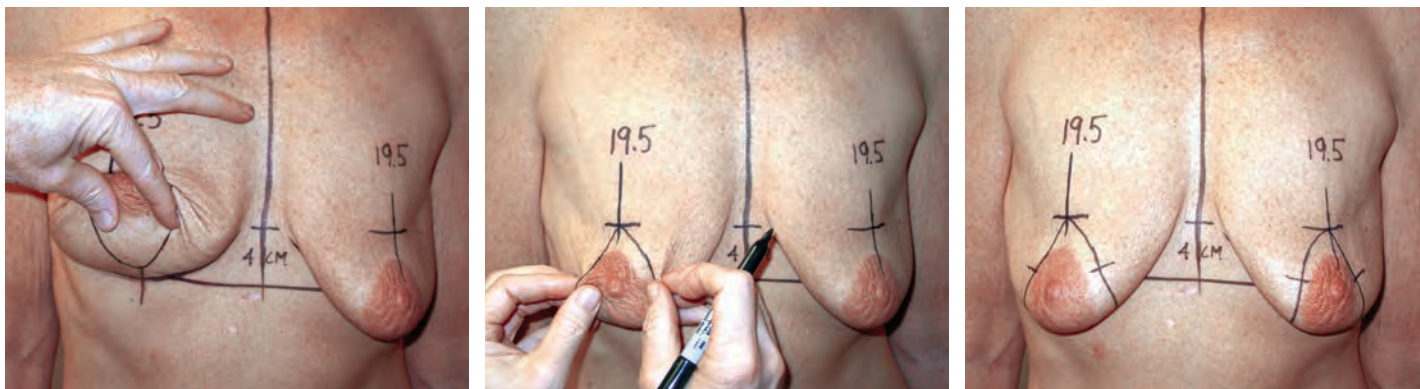
the parameters are vastly disparate, adjustments are made. Final nipple position is usually determined intraoperatively after the vertical closure, so the initial point merely represents a best guess. The next mark is the midline of the breast on its anterior surface. We aim toward the lateral border of the neck as if a tape measure were draped around the neck, as some surgeons have recommended. The midpoint of the inframammary fold is also an important landmark because this is where the bottom of the vertical limbs will be centered.



The breast is then gently distracted laterally so that the medial pillar can be marked in line with the midline superiorly and inferiorly. The mark is joined with the inferior mammary midline with a curvilinear line that ends a few centimeters above the inframammary fold. The same maneuver in the opposite direction defines the lateral pillar. It is most important to view the shape and volume of the tissues left behind (outside of the pillar markings), because these will determine the ultimate shape of the breast.



Once the vertical markings are positioned, these are drawn into a parabolic shape inferiorly, ending 2 to 3 cm above the native fold. Superiorly, the lines are curved up to the new nipple point, taking no additional skin around the nipple-areola complex initially.



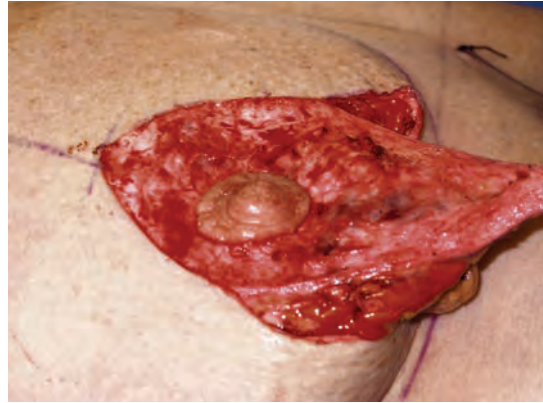
The top of the vertical closure is estimated by the pinch technique so that not too much skin will be required to be gathered in the periareolar closure. The secret to good periareolar scars is to make certain this is closed without excessive tension. For smaller mastopexies, the periareolar circle is marked for deepithelialization if we are confident that the nipple position has been properly determined. The greater the degree of ptosis, the less likely we are to commit to the new nipple position definitively.

From the top of the vertical closure, one measures down 5 to 6 cm and makes another mark that will represent the approximate position of the new fold. The breast tissue below that point will comprise the bottom of the superiorly based flap or will be trimmed. Any convexities in the axillary area that may need suction contouring must be marked.

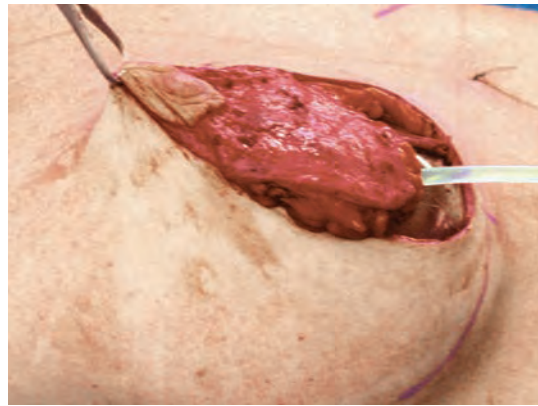
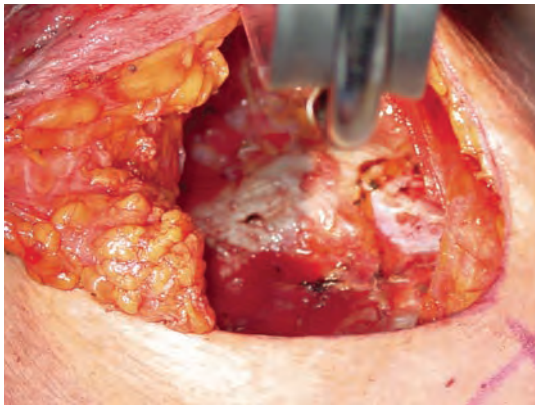
The design of the flap will depend on the need to accentuate the upper pole. If a small amount of breast tissue needs to be resected, it is this flap tissue that is most readily available for trimming.

Technique

After the patient is placed under general anesthesia, we make certain that she is centered on the operating table and that her arms are properly secured so we can sit the patient up for intraoperative assessment of the result. After the patient is draped, we place pendulum sutures at the sternal notch and the xyphoid. Skin staples or Adair clamps can then be used to verify that not too much tissue has been marked for the pillar closure, making horizontal approximation too tight. The nipple is marked with a 42 mm template and then 0.5% lidocaine with 1:200,000 epinephrine is infiltrated to help control bleeding.



After the entire segment between the medial and lateral pillars and the periareolar skin has been deepithelialized, the breast is elevated off the pectoralis fascia. Unless the bases of the pillars are to be trimmed, it is unnecessary to undermine much medially and laterally. However, it is important to dissect up to the top of the superior pole so that the flap can be placed as high as possible.

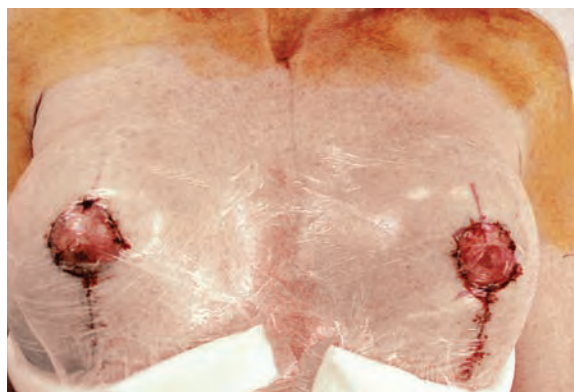


Once the breast is undermined, a flap is placed in the subpectoral pocket and the medial and lateral cuts are made, isolating the flap on its superior blood supply. The cuts are stopped at the previous mark, which will also represent the 6 o'clock position of the future exteriorized nipple-areola complex. If no implant is to be used, a subglandular dissection is performed. With saline implants, we prefer a subpectoral pocket, but with smaller implants and particularly silicone gel devices, we often use the subglandular pocket.



The flap is then folded underneath into the upper pole and sutured with 2-0 Vicryl pop-offs. The pillars are then reapproximated, beginning at the top, then the most inferior point, followed by a few sutures in between. If the flap has been trimmed off, the undersurface of the gland is sutured as high up in the infraclavicular space as possible. A bite of lateral breast parenchyma is also grasped at the inferior extent of the lateral contour and sutured medially in the midline to help cone the breast and keep it from falling laterally toward the axilla. A 15 Fr Blake drain is placed along the lateral gutter and the vertical portion temporally stapled. Note the upper pole fill and the improved nipple position in relation to the breast mass (*above, right*).

The opposite breast can then be shaped in the same way and to the same point of vertical stapling. Next the patient is positioned upright, and with the nipple template, the final nipple position is marked. Sometimes a temporary periareolar purse-string suture can take up some loose skin in this area before final markings are made with the template. Final deepithelialization is completed, followed by layered skin closure.



The dressing, consisting of large, rectangular sheets of Tegaderm, supports the final breast shape. The nipple should not be compressed by the dressing. We use a rolled-up ABD pad taped into a “hotdog” shape and held in place along the curve of the new inframammary fold using Tegaderm. Although the drain can be removed the following day, the Tegaderm dressing is left in place for 2 weeks.

After the final dressings are removed, the patient is advised to wear a good supporting bra day and night for 8 weeks. Scars are treated with Mederma or Scarguard.

Use of Implants With Mastopexy

The most conservative approach when an implant is also planned is to place the implant first and tailor-tack the skin over the implant to make certain the markings are correct. We prefer to place the implant in the subpectoral position if the patient chooses a saline implant or if the upper pole tissues are excessively thin (pinch thickness less than 3 cm). A silicone gel implant can be placed in the subglandular position with less concern about visibility or palpability. We often use at least a small flap into the upper pole, even in the presence of an implant. The flap can be sutured to the undersurface of the breast itself or to the pectoralis fascia. Rarely is it possible to achieve too much upper pole fullness in a mastopexy.

Selection of saline or silicone implants follows a discussion with the patient and examination of the quality of tissue both skin and parenchyma. Saline implants tend to be more palpable and visible. Because of this, we tend to use saline implants in cases in which the patient prefers them and the skin and parenchyma are thicker. Silicone implants can be used in either position; however, the underlying parenchyma needs to be firm to support the additional stress if the implants are to be placed in the subglandular position. It is always best to scale down the size and dimensions of implants in augmentation mastopexy cases to minimize downward forces on the newly lifted tissues.

Wise Vertical Scar With a Long Horizontal Scar

The Wise pattern vertical scar with a long horizontal scar is based on the reduction technique of the same name. The long horizontal component is necessary to allow adequate resection of the skin envelope. This technique is best suited for women with moderate to severe breast ptosis with poor-quality skin and/or a large amount of skin excess and a moderate amount of glandular tissue. The skin markings are familiar to most plastic surgeons trained in the United States because of the popularity of the Wise breast reduction technique. However, unlike the reduction technique, removal of breast parenchyma is usually not needed.

Proponents of this technique favor the ability to see the final shape while the patient is still on the table and the chance to remove the skin excess, both of which decrease the rate of reoperation. This technique is performed at the expense of longer scars. The horizontal component runs along the inframammary fold from the medialmost

to the lateralmost aspect of the breast, sometimes even farther laterally along the chest wall. The medial limbs must not join in the center of the chest. This area is most prone to hypertrophic scarring and any extension of scar length should not be performed in this direction.

Long-term complications of this procedure include recurrent ptosis or bottoming out of the mastopexy. This occurs because the breast shape is maintained by the skin envelope rather than support from the gland.

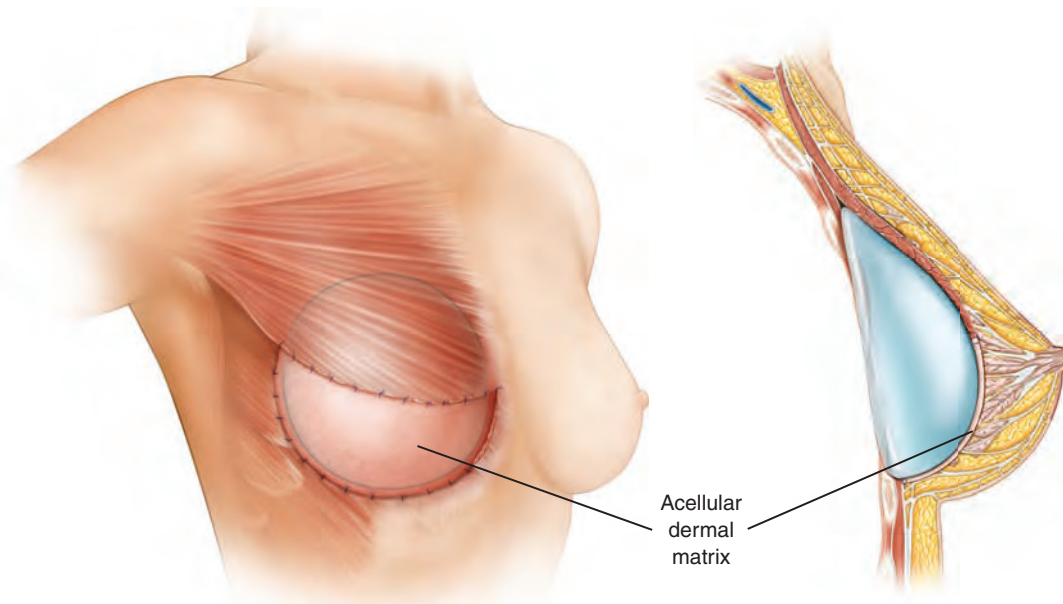
Technique

Markings proceed using the standard Wise pattern. With the patient in the upright position, the breast meridian is marked. The level of the inframammary fold is transposed anteriorly to intersect with the meridian to mark the level of the new nipple. The Wise keyhole pattern is spread to encompass the original areola. It is placed so that the superior aspect of the pattern lies 2 cm higher than the level of the new nipple. The markings are checked by pinching together the medial and lateral limbs to assess tension. The closure should be snug to compensate for the eventual skin relaxation, but not tight enough to compromise vascularity. The vertical limbs are extended medially and laterally to intersect with the inframammary fold.

In the operating room, the portion of the areola to be preserved is marked with an areolar marker of the appropriate diameter. The area within the marks is deepithelialized. Transdermal incisions are made along the upper portion of what would be the vertical bipedicle flap of a reduction mammoplasty on either side of the nipple-areola complex. If there is an abundance of deepithelialized breast tissue below the inframammary fold, the gland is dissected off the pectoralis muscle, starting from the inframammary fold and proceeding upward, creating a superiorly based dermoglandular pedicle. The dissection continues until the pocket can accept the excess inferior glandular tissue. This tissue is folded behind the breast and attached to the pectoralis fascia high enough to eliminate gross glandular redundancy. The skin is closed in standard fashion with little or no further undermining. The nipple-areola complex is positioned and sutured into place.

Biologic Meshes

Mastopexy, and more frequently augmentation mastopexy, is plagued with recurrent ptosis. The “holy grail” in this problem involves creation of a durable internal brassiere that is resistant to stretching out over time. This problem is exacerbated when an implant adds weight and strain on breast parenchyma and skin. The use of acellular dermal matrix as well as autologous dermal slings have been used to help create an internal brassiere by reinforcement of the worn-out parenchyma.



Placement of acellular dermal matrix in between implant and breast parenchyma

To correct bottoming out with a dual-plane type of augmentation, dermal meshes can be used as an inferior sling to connect the implant to the chest wall, effectively fixing the location of the inframammary fold and supporting the weight of the implant.

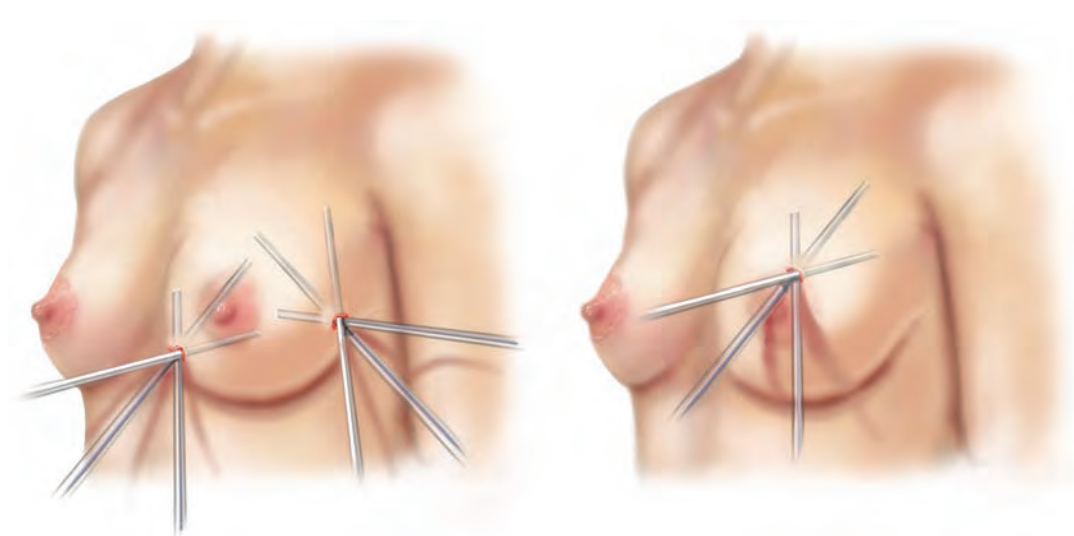
Maxwell and Gabriel have demonstrated the effective use of acellular dermal matrix to correct pocket deformities throughout the breast, whereas Colwell and Breuing have used these dermal matrices in primary mastopexies to have additional support for the stretched-out breast parenchyma. Regardless of the location that these dermal matrices are placed in, they require fixation to stable structures, either the fascia of the pectoralis or the reflection of the inframammary fold. They permit the surgeon to shape the glandular structures more effectively, rather than relying on the skin envelope for long-term shaping of the breast. To minimize complications arising from seroma and/or infection, the surgeon must create a pocket of the dermal matrix that is sandwiched between two vascularized surfaces to maximize vascular ingrowth and incorporation. The drawback to these procedures has been the cost of acellular dermal matrices.

Liposuction

Liposuction has been used to reduce breast size and with concomitant skin retraction, raising the level of the nipple-areola complex. The most obvious benefit is provision of a breast lift with minimal scarring. The preservation of neurovascular structures is another advantage. The limitations of this procedure lie in the fact that the majority of the substance removed from the breast is fat, not breast parenchyma. In addition, the patient must have supple, elastic skin to achieve the greatest benefit.

With the advent of ultrasound-assisted lipectomy (UAL), more-aggressive cases have been tried, because UAL can assist in skin retraction and hence greater nipple elevation than could be accomplished with standard suction-assisted lipectomy (SAL).

The ideal patient for this procedure has mild breast hypertrophy resulting from an overabundance of fat, minimal ptosis, and good skin quality. The indications for this procedure are also expanded to women who have already had a breast reduction procedure and want a small adjustment. The benefits are that further manipulation of the pedicle is avoided, and there is a decreased risk of devascularization and/or nerve injury.



The breast is usually accessed through two small stab incisions above the inframammary fold at the medial and lateral aspects of the breast, and another one at the areola. The placement of these incisions facilitates a more uniform removal of fat by allowing overlap. When this technique is employed correctly, there is minimal risk of damage to the neurovascular supply of the nipple and hence a decreased risk of nipple necrosis and/or loss of sensation.

The main disadvantage of this treatment is its limited application. Only a small subset of women fits the strict criteria for this procedure. On the wrong patient, this technique will produce suboptimal results that may be very difficult to correct.

Technique

The breast should be marked with the patient standing. Contour circles to delineate the areas of greatest protrusion should be used. Standard wetting solution is used (1 L lactated Ringer's solution, 1 ml of 1:1000 epinephrine, and 25 ml 1% lidocaine) when general anesthesia is employed. If the plan is to use local anesthesia alone, the breast may be blocked using up to 100 ml of 0.25% bupivacaine (Marcaine) with 1:400,000 fresh epinephrine and 300 units of hyaluronidase.

Cannula selection usually depends on the experience of the surgeon. Inexperienced surgeons should use a smaller cannula at first to “get a feel” for the patient's tissues and then switch to a larger cannula for major tissue removal. Pretunneling is not required. Care should be taken to avoid inadvertently entering the chest cavity.



The breasts are marked before liposuction. The strategy should promote even resection of fat in areas of excess as well as suctioning of the base of the breast to reduce the breast mound so that the skin can retract more against the chest wall. The goals of suctioning are correction of the hypertrophy and a decrease in the overall weight of the breast. Accurate recording of suction volume is essential to prevent overresection and asymmetry. It is much easier to remove excess tissue later—but virtually impossible to replace overaggressively suctioned breast fat.

Postoperatively, no drains or sutures are used. Absorbent pads are used to catch the drainage. Paper tape is applied horizontally from the bottom of the breast toward the nipple-areola complex, forming a sling under the lower portion of the breast. Then horizontal pieces of paper tape are applied from the superior portion of the breast downward toward the nipple-areola complex. A Reston sponge is applied in half-moon shapes, followed by a snug brassiere. Firm, supportive pressure on the breast is the goal of these dressings. The dressings are removed at 1 week and the patient's bra is placed in a more contoured bra. To help combat any persistent edema, the patient is instructed to wear the bra day and night for up to 6 months.

Mastopexy to Correct the Overaugmented Breast

One of the increasingly common operations that we perform is to revise patients who underwent augmentation years earlier with large saline implants and now have breasts that are too large and too low. Many other presentations can occur, including ptosis with capsular contracture, which can produce bizarre asymmetrical configurations for which a treatment plan is difficult to develop. Some of these patients had large implants placed inappropriately in an attempt to treat breast ptosis by “filling up” the deflated skin envelope because the patient would not accept additional scars. Others have simply gained breast size from a weight increase over the decades.

Our approach to these patients, especially when they have saline implants in place, is to perform a preliminary in-office deflation of their implants to set up the breast for definitive correction. This simple procedure is done with a local anesthetic; an 18-gauge needle is inserted into the implant through the lower pole while compressing the device with the opposite hand until it is completely deflated. The patient then has an opportunity to live with her natural breast shape and size for 3 or 4 weeks while the ligaments shorten and the skin recovers from the overstretched condition. This has the advantage of giving the patient the opportunity to decide whether she even needs or wants additional implants as well as shape correction with a mastopexy. Some patients have a satisfactory shape and can simply undergo reaugmentation, usually in a new plane, and their implants are often replaced with silicone gel devices.

Many of these reoperative patients have the idea that they must have implants to give them the shape they want, but the two-stage approach allows them to see that they have adequate parenchyma to produce breasts of suitable size if a mastopexy alone can be performed. It is much easier to plan the definitive correction after implant deflation than to try to accomplish everything in a single stage. This approach decreases the chances of the patient’s needing yet another revision.

Postoperative Care

Postoperative care following a mastopexy starts in the operating room. Because of our preference for parenchymal reshaping to maintain a more permanent result, the breast should be held in its exaggerated shape for the first several weeks after surgery; that is, the fullness of the upper pole, with a flattened lower pole shape, must be splinted to assist in solid internal healing to keep the breast shape high and round.

The use of Tegaderm has been exceedingly helpful in this regard. We use large sheets cut longitudinally so that two long, narrow sheets can be used as a clear, supportive dressing. Care must be taken not to pull the Tegaderm over the skin, because this will create shear forces that can cause blistering. Rather, the breast is held in the desired position and the Tegaderm is simply laid down flat against the skin to hold it in place. The first sheet goes from lateral to medial, from the nipple down to the inframammary fold. This material can also be used to support the drain and maintain its position. The second sheet goes across the upper pole, overlapping the lower sheet at approximately the level of the nipple. We usually cut out a small segment to avoid flattening the nipple. A rolled-up ABD sponge taped into a large “hotdog” shape is used to accentuate the pressure curving along the new inframammary fold. This sponge is held in place with a half-sheet of Tegaderm. Next, we place the patient in a support bra, which helps maintain the final shape. An advantage of using Tegaderm is that when the patient takes off the bra, she can shower normally without losing support.

The drain is ordinarily removed on the first postoperative day. With a smaller mastopexy, we may choose not to use a drain at all. Typically, a mastopexy procedure is not associated with anything more than minor pain. Oral analgesics are sufficient, and ketorolac tromethamine (Toradol) has also been helpful in patients who are sensitive to narcotics.

The patient is seen 1 week after drain removal. At this time a small amount of the Tegaderm is removed around the edge of the areola, and the interrupted nylon sutures are removed. At 2 weeks postoperatively the patient returns after removing all of the remainder of the Tegaderm in the shower in the morning. The breasts are simply gently washed, patted dry, or dried with a hairdryer, and the patient puts the support bra back on.

We recommend that the patient wear a support bra day and night for 8 weeks following mastopexy. “Push-up” bras that accentuate the upper pole are helpful during this period to encourage the breast to heal in a high, round position.

Scar treatment begins 3 weeks postoperatively with such over-the-counter preparations as Mederma or Scarguard. An underwire bra often helps define the new inframammary fold shape and position. Typically, we do not consider scar revisions for 1 year after surgery, although if a small amount of redundant tissue exists at the inferiormost portion of the vertical scar at 6 months postoperatively, we may consider a small revision in the office if the patient is unable to wear a swimsuit or is uncomfortable with it.

Outcomes and Complications

Although patients who undergo mastopexy always look better than they might have looked had they not had the operation, the result must be considered semipermanent. Invariably, a little shape is lost over time, and the nipple descends. If bottoming out occurs, the nipple position may be disproportionately high. These shape issues are ordinarily addressed at 1 to 2 years postoperatively to let the shape settle before any revision is offered.



This 37-year-old woman underwent vertical mastopexy to treat pseudoptosis. Notice the error on the right in placing the nipple too high on the breast mound. She is shown before and 1 year after surgery. The lateral views show the considerable breast elevation that has been achieved, clearly demonstrating that the nipple position is too high.

Bleeding and infection are rarely seen after a mastopexy. Nipple and areolar deformities can usually be prevented by avoiding tension on the closure. We do not excise too much skin and make certain that the pedicle moves freely to the new nipple position. If the scar is wide or the shape of the areola is irregular, these problems can be corrected rather easily by reexcision and closure in the proper shape.

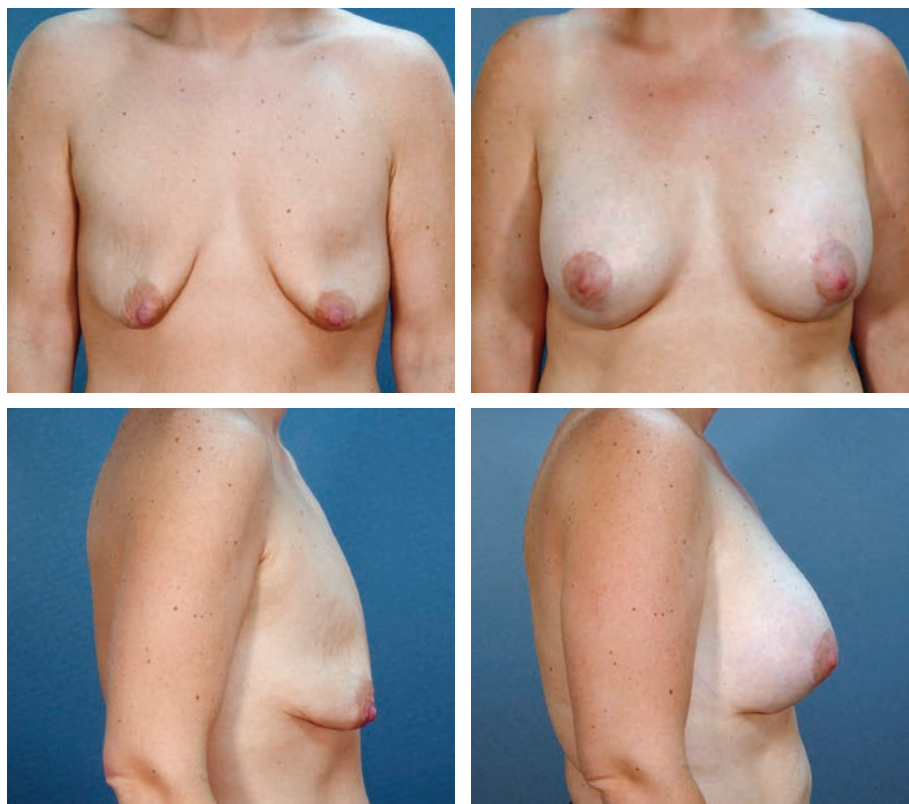
As in the case of reduction mammoplasty, breast-feeding following mastopexy may or may not be successful. In patients who do become pregnant after mastopexy, we encourage them to try breast-feeding, but to be aware that they may have to supplement the nutritional needs of the baby. It is important to advise patients that additional corrections may be desirable when pregnancies occur after mastopexy.

It is not uncommon to encounter some problems with implant malposition when a mastopexy is done concomitantly. As opposed to breast augmentation alone, where malposition problems may be addressed as early as 3 months postoperatively, we are reluctant to correct the augmentation-mastopexy patient for at least 6 months, because we have seen many cases in which the deformity either improves on its own or is not fully stabilized during this time frame. Of course, correction of these problems is aimed at either changing the level of the implant by capsulotomy or capsulorrhaphy or revising the mastopexy if the implant is in the proper location. Typically, mastopexy revisions are possible by skin-only techniques.

Chronic pain following mastopexy can be enigmatic. Occasionally this is caused by ongoing fibrocystic breast disease, chondrochondritis, or sutures that have inadvertently encircled sensory nerve fibers. The latter is usually diagnosed by pinpoint tenderness laterally with shooting pain and can be attributed to the neuroma. A small amount of lidocaine or bupivacaine in the area is usually diagnostic. Fortunately, this usually resolves without treatment.

Most patients remain pleased with mastopexy results, particularly as the years go by and the scars fade. We have seen patients in whom the scars become virtually invisible. Late tanning (more than 9 months postoperatively) appears to help fade the scars. If the shape remains satisfactory, the scars are well accepted by most patients.

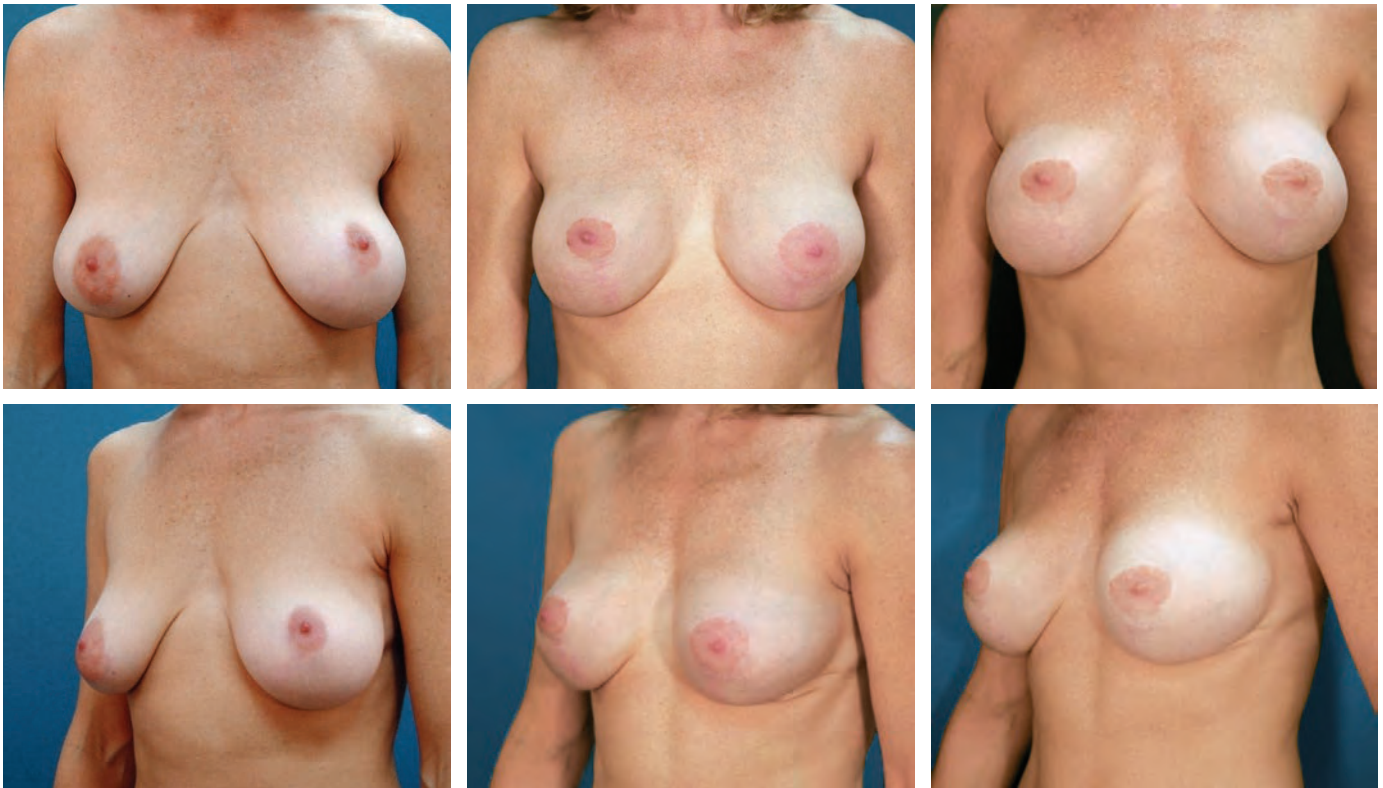
Results



This 44-year-old patient had tissues that were very fatty without much glandular substance. An implant was obviously necessary to lend adequate volume and shape. Additional factors included lack of support from any type of glandular flap. Therefore the plan included placing an implant with an appropriate base diameter. This patient chose saline; however, our preference is a round or shaped silicone gel device in most cases. She is shown 1 year after placement of a saline-filled implant with a final volume of 360 cc in the subpectoral position and a skin-tightening vertical mastopexy.



In this 40-year-old patient, we considered adding an implant, but because she could create her desired shape and size in a bra, we decided a mastopexy alone was all that was needed. She underwent a vertical mastopexy in which the superiorly based parenchymal flap from the lower pole was folded underneath the upper pole to create some additional upper pole convexity. She is shown 7 months postoperatively. If this patient desires additional fullness, an implant can be added later after the mastopexy is healed and stable.



Preoperative

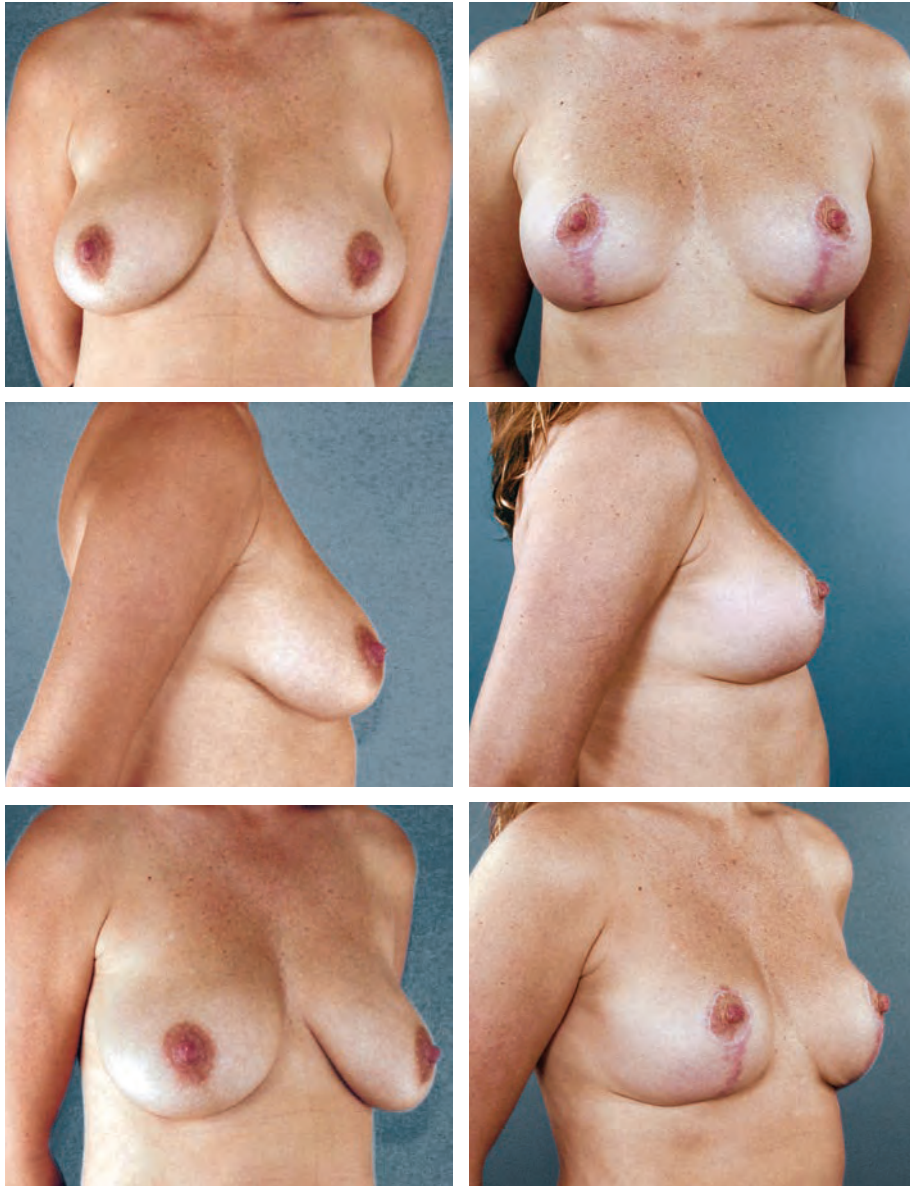
9 months postoperatively

2 years postoperatively

This 38-year-old woman had an unusual asymmetry condition in which the larger breast had a higher, smaller nipple-areola complex. Both breasts required a mastopexy to reshape the parenchyma; the plan included reducing the volume on the left so that the parenchymal volumes could be equalized. This approach allowed equal sized and shaped implants to be placed. When the ratio of breast parenchymal volume to implant volume and dimensions is equal, the evolution of shape over time is much more likely to result in a long-lasting, symmetrical correction.

The correction included an autoaugmentation with a superiorly based parenchymal flap on the right with a 150 cc smooth silicone gel implant. On the left breast, a 154 g reduction was done in the inferior pole, and a 150 cc silicone implant placed.

Although her result was satisfactory at 9 months postoperatively, by 2 years there was a worsening of the shape on the right. This was associated with a 5-pound weight loss that was significant in this very petite patient.



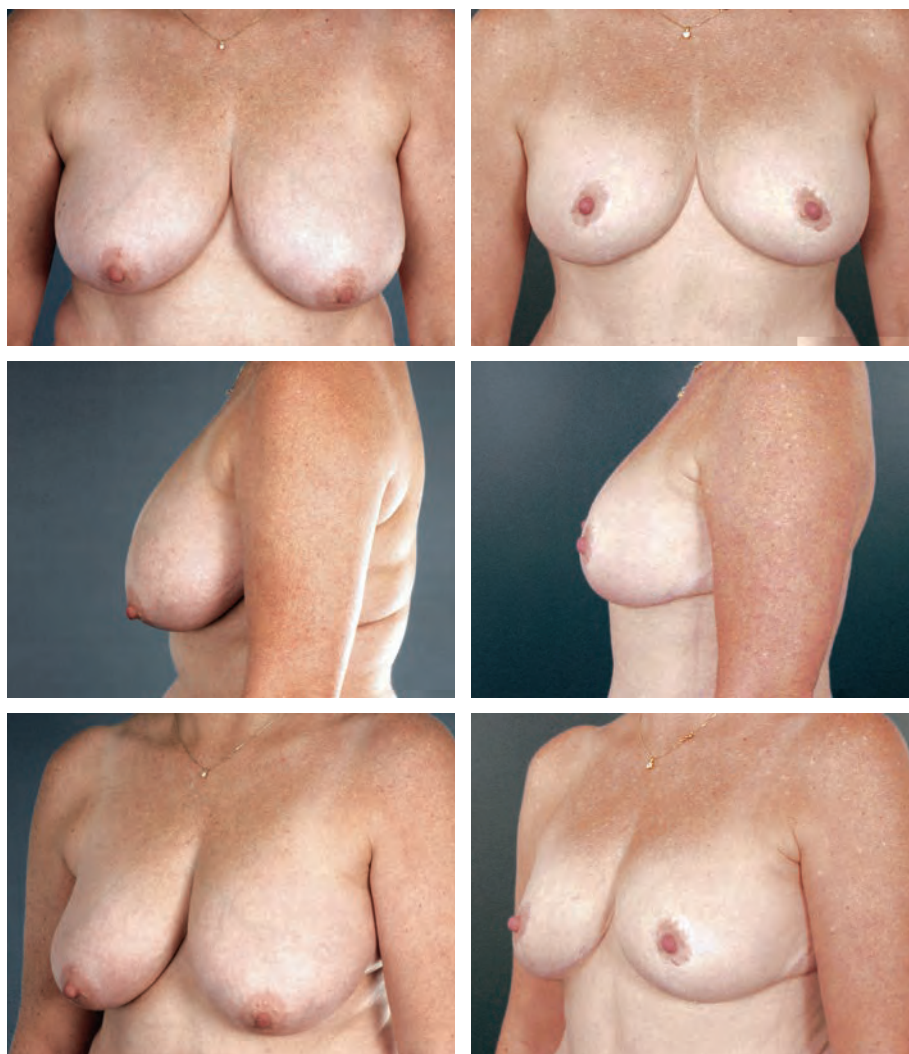
This 37-year-old woman underwent a vertical mastopexy with a small, 200 g reduction. The patient is shown before and 1 year after surgery.



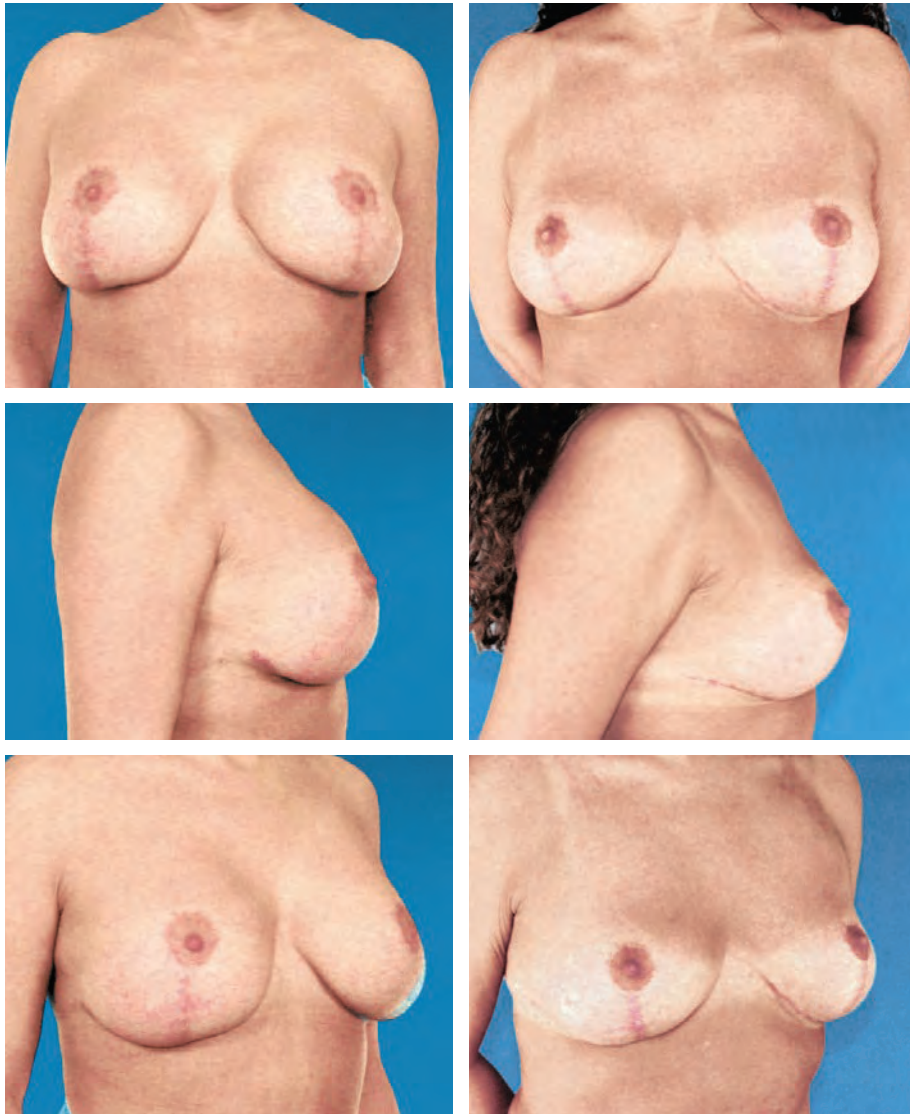
This 36-year-old woman presented with asymmetry. She is shown preoperatively and 3 months after vertical mastopexy in which 30 g of tissue was resected from the right and 200 g from the left breast.



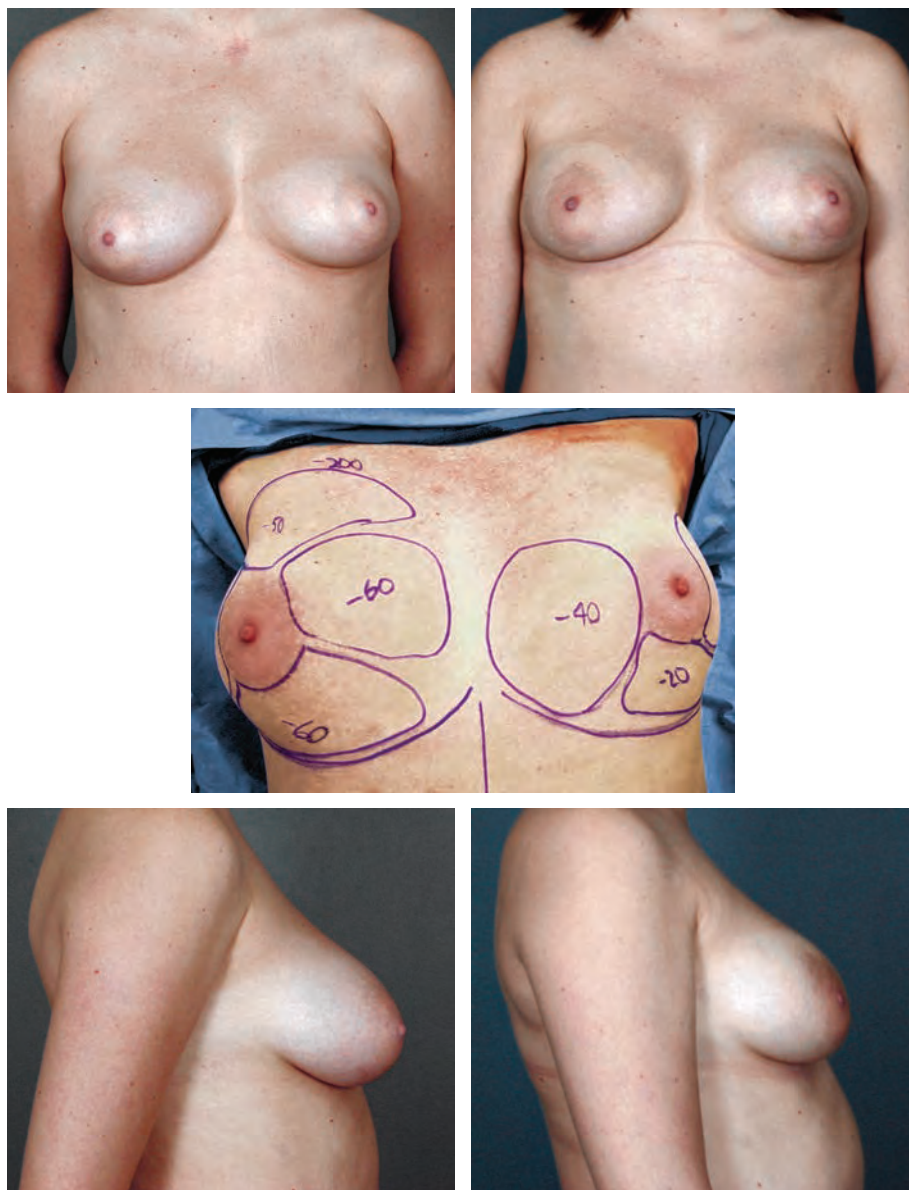
This 42-year-old woman underwent explantation of 360 cc saline implants and subsequent vertical mastopexy. She is shown preoperatively and 9 months postoperatively.



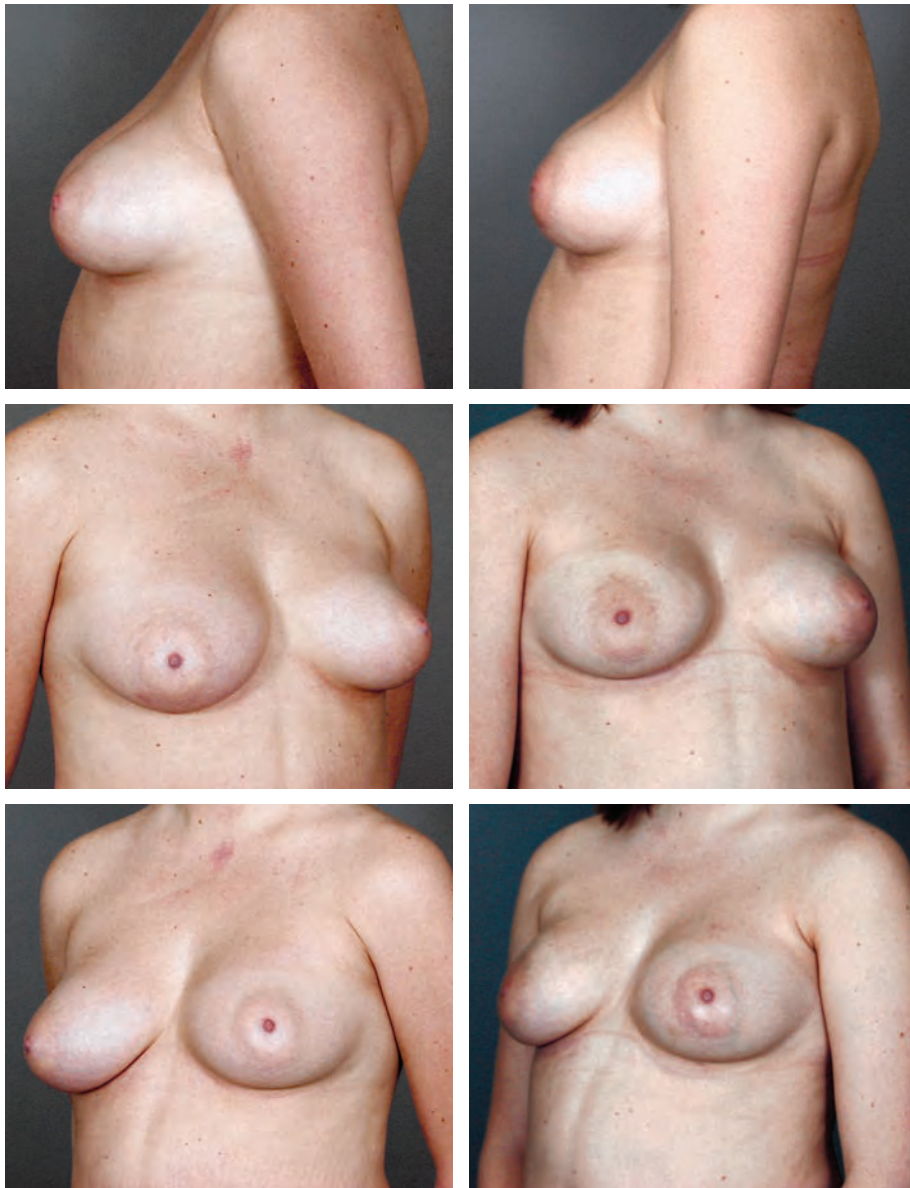
This 47-year-old woman had severe ptosis and glandular excess. An inverted-T reduction with superomedial pedicle was performed. She is shown before and 4 years after surgery.



This 43-year-old patient who had a previous augmentation mastopexy underwent explantation of 200 cc implants and then mastopexy with an inverted-T pattern. She is shown before and 9 months after surgery.

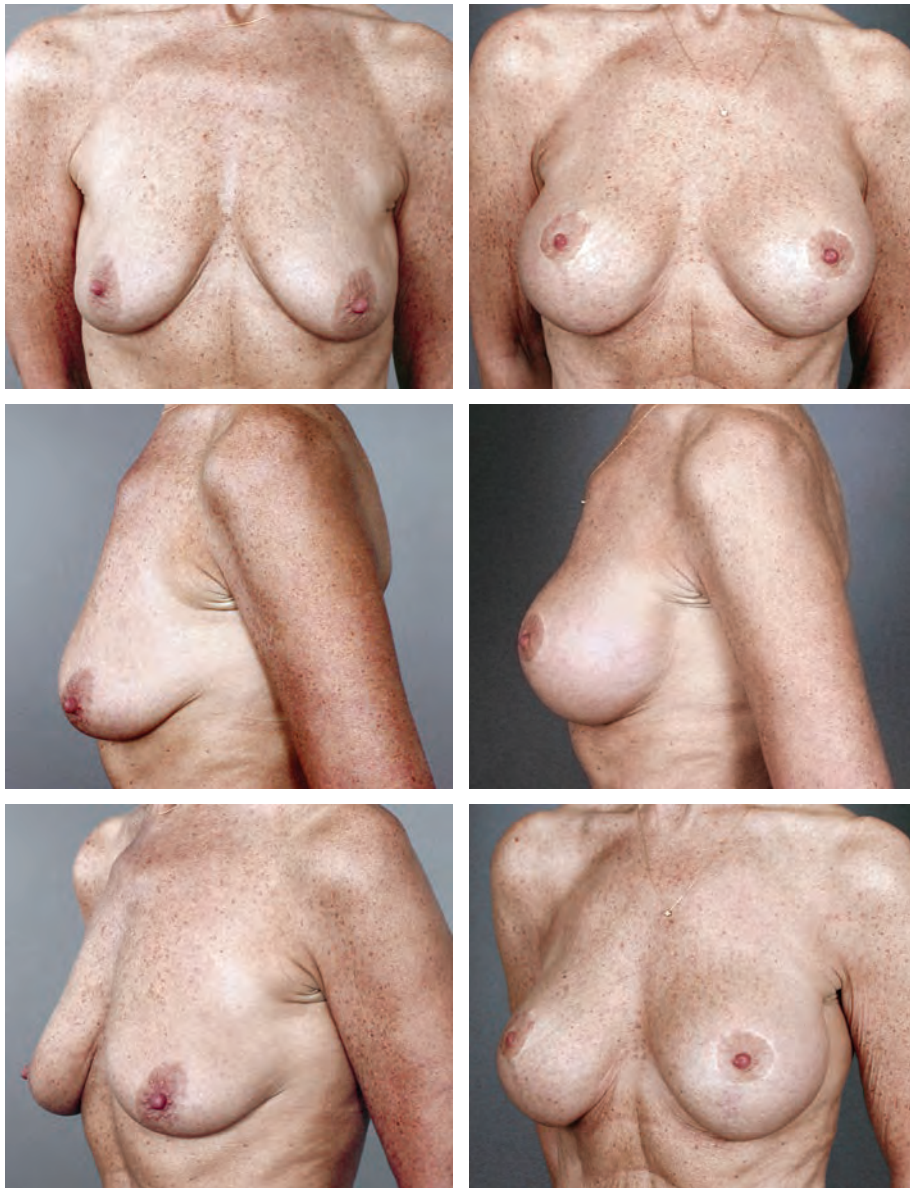


This 24-year-old woman had macromastia as well as breast asymmetry, with the right side larger than the left; 100 cc of tissue was aspirated from the left breast and 350 cc from the right. She is shown before and 1 month after liposuction.





This 37-year-old woman was treated for severe ptosis. A Wise pattern mastopexy with a superior pedicle was done. No reduction was performed on the left breast, and 100 g of tissue was resected from the right. She is shown before and 3 months after surgery.



This 57-year-old woman had moderate ptosis and breast atrophy. Augmentation with 275 cc implants was performed, followed by vertical mastopexy. She is shown pre-operatively and 1 year postoperatively.

Concluding Thoughts

At present, all mastopexy techniques are imperfect. Although surgeons are doing a better job of reducing overall scar length, we still struggle to obtain a beautiful, stable, long-term shape that will justify the scarring. Most women will accept the scars if the shape is attractive. The periareolar techniques work best if the breast tissue is relatively fibrous and the skin is good. We await the development of a suitable internal mesh to use in the Góes technique. In the meantime, we have found that the vertical techniques provide the best, most predictable results, with or without the use of implants.

Clinical Caveats

Periareolar Mastopexy Without Parenchymal Reshaping

This technique is suitable only in mild to moderate ptosis cases in which a minimal amount of elevation is required.

The amount of nonpigmented skin excision should be less than the amount of pigmented skin.

Benelli Periareolar Mastopexy Technique

The surgeon should start with mild to moderate ptosis cases until he or she is more familiar with this technique.

Although this technique can be applied to more advanced degrees of ptosis, it has its limitations in treating patients with severe ptosis and/or poor-quality skin.

The best results are with patients without striae and with dense fibroglandular parenchyma.

The amount of skin removed should be limited to decrease the resultant periareolar scalloping.

Tension on the parenchymal sutures should be avoided to preserve maximal glandular and nipple areolar circulation.

Góes Periareolar Technique With Mesh Support

The surgeon should accept a slightly larger areolar size in relation to the base width of the breast.

The amount of skin removed lateral to the nipple-areola complex should be limited.

Flap dissection should be performed very carefully so that the skin flaps drape smoothly over the mesh.

The space between the mesh and skin should be drained for at least 1 week.

The original mesh used (Vicryl/Dacron) is no longer available. The current preferred mesh is Vipro, manufactured by Ethicon.

Vertical Mastopexy Without Implants

The nipple position is set approximately 2 cm below the usual *A-point*. (The A-point in breast surgery refers to the anterior projection of the inframammary fold onto the breast. With inverted-T techniques, this represents the position of the new nipple. With vertical mastopexy, it represents the top of the areola.)

The surgeon should be cautious in marking the medial and lateral pillars, keeping in mind that minimal if any breast tissue will be excised.

Parenchymal shaping sutures are used in the superior pole and in the lateral pillars to assist in shaping the breast.

The new nipple-areolar position is marked with an areolar template with the patient in the upright position before final suturing.

Securing the breast with either Tegaderm or Micropore paper tape for 2 to 3 weeks helps to mold the final breast shape.

Liposuction Only

The key to success with liposuction is correct patient selection.

The ideal patient is one in whom the nipple-areola complex is already in a good position.

Liposuction-only candidates should have a majority of fat rather than fibroglandular tissue.

Wise Pattern

The surgeon should attempt to tailor the horizontal component of the scar within the new inframammary crease to help camouflage it.

The pattern is useful for reoperative cases when the breasts have been overaugmented.

A two-stage approach is planned with in-office deflation at least 4 weeks before the definitive correction.

The surgeon meets with the patient 1 week before the final correction to determine whether an implant is needed, and if so, what type and size.

Continued

Clinical Caveats—cont'd

Biologic Meshes

Biologic meshes are useful adjuncts in primary cases in which the breast parenchyma and skin are very stretched out.

Mesh is invaluable in revisional cases of augmentation mastopexy where the breast parenchyma is lacking.

The correction must be good while the patient is still on the operating table, because there will be very little settling over time.

Ideally, a “lamellar” structure will be created to coapt acellular dermal matrix to vascularized tissue, such as a skin flap and/or breast parenchyma.

These matrices must be drained to avoid seroma and to enhance the revascularization and incorporation of the matrix.

The greatest drawback is the cost of acellular dermal matrix.

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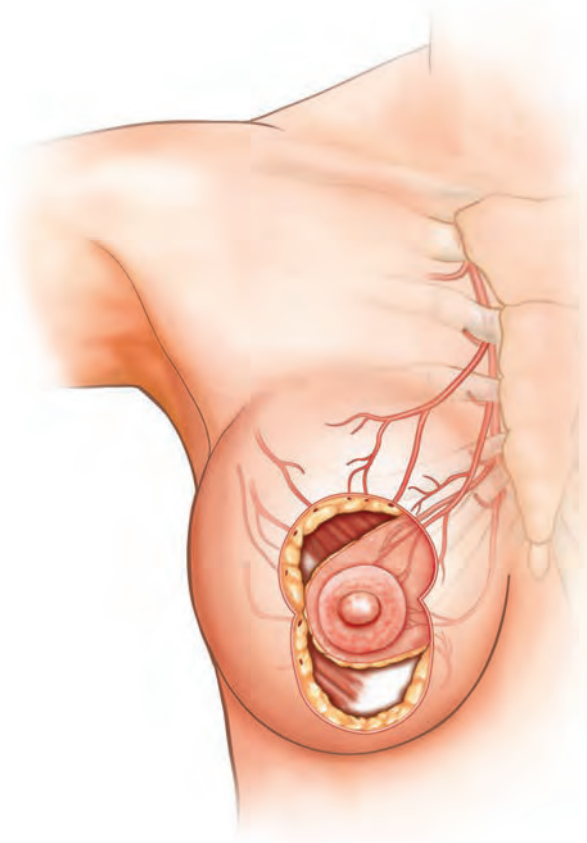
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CHAPTER 68

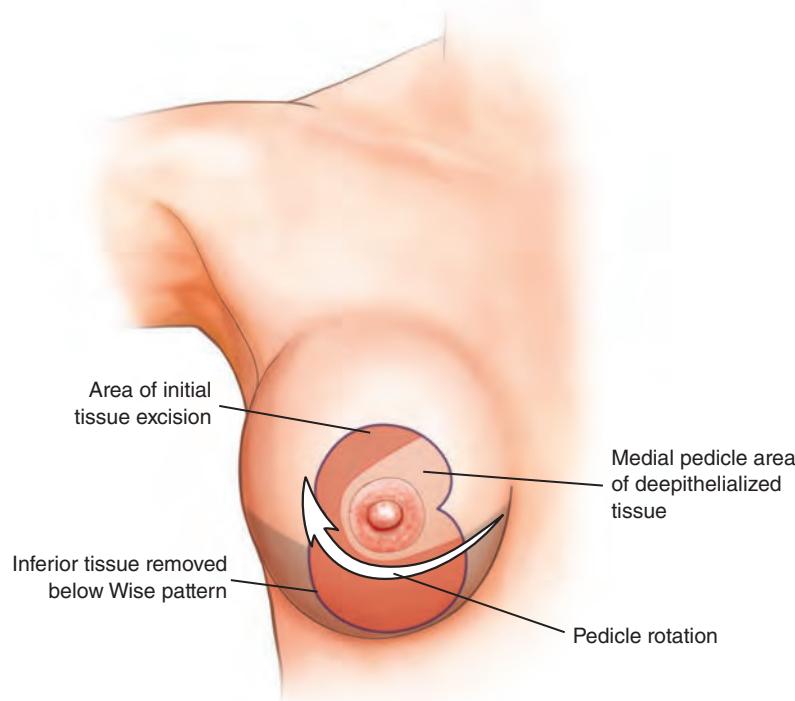


Breast Reduction: *The Medial Pedicle Technique*

ELIZABETH J. HALL-FINDLAY

The key to the medial pedicle vertical breast reduction technique is less about creating shorter scars than it is about understanding its fundamental concepts. Most inverted-T breast reduction approaches remove a horizontal ellipse of skin and breast tissue that when closed leaves medial and lateral dog-ears. Most vertical approaches remove a vertical ellipse of skin and breast tissue and when closed leave superior and inferior dog-ears. Removal of an inferior vertical wedge of breast tissue allows the surgeon to not only narrow and cone the breast but also to remove the heavy inferior breast tissue, leaving behind the superior breast tissue.

There are multiple vertical approaches and numerous pedicle choices. I prefer the medial pedicle because it has a good blood supply, the pedicle rotates easily into position without kinking or compression, and the retained sensation is equivalent to that of the other available pedicle approaches. The inferior border of the medial pedicle becomes the medial pillar so that, as it rotates into position, it leaves an elegant curve to the lower pole of the breast.



It is essential to understand that the medial pedicle vertical breast reduction uses the Wise pattern as a good breast (brassiere) design for the pattern of the parenchyma that should be left behind rather than for what should be removed. Once the vertical wedge is removed and the breast is coned, all breast tissue inferior to the Wise pattern is removed either directly or with liposuction. The skin is then allowed to re-drape over the newly shaped breast mound.

The belief that surgeons must choose between scars and shape is not true. The medial pedicle vertical breast reduction not only results in reduced scars but also maintains a good, long-lasting breast shape. The surgery takes less time, blood loss is less, and

the recovery is faster. In my experience, the incidence of complications is also significantly lower with vertical breast reductions than with inverted-T inferior pedicle breast reductions. There are more pucker revisions with the vertical approach, but that is partly a function of being easily able to perform a revision and the surgeon's threshold for revision. Many patients who undergo inverted-T procedures are told that the lateral and medial dog-ears cannot be corrected, and this makes the revision rate low.

Evolution of Technique

When I first tried vertical breast reduction techniques in 1993, I could see that there was a definite improvement in shape, but I had problems with the superior pedicle; it could be difficult to inset, and I did not understand the blood supply. I thought it would be better as a full-thickness pedicle, but in fact, it is safer and less likely to be compressed when it is thinned. The problem with thinning the superior pedicle is that it leaves an empty space underneath, which tends to leave a concave inferior pole for a few weeks after surgery. The medial pedicle is easy to inset, and the shape of the breast while the patient is still on the operating table is quite good.

I then tried a lateral pedicle, because I thought it would have the best chance of retaining good sensation, but again, I did not really understand the anatomy. The problem with the lateral pedicle is that the tissue that forms the base of the pedicle is exactly the same tissue that needs to be removed to produce a good reduction and an aesthetic breast contour. I could see that the medial pedicle gave a better shape, but I was also surprised that the medial pedicle produced excellent recovery of sensation.



In this patient a lateral pedicle was used on her right side and a medial pedicle on the left. She had good return of sensation in both breasts. The problem with the lateral pedicle is that the base of the pedicle prevents good resection of the excess lateral breast tissue.

Advantages and Disadvantages

The advantages are in the reduced scarring and better shape, and when surgeons realize that *they do not need any tension on the skin closure*, the wound-healing problems and complications are dramatically reduced.

Another advantage is that the concept of the medial pedicle and vertical parenchymal resection can be used in much larger breast reductions, even when an inverted-T skin resection pattern is needed to reduce the redundant skin. Skin does not need to be removed as often as surgeons think, but some patients have far too much skin, or too much skin of poor quality. The advantages of the medial pedicle with the inferior resection can still be preserved, even when the final closure has increased scarring with a T, J, or an L.

The disadvantage of the medial pedicle vertical breast reduction is that inevitably nipple necrosis will occur in some cases. I believe that there are four main arterial supplies to the breast, and sometimes only three of the four are dominant. We cannot determine preoperatively which pedicle will be safe. I believe that nipple necrosis is inevitable in a large-volume practice, and it is more likely to be a statistical occurrence rather than a result of bad surgery.

Indications and Contraindications

The best candidates for a medial pedicle vertical breast reduction are young, healthy women who need a small- to moderate-sized breast reduction. There is more of a learning curve for the larger reductions, but the method is still excellent. However, there is a point at which an inverted-T skin resection pattern will be needed, but this point is not nearly as early as some surgeons envision.

The best results in all breast reductions are achieved in women who are not overweight; the cosmetic result is not as good in heavy or obese patients. In some very large-breasted women, any of the pedicles chosen will be long. Theoretically, the blood supply stretches with the breast as it grows and becomes ptotic, but the reality is that nipple necrosis is more likely with the longer pedicles. The other problem

with excessively long pedicles is their sheer volume, which limits the size of the reduction and increases the weight of the breast in the lower pole. This extra weight can be sutured up onto the chest wall, but it will tend to bottom out with time.

Some patients who have large breasts, good nipple position, and a large proportion of fat to gland may be better candidates for liposuction-only breast reduction (see Chapter 71).

Patient Profiles



This patient is young and healthy, and close to her ideal body weight. She needed a moderate-sized breast reduction and was a good candidate for a medial pedicle vertical breast reduction, which was especially fortunate, because she turned out to be a bad scar former.



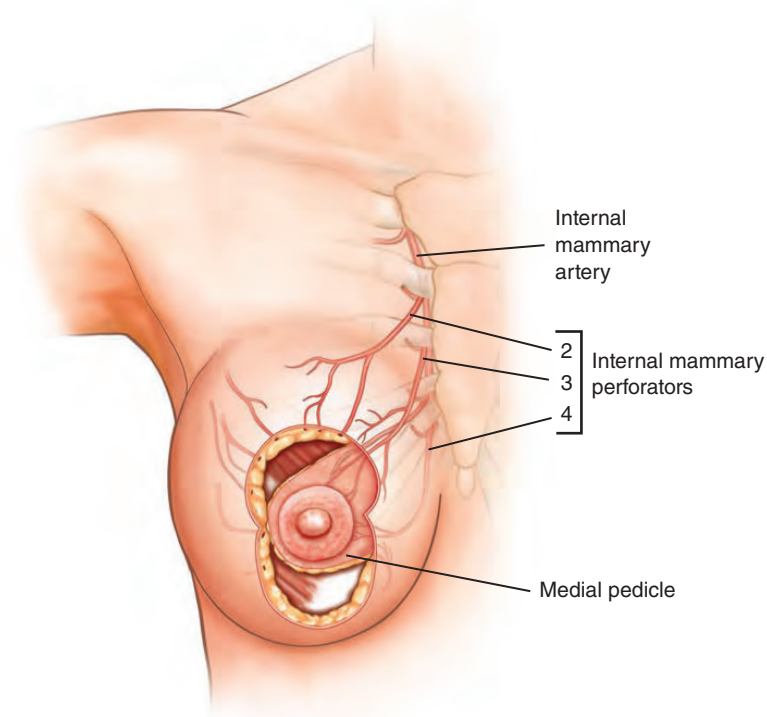
This older woman is a less than an ideal candidate because she has very large breasts, and her cosmetic result will not be ideal, because she is not close to her ideal weight. A further reduction might be indicated to reduce some of the volume that still exists in the lower pole.

Pertinent Anatomy

Blood Supply

The blood supply to the breast is mainly superficial; the arteries and veins are in the subcutaneous tissue that was pushed outward as the breast developed. The breast is a skin-derived subcutaneous structure that is attached loosely to the skin (and firmly at the nipple). It is only very loosely “attached” to the chest wall. These attachments are easily swept away with a finger during a subglandular breast augmentation. The breast is held in place by fascial condensations inferiorly (the inframammary fold) and medially (over the sternum). These act much like the gluteal fold and the sacrum. The breast moves easily over the chest wall, is quite mobile, and is not held in place either superiorly or laterally.

When a woman lies on her side, the upper breast folds over the sternum medially and the lower breast slides out. Only the lower breast border (inframammary fold) and the medial breast border are relatively fixed structures holding the breast in place.



The artery to a superior pedicle comes (usually) from the second intercostal space; it descends and enters the nipple area just medial to breast meridian and is always about 1 cm deep to the skin. It bleeds with significant force when cut during creation of a medial pedicle; it can be traced with a pencil Doppler preoperatively. The artery to the medial pedicle also comes from the internal mammary system (usually from the third intercostal space); it curves around the sternum, penetrates the pectoralis, and is pushed outward with the subcutaneous tissue.

The deep system then comes from the fourth intercostal space and enters the posterior aspect of the breast as it perforates the intercostal muscles and the pectoralis. It enters the breast just medial to the breast meridian. It has accompanying venae comitantes, and these vessels are all cut when a medial pedicle vertical breast reduction is performed. It is this artery (and branches) and veins that are enclosed in the septum described by Würinger et al. This is the blood supply to an inferior or central pedicle.

The fifth and sixth intercostal arteries from the internal mammary system also enter the breast just above the inframammary fold and add extra security to an inferior pedicle. Many of these lower vessels are cut during creation of a central pedicle.

The only other blood supply is the superficial branch of the lateral thoracic artery; it can be seen curling around the pectoralis and entering the lateral aspect of the breast. It supplies a lateral pedicle.

It is interesting that the veins do not accompany the arteries except for the deep perforator; they can be seen just under the dermis and drain mainly superomedially. That is why I no longer infiltrate my incision lines—I kept hitting veins and causing small subcutaneous hematomas.

Innervation

Although the main innervation to the nipple may come from the lateral branch of the fourth intercostal nerve, there is no question that good innervation comes from all four quadrants of the breast. It appears that all the pedicles—lateral, medial, superior, inferior, and central—all have fairly equivalent sensation. I tell my patients that about 85% of patients will recover normal to near-normal nipple sensation. However, they are all warned that they may lose feeling completely in the nipples.

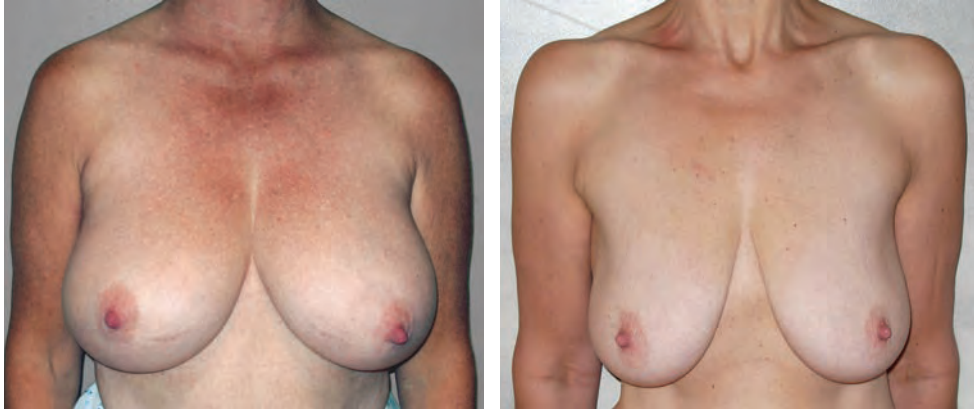
Most of the glandular breast tissue is concentrated deep to the nipple-areola complex and laterally in the upper-outer quadrant. The medial aspect of the breast has some glandular tissue but a higher proportion of fat.

Preoperative Assessment

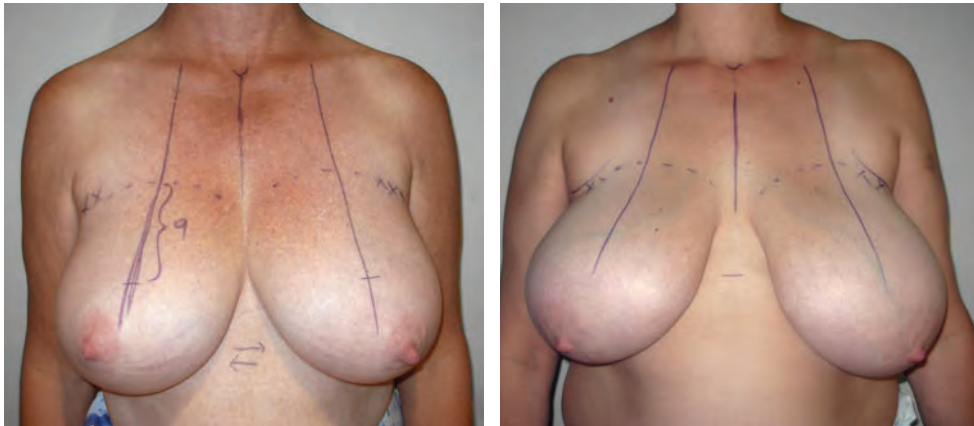
A key ingredient to a successful breast reduction operation is patient education. I have a detailed handout to give to patients; the contents are reinforced with a DVD and a group PowerPoint session. It is essential to make patients understand what can and cannot be achieved. I make certain that patients comprehend the concept of *high-breasted* and *low-breasted* and that I cannot surgically change the breast footprint, or where the breast sits on the chest wall.

I find that taking photographs during the consultation and marking them for the patient is very helpful. I can show the patient where her upper breast border is and reinforce that I cannot change it. I also draw on the lateral view to show her that she will still have some ptosis; I warn all patients that they will still be able to hold at

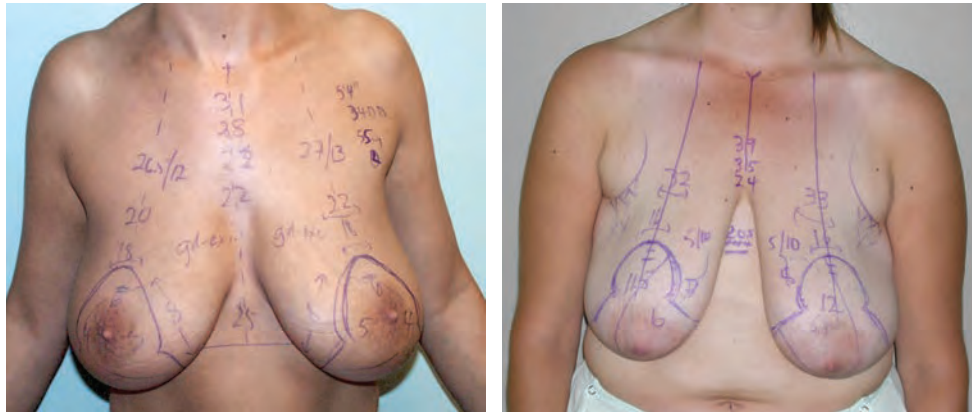
least one pencil underneath the breast. I can only change the lateral and inferior excess along with narrowing the base diameter. Patients often think that they have no upper pole fullness because they see their breasts as “flat,” but then I can show them with the pinch test and the drawing that they can get more projection (or perkiness) with a medial pedicle vertical breast reduction.



The patient on the left is high-breasted, with good upper pole fullness; the patient on the right is low-breasted, with poor upper pole fullness. Not only do both patients require different surgical approaches, but also they need to have very different expectations.



The patient on the left has a high upper breast border but a low inframammary fold level. She has a high breast footprint, but it is long vertically. The patient on the right has a high upper breast border and a high inframammary fold level. She has a high breast footprint, but the footprint is relatively short vertically.

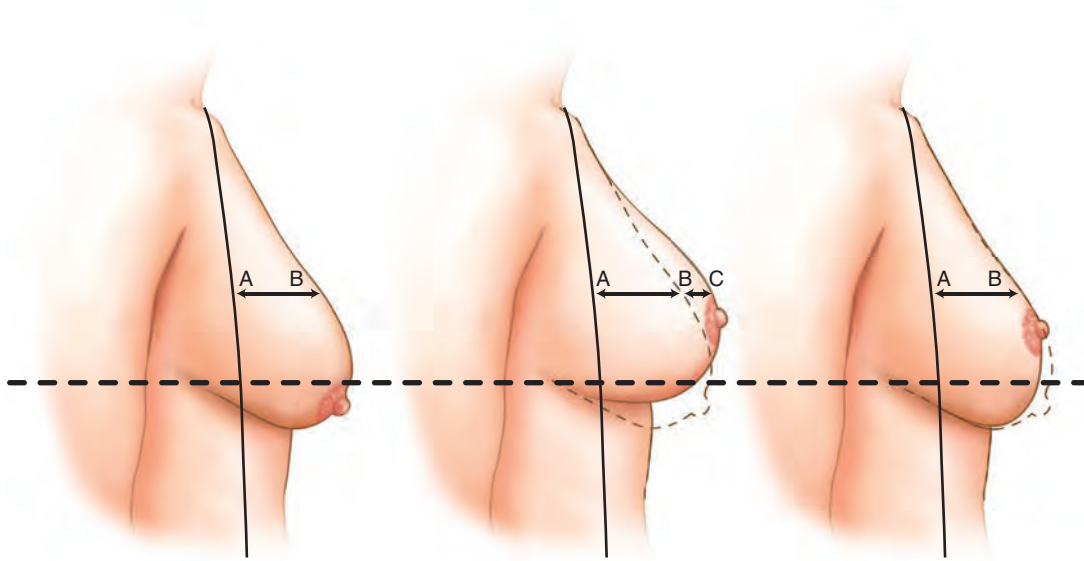


The patient on the left has a very low upper breast border and an inframammary fold level that is actually below her elbow crease. She has a low breast footprint that is long vertically. The patient on the right has a very low upper breast border but a very high inframammary fold level. She has a low breast footprint that is actually very short vertically. (Not all numbers shown on these patients are necessary for surgical marking; some are done for preoperative and postoperative measurement for later assessment purposes.)

My examination consists of assessing the breast footprint—the upper, lateral, medial, and inferior breast borders—and then the third dimension—how the breast sits on that footprint. Does the patient have good upper pole fullness? If so, a better cosmetic result can be achieved. If a patient has a great deal of ptosis and a poor upper pole, it will be futile to try to push the excess inferior breast tissue into the upper pole, because it will just drop down again. I can visualize how long the pedicle might be and whether I need to warn the patient about a possible free nipple graft (very rare). I assess the skin quality and skin excess and again determine whether I need to warn the patient that I might need to add a “hockey stick” to their vertical scar.



The results in these two patients will be very different with any type of breast reduction. The patient on the left not only has a high breast footprint, but she also has excellent upper pole fullness. The patient on the right has a low breast footprint and very poor upper pole fullness. Any attempt to push tissue into the upper pole is doomed to failure over time.

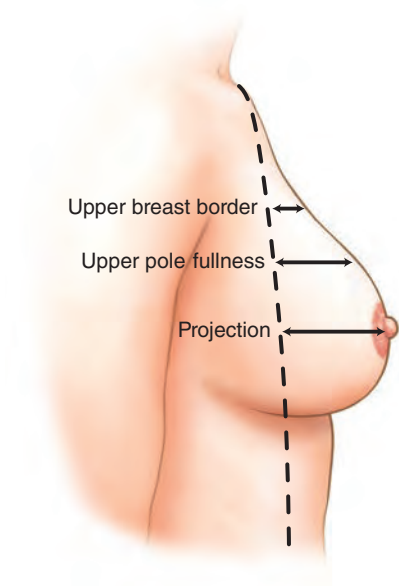


It is important to decide preoperatively how much tissue will need to be removed. Any attempt to push *AB* out to *C* will inevitably result in the loss of *BC* and will cause bottoming out.



The problem of bottoming out is illustrated in this patient. Although the nipple was clearly placed too high, there is still too much tissue in the lower pole. This example of bottoming out is the fault of the surgeon (me)—not the procedure. A patient like this provides the surgeon with a very difficult challenge.

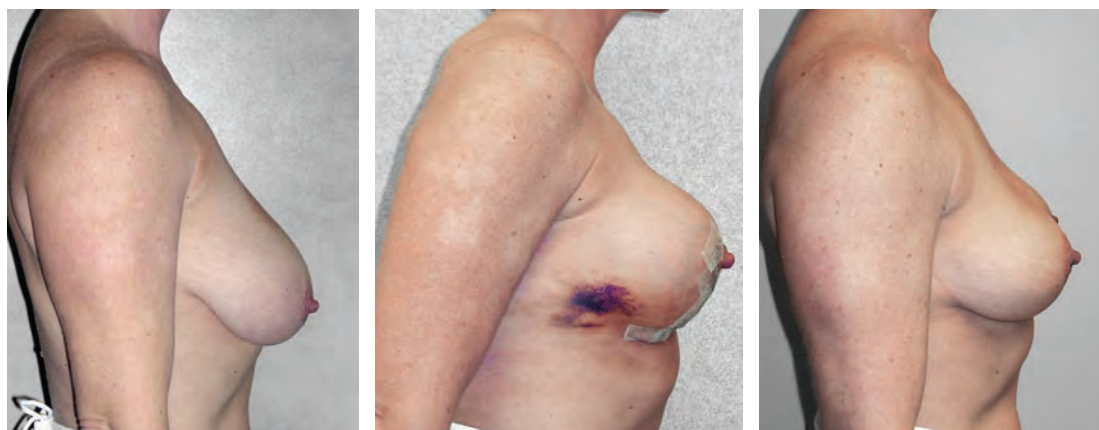
Although it is tempting to elevate the upper pole of the breast and suture the breast tissue up to the chest wall to elevate the upper breast border or to achieve more upper pole fullness, results will be disappointing.



It is important to understand some definitions. The *upper breast border* is at the junction of the chest wall and the breast. Sometimes this is well demarcated, and sometimes it is a gentle slope. *Projection* is the measurement from the chest wall to the anteriormost projecting part of the breast. This is where the nipple is ideally situated.



The upper breast border is clearly demarcated in this patient. Although projection is definitely improved, there is no improvement in upper pole fullness or elevation of the upper breast border.



This patient shows that the initial improvement in upper pole fullness achieved by suturing breast tissue up to the chest wall is lost over time.

I tried elevating the upper breast tissue and suturing it higher on the chest wall in 77 patients. I used absorbable 3-0 PDS in 43 patients and nonabsorbable 3-0 Ticron in 34 patients. In the 72 patients who returned for follow-up, none of the initial improvement lasted for more than 5 months. The upper breast border remained unchanged, and the upper pole dropped back to its original position. Projection, on the other hand, was definitely improved.

Improvement in upper pole fullness can occasionally be obtained by using the method popularized by Ruth Graf (see Chapter 72). This takes the inferior wedge of breast tissue that is normally removed in a breast reduction and uses it as a chest wall-based flap that is held in place by a strip of pectoralis muscle. Using this vertical wedge as a flap was originally described by Liacyr Ribeiro, and it is a good method for rearranging the breast tissue in a mastopexy. The pectoralis loop is effective at holding the wedge of breast tissue higher on the chest wall, and it definitely improves projection and can help fill the upper pole to some degree.

I also warn patients that I often cannot make their breast as small as either of us would like. I cannot achieve as significant a reduction with the vertical approaches as I could when I performed inverted-T inferior pedicle reductions. The photographs taken during the consultation are also useful for pointing out any asymmetries and warning patients that symmetry is a goal but impossible to achieve. Patients are also warned that breasts will change with time, gravity, pregnancy, weight gain, and weight loss.

Teenagers are well aware that their breasts might grow as they continue to develop and that a re-reduction might be indicated. I think that this is far better for many teenagers than having them suffer until they are older, because they tend to withdraw and stop participating in sports and other activities if their breasts are large. As long as the teenager understands the procedure and its limitations, I am fully prepared to perform the surgery when it is physically indicated. The same applies to older patients. It is not age that matters; it is the health and the psychological maturity of the patient.

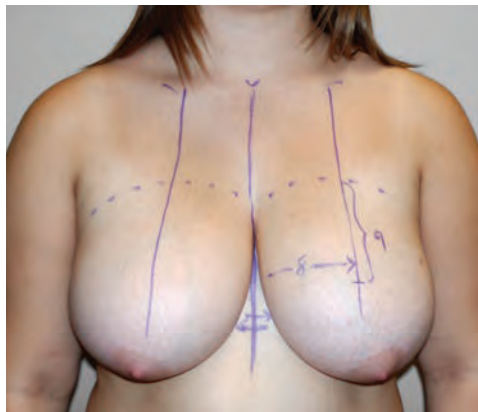
Preoperative Planning

Much of preoperative planning consists of patient education. A preoperatively informed patient is a surgeon's best ally.

Markings

Upper Breast Border and Inframammary Fold

I start by marking the upper breast border (the junction of the chest wall and the breast). This is sometimes a very clear demarcation, and sometimes it is less well defined. The upper breast border is often at the top of any striae that may be present. I then mark the inframammary fold.



I have marked the upper breast border of this patient with a dashed line. She is high-breasted, with good upper pole fullness. The lowest point of her inframammary fold is marked on the midline of the chest wall, with the right fold being slightly higher than the left. The breast meridian is marked where it is expected to be once the reduction is completed.

Ideal Breast Meridian

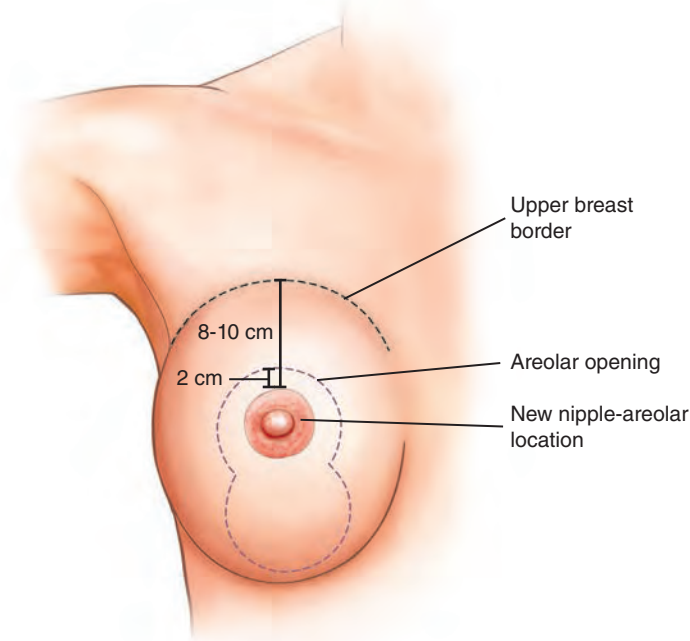
The breast meridian should be marked at its ideal or desired position, not at its existing position. Sometimes the nipples are too medial, and sometimes they are too lateral. It is best to err on the side of placing the meridian slightly lateral to a line that would bisect the resulting breast after the reduction is performed. More of the lateral breast tissue can be removed with the medial pedicle vertical breast reduction, so the line can be placed slightly more medially than one would in an inverted-T breast reduction. It does not matter where the line starts at the clavicle, but it should be at the midline of the breast at the level of the new nipple position. This will usually be about 8 to 10 cm from the midline of the chest wall.



In the patient on the left, the new meridian does coincide with the existing meridian. In the patient in the middle, the existing meridian would be too medial. In the patient on the right, the existing meridian would be too lateral.

The surgeon should place the new meridian just lateral to the line bisecting the resulting breast, because nipples placed too medially look odd. On the other hand, the medial pedicle vertical breast reduction removes more of the lateral breast and narrows the breast cone better than the inverted-T procedures, and the meridian can be drawn a bit more medially than in an inverted-T reduction.

New Nipple Position



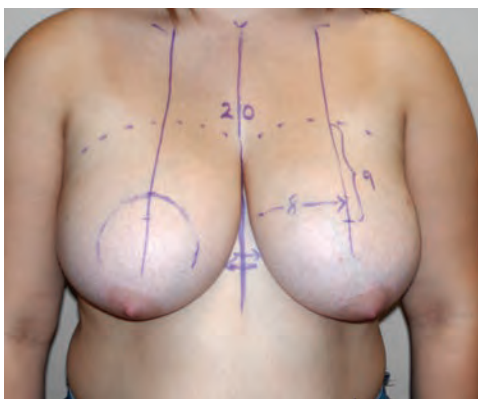
The new nipple position should be on the new breast meridian, about 8 to 10 cm below the upper breast border. The surgeon should position the nipple too low rather than too high, because a nipple placed too high is almost impossible to lower post-operatively, but it is easy to elevate a nipple that has been placed too low. It is better

to mark the new nipple position in relation to the upper breast border rather than to the inframammary fold. The fold itself is a good landmark in many patients, but it can be misleading in about 15% of patients.

Marking the new nipple at an arbitrary distance from the inframammary fold or the clavicle will also result in problems, especially in low-breasted patients. In the illustration on p. 2457, the new nipple position has been marked higher than the inframammary fold because the woman is high-breasted and has good upper pole fullness. The surgeon should be careful to lower the nipple position in a patient with very poor upper pole fullness. It is difficult to lower a nipple that has been placed too high.

Areolar Opening

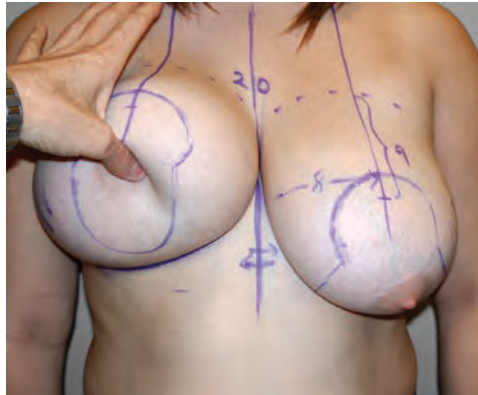
The top of the areolar opening should then be marked about 2 cm above the new nipple position. Most areolae are designed to result in a diameter of about 4 to 5 cm. The areolar opening can easily be drawn freehand and then pinched at the bottom to make certain that it forms a circle when closed.



Care should be taken to ensure that the areolar-opening markings match from one side to the other.

Skin Resection Pattern

The skin resection pattern follows the vertical lines that would be used in an inverted-T Wise pattern breast reduction. Instead of carrying the vertical limbs laterally and medially, once 5 cm is reached, they are joined together well above the inframammary fold.

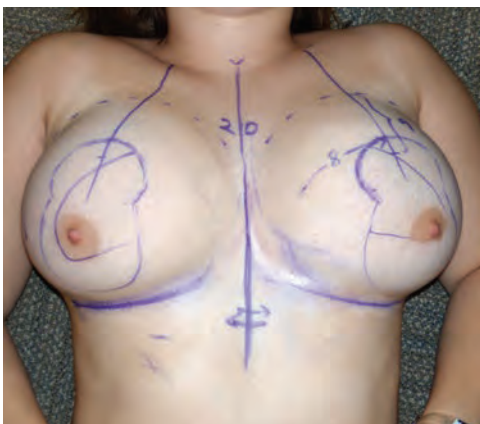


These lines will match up with the breast and chest wall meridians when the breast is rotated medially and laterally. The surgeon can pinch the lines together to make certain that not too much skin is being removed. Since a medial pedicle vertical breast reduction does not use the skin as a brassiere and tension on the skin closure only causes wound healing problems, it is better to be conservative with the skin resection pattern and not take too much skin.

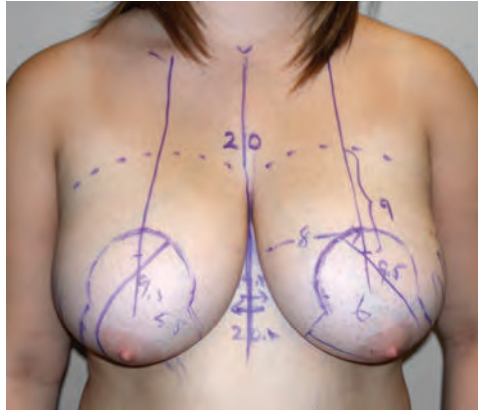
The lines need to be joined at least 2 to 4 cm above the inframammary fold. This is not only because closure of an ellipse lengthens the scar but also because the inframammary fold often rises. If the lines are brought down to the fold, the scar will inevitably end up on the chest wall. It is also important to make the skin resection pattern as a U rather than a V. It may be tempting to create a V, because it may seem to avoid a pucker more easily, but in fact the opposite can occur—a postoperative pucker is more likely to be the result of excess subcutaneous tissue rather than skin. It is more difficult to remove enough of the inferior subcutaneous tissue when a V is designed.

Medially Based Pedicle

The medially based pedicle is best drawn with half of the base in the areolar opening and half on the vertical limb. The inferior border of the medial pedicle will become the medial pillar. The base of the medial pedicle is usually about 6 to 10 cm.

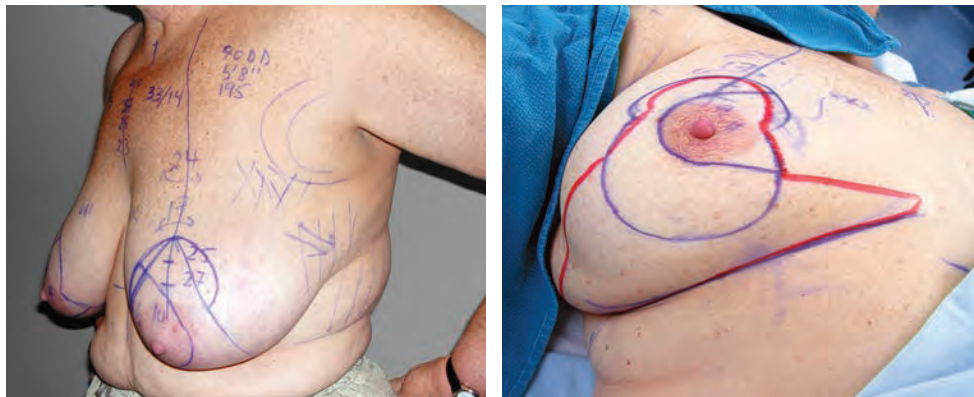


It is wise to try to incorporate one of the veins that are visible through the skin in the base of the pedicle, especially when the pedicle is long. A true “superomedial” pedicle can be designed to take advantage of the descending artery from the second interspace. It usually enters the areolar opening just medial to the breast meridian, but it will be missed in this patient. This patient has a very short pedicle so a pure medial pedicle can be used. A pure medial pedicle is often called a superomedial pedicle, because it looks that way when a patient stands up.



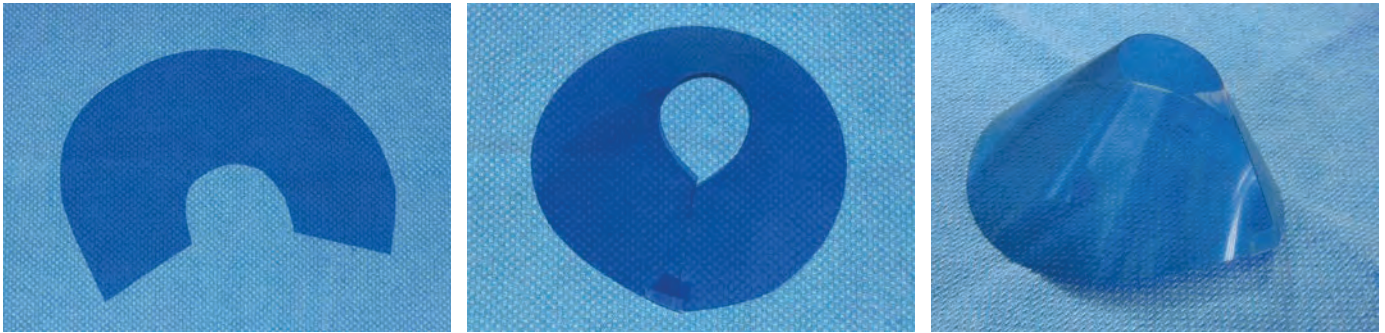
A true superomedial pedicle has a base that crosses and extends slightly lateral to the breast meridian. This will make the pedicle more difficult to inset, but because the blood supply is superficial, the surgeon is free to debulk the area deep to the breast meridian if the pedicle is stiff or difficult to inset. This maneuver can preserve the descending artery that normally supplies a superior pedicle.

Areas to Be Liposuctioned



Any areas past the breast borders that are to be liposuctioned are then marked. A different patient is shown above with the lateral chest wall areas and preaxillary areas marked for liposuction. The indented area just below the preaxillary fullness is marked with X's as an area to avoid resection either directly or with liposuction.

This shows difference between the vertical markings in blue (which resemble a snowman) and the Wise pattern inverted-T red markings. Although the nipple should actually be placed lower in a vertical approach (to accommodate the increased projection), the markings are clearly fairly similar. I will remove all parenchyma (except the medial pedicle) below the red lines, but I will only remove the skin within the blue lines. The idea is to leave parenchyma attached to the skin above the red lines, leaving behind the Wise pattern.



The Wise pattern is a good design for what should be left behind. The skin does not usually need to be removed in the same pattern, but it can be allowed to redrape over the new breast shape. The skin is not used as a brassiere, so closure does not need to be tight.

The Wise pattern, once brought together, nicely cones the remaining breast tissue. The surgeon should keep this shape in mind when performing the resection. It is a good design for what should be left behind.



These images show how the surgeon can visualize what will be left behind and how the shape is coned with an inferior vertical wedge resection when the medial and lateral pillars are brought together. Everything beyond the Wise pattern is removed either directly or with liposuction.



The crosshatched areas shown are where liposuction is to be performed.

Operative Technique

Positioning

The patient is placed supine on the operating table with the arms angled outward. For surgeons who wish to position the patient upright at the end of the procedure, the arms should be carefully wrapped and the patient positioned on the table so that her back can go up in the right position.

Infiltration

I no longer infiltrate the incision lines, because I want to preserve any veins that are found just below the dermis. I infiltrate the areas to be suctioned with either a tumescent type of fluid (1 L Ringer's lactate with 1 ml of 1:1000 epinephrine and 20 ml of 2% plain lidocaine) or lidocaine with epinephrine (20 ml of 1% lidocaine with 1:200,000 epinephrine diluted with 60 ml of saline solution). I use approximately 300 to 500 ml of tumescent fluid per side, or about 40 ml of the lidocaine with epinephrine per side. Most of the infiltrate is placed in the lateral chest wall, preaxillary areas, and just above the inframammary fold. These are the areas where most of the liposuction is performed.

Pedicle Creation

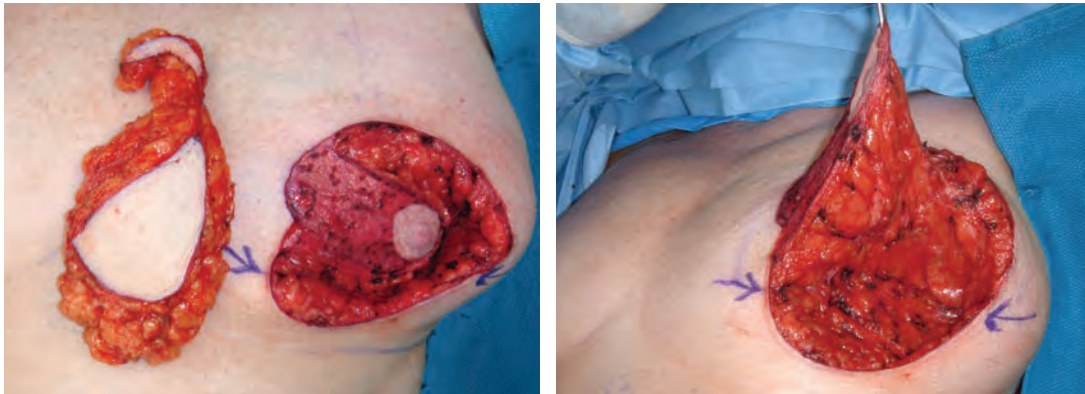
The pedicle is deepithelialized in the usual fashion by placing a lap pad around the base of the breast and holding it with a Kocher clamp. This puts the skin under tension and allows it to be removed more easily. The medial pedicle is much easier to deepithelialize than an inferior pedicle. A cuff of tissue is left around the new areola using the Schwartzman maneuver.



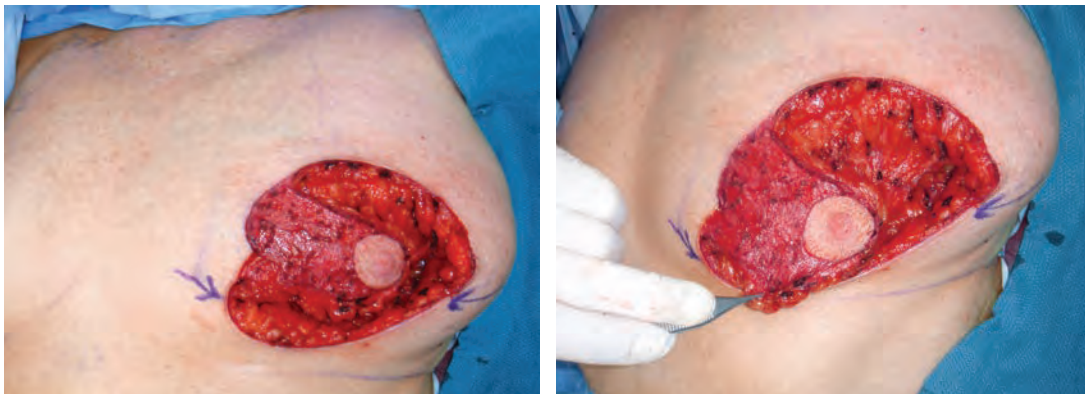
Even when the nipple is high and contained within the areolar opening, I still prefer a medially based pedicle. This not only allows me better access to the excess lateral breast tissue but it also maintains the elegant curve to the lower pole of the breast because the inferior border of the medial pedicle becomes the medial pillar.

The pedicle is then cut straight down to chest wall to create a full thickness pedicle. The blood supply is superficial but keeping it full thickness allows preservation of sensation and ductal tissue.

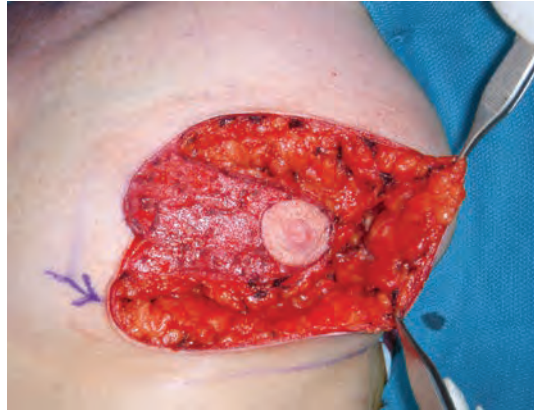
Parenchymal Resection



The pedicle creation and parenchymal resection are performed together, with the pedicle remaining full thickness and the resection being performed en bloc. The arrows above show the lower limits of the pillars. The left arrow shows the inferior border of the medial pedicle, which, when rotated up, becomes the medial pillar. Both pillars will be about 7 cm long in an ideal C cup breast.



Because the pedicle will tend to be thin at the distal end (not because it is actually thinned, but it will appear to be thinned much like an inferior pedicle), it is important to leave a small platform of tissue superiorly and laterally to help prevent post-operative areolar retraction. However, this tissue cannot be pushed up into the upper pole to try to increase upper pole fullness, because it will drop back down again.



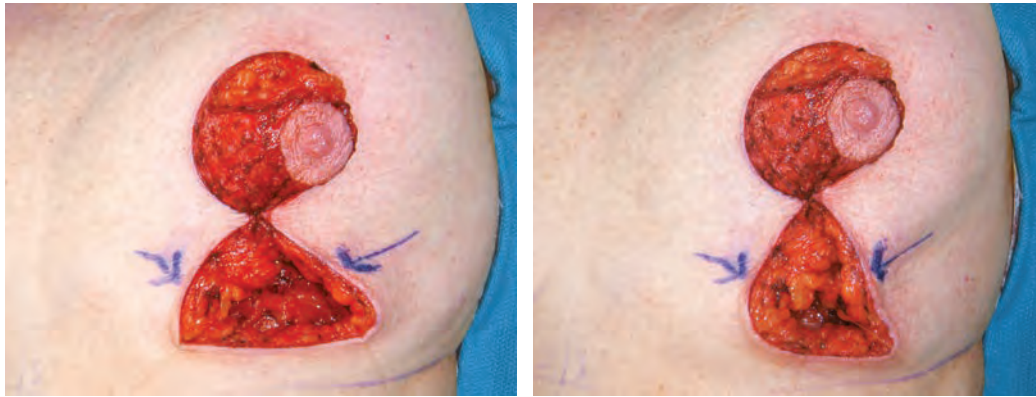
The breast tissue is removed laterally by beveling out the resection after leaving behind a 2 cm lateral pillar that is about 7 cm long. The parenchyma beyond that is then removed by beveling out under the lateral flap and removing tissue parallel to the chest wall. If the patient has very thick glandular breast tissue (many teenagers, for example), this tissue must actually be carefully carved out, making certain not to leave any ridges behind. Breasts that have a higher fat content will be more forgiving. It is often difficult to make breasts small enough when using a medial pedicle vertical breast reduction, and it is this lateral breast tissue that needs to be more extensively resected.



It is important to remove all breast tissue below the Wise pattern and this includes removing tissue by undermining down to the inframammary fold. I find it easiest to grasp this extra tissue with a Kocher clamp and then resect it. It is important to leave enough fat on the dermis so that postoperative scar contracture does not occur. Tissue is removed all along the inframammary fold both medially and laterally. Some of this tissue is quite fibrous and will need to be directly excised. It can be complemented with liposuction, which is usually performed after closure of the pillars and the deep dermis.



With the resection complete, it can be seen that the pectoralis fascia is not exposed. The pedicle is being held up by a skin hook. Exposure of the pectoralis muscle can not only cause more bleeding but it can also damage some of the nerves that supply the nipple. The deep branch of the lateral fourth intercostal nerve travels just above the pectoralis fascia and then turns up toward the nipple at the breast meridian. The surgeon should exercise care not to damage the pectoralis fascia and keep the pedicle full thickness to preserve this nerve.

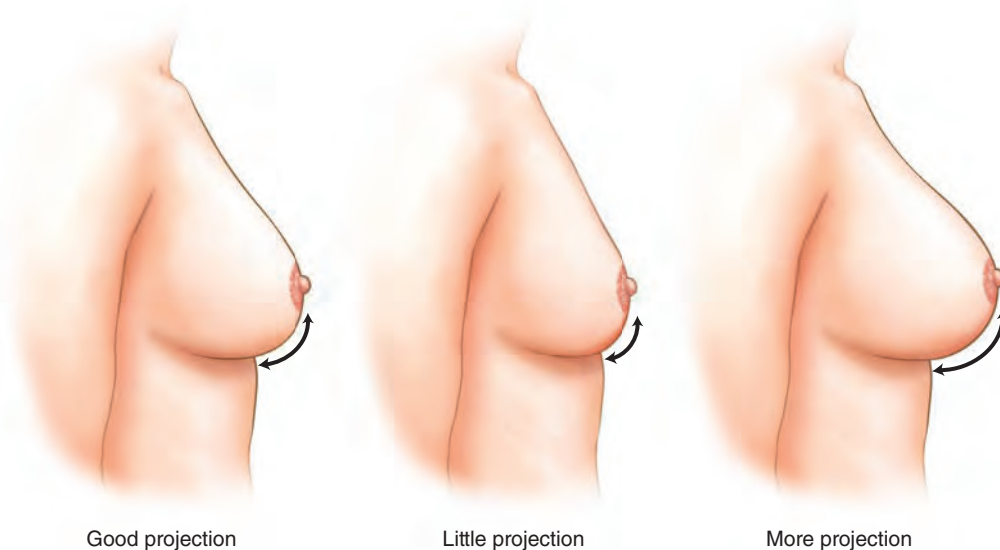


The arrows in these photos show the inferior aspect of both pillars. It can be seen that the inferior border of the medial pedicle becomes the medial pillar. The pillar sutures start at the level of the arrows about 1 or 2 cm deep to the skin. I use 3-0 Monocryl to close the pillars; only about three or four sutures are used. It is not necessary, and in fact is contraindicated, to try to mobilize lateral tissue and close it under tension. The pillar closure should have very little tension. The pedicle can be pulled up during closure to make certain that the pillar can be better visualized. It might be advisable to suture extra long pedicles to breast tissue to help hold them there while healing occurs. Large, deep bites are not necessary; pedicle sutures are only needed so that fibrous-type tissue can heal to fibrous-type tissue.



The deep dermis is closed and then liposuction is performed in the areas marked. It is easier to close the deep dermis first to provide some resistance when performing the liposuction. The breast that remains behind has a Wise-pattern shape.

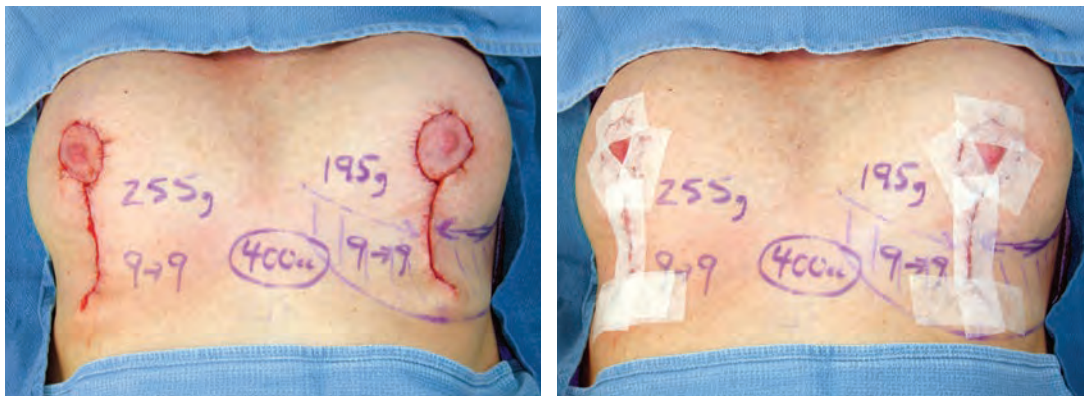
The areola is closed with four interrupted deep dermal sutures. The areola is sutured into place in the position in which it seems to sit the most easily without any kinking. Both the deep dermis and the subcuticular closure are completed using 3-0 Monocryl. The vertical incision is not gathered. When vertical breast reduction was initially introduced, it was thought that the vertical incision could and should be kept short by cinching up the closure. This did not work, however, because the incisions stretched back out (and if they didn't, they required revision). Not only did it not work, but the extra length is actually necessary to accommodate the extra projection that is achieved with a vertical approach. A B cup breast will have a vertical length (from the lower edge of the areola to the inframammary fold) of about 7 cm, a C cup breast will have a length of about 9 cm, and a D cup breast about 11 cm.



This illustration demonstrates how a longer vertical length from the bottom of the areola to the inframammary fold is actually desirable. A 5 cm vertical length results in a flattened breast with very little projection.



In these photographs it is evident that the vertical length is longer with larger breasts and that vertical length is needed to accommodate projection. The skin is not sutured to breast tissue, and the skin pucker is not sutured down to the chest wall; this would just delay resolution of the shape.



This patient had 255 g removed from her right breast and 195 g from her left breast. Liposuction volume was 400 cc. The vertical incisions measured 9 cm before closure and 9 cm after closure. The incisions were not cinched or gathered and the skin is not tacked down to either chest wall or breast parenchyma. The incisions were then covered with Micropore paper tape. Drains are rarely used. Patients are allowed to shower the next day, and the tape remains in place for 3 to 4 weeks.

Postoperative Care

Patients are placed in a noncompressing brassiere to provide support for about 2 weeks. They are not required to wear the brassiere, but most patients will wear some form of support for 2 to 3 weeks night and day. Patients are encouraged to shower the next day, and the paper tape forms a good cover and bandage. The tape is actually difficult to remove before 3 to 4 weeks, and it is easier to remove dry than in the shower.

Most patients understand that it takes about 1 to 2 weeks to get back to normal activities and 3 to 4 weeks to resume sporting activities. They can walk during the first week or so to remain fit, and they can walk uphill if they want to maintain an aerobic training level. They are advised to start with the stationary bicycle and then with time to progress to jogging. They can use lower-body weights initially, but they should hold off on upper-body weights for a few weeks. Patients are not restricted in their arm movement or in driving.

Problems

It is important to avoid any tension on the breast tissue or on the skin. Tension on the skin causes wound-healing problems, and tension on the breast parenchyma causes eventual loss of contour.

The most significant problem with a medial pedicle vertical breast reduction is the inability to make breasts as small as we would like. None of the breast reduction techniques can elevate the breast footprint and none of them can elevate the upper breast border. It can be difficult to achieve symmetry.

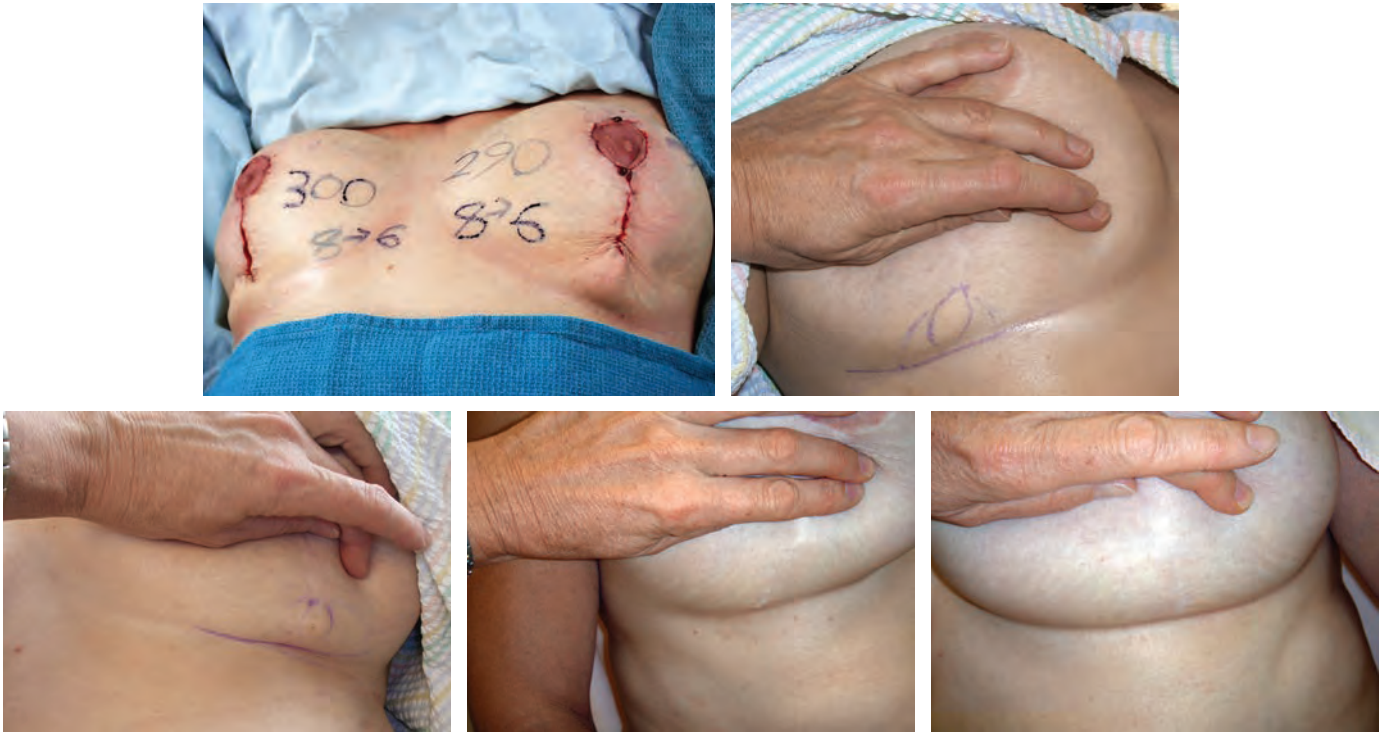
The most common reasons for revision are for correction of an inferior breast pucker, re-reduction, and correction of asymmetry. The most common complications are hematoma, seroma, infection, wound-healing problems, dehiscence, fat necrosis, and nipple necrosis.

Revisions

Correction of an Inferior Breast Pucker

It is not necessarily the case that puckers are more common with the vertical approach but they are easier to correct than the medial and lateral puckers that occur with an inverted-T procedure. Puckers can be prevented by adding a T, a J, or an L at the time of the initial surgery, but de Mey and colleagues noted that adding a T did not necessarily lower the revision rate. It is not always easy to design a T or to know exactly where to put it.

Puckers occur in many patients' breasts, but the pucker tends to disappear over time as it tucks in. Initially I thought it was best to correct puckers by adding a T incision, but that often adds two new dog-ears to chase. It is usually better to correct a pucker through a vertical skin incision and a horizontal fat excision. Most puckers are actually caused by excess subcutaneous tissue rather than by excess skin.



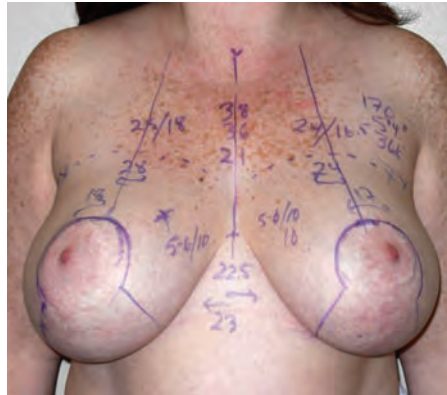
This patient had 300 g removed from the right breast and 290 g from the left breast. Her small puckers were corrected through small vertical elliptical skin excisions and larger horizontal fat excisions, with good results.



The same patient is seen at her 4-year follow-up.

Re-reduction

Re-reduction is not always straightforward. It is important not to remove too much skin. Wider tissue excision can be performed, especially laterally, as in the following patient. Liposuction is an important adjunct to a re-reduction. But often the vertical scar ends up too long, and the surgeon may need to add a J and an L or a T. Unfortunately, sometimes increased problems with dog-ears can be a nuisance.



This patient initially had a vertical breast reduction. She underwent re-reduction surgery, in which 403 g and 290 g were removed, and another 375 cc of liposuction. The vertical incision was too long, and a J and an L were added. It can be seen that this does not always solve the problem, because it adds a new lateral dog-ear to be chased.

Correction of Asymmetry

It is important to lower the new nipple position on the larger side when performing a breast reduction. This lower nipple position will be needed only partly because of the tension on the skin with the increased weight. But this is more of a problem with the vertical approach because closure of a wider inferior ellipse will push the ends further.



For this patient, the new nipple position should have been placed lower on the larger breast. Part of the problem is that the nipple has been pushed up; in addition, not enough inferior breast tissue was resected on the right side.

Complications

Hematoma



This patient came in 2 weeks after surgery with a hematoma. At that stage it was allowed to resolve on its own. This patient had had drains in place, and she was fine the morning after surgery, when the drains were removed. It is assumed that the actual removal of the drain led to some bleeding, which caused the hematoma. Since this instance, I have not used drains routinely.

It is important to know the vascular anatomy of the breast and to seek out any potential bleeders before closure. This is especially important in patients in whom tumescent infiltration has been used. The vessels may be in spasm, only to release later when the epinephrine effect has worn off.

The incidence of hematoma has only been about 1 in 400 patients.

Seroma

Seroma is probably fairly common. I have not aspirated or drained seromas routinely, and they seem to resolve uneventfully. We keep close contact with patients postoperatively, and rarely has a patient reported any spontaneous drainage. Unlike an abdominoplasty, in which a seroma does not have a path to drain, a breast seroma seems to resorb quite well.

Infection

Inevitably, infection will occasionally occur. I was able to reduce not only the incidence of infection in my patients but also the incidence of suture-spitting when I began to order 1 week of antibiotic therapy for all patients. The suture-spitting problem disappeared almost completely. Breasts have multiple ducts exposed to the environment, and I believe that they are not completely “clean.”



As reported by Bratzler and Houck, the National Surgical Infection Project now recommends giving only one intraoperative dose of antibiotics; unfortunately, when I did that, some suture-spitting and low-grade infection occurred, as seen above. The incidence of this problem seems to be reduced by using an antibacterial (triclosan-impregnated) suture (Monocryl Plus) and giving one intraoperative dose of an antibiotic agent. I think that many cases of suture-spitting were caused by low-grade infection.

Wound-Healing Problems



Although infection is one cause of wound-healing problems, I think that many areas of delayed healing are actually areas of too much tension. Wound-healing problems are common in inverted-T procedures at the T junction, and open sores and delayed healing are the most commonly reported problems with inverted-T breast reductions.

Now that I make certain that I avoid any constriction on the skin closure, the incidence of healing problems is extremely low. It is important to close the breast tissue pillars (to avoid fat necrosis) under very little tension and to close the skin (to avoid wound-healing problems) under very little tension.

Dehiscence



This type of wound dehiscence is uncommon and can result from either a low grade infection or more likely a suture failure. It is best not to resuture the area but to let it heal by secondary intention, as shown here.

Fat Necrosis

Fat necrosis tends to occur in the upper pole of the breast, just above the areola. This is most likely caused by some parasitic fat at the end of the pedicle that did not have an adequate blood supply. Although I have encountered a few patients with a firm mass in this area in the first few weeks to months after surgery, these masses have all resolved on their own without requiring any surgical intervention.

Fat necrosis can occur if large, constricting bites of tissue are taken to close the pillars. This is more likely to be a problem if the pillars are closed under tension.

More commonly, fat necrosis occurs in association with nipple necrosis when the blood supply to the pedicle fails.

Nipple Necrosis

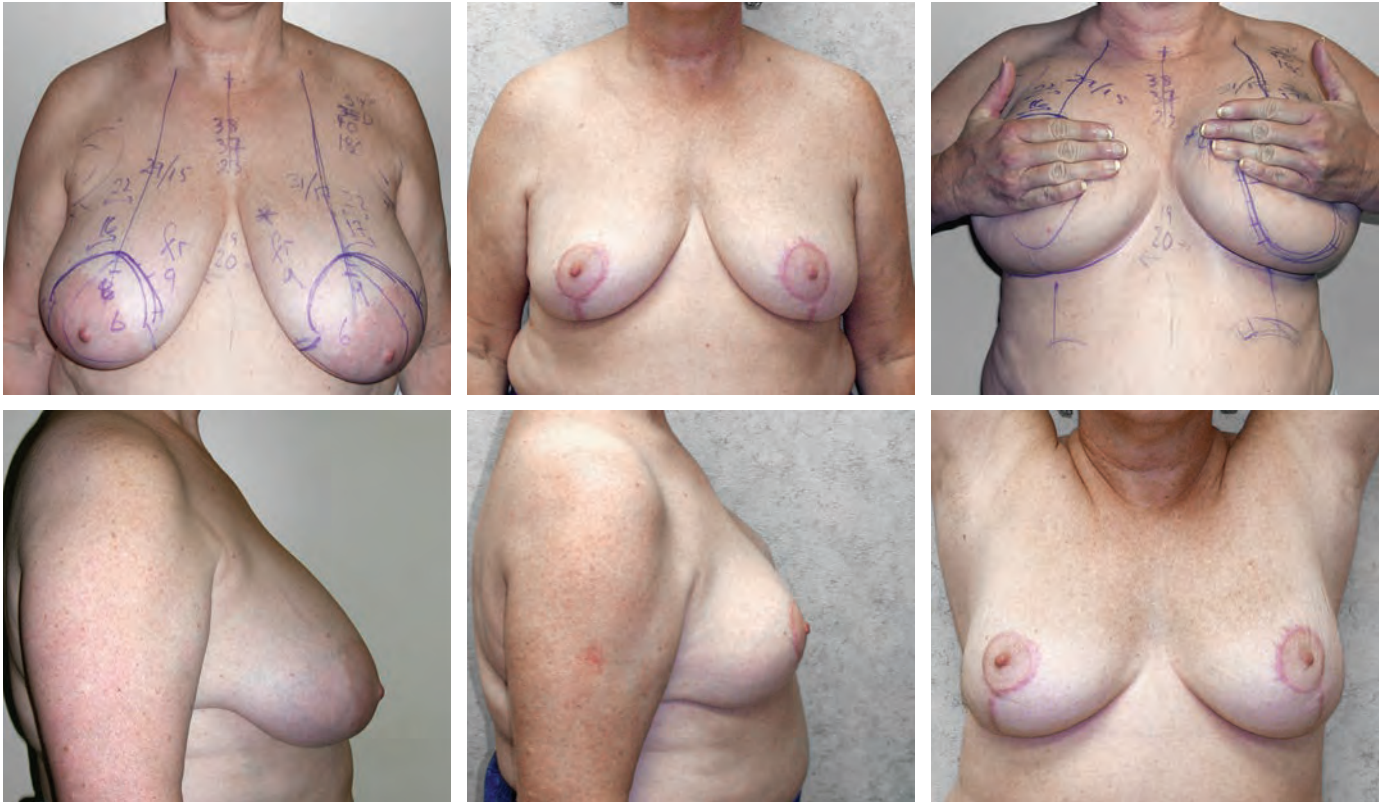


Unfortunately, nipple necrosis can and does occur. This patient had partial nipple and areolar necrosis that healed very well without intervention. The first postoperative photograph shows the patient 4 weeks after surgery, the second at 6 weeks, and the third at 4 months. It is better to wait and see what results rather than debriding the tissue too early.

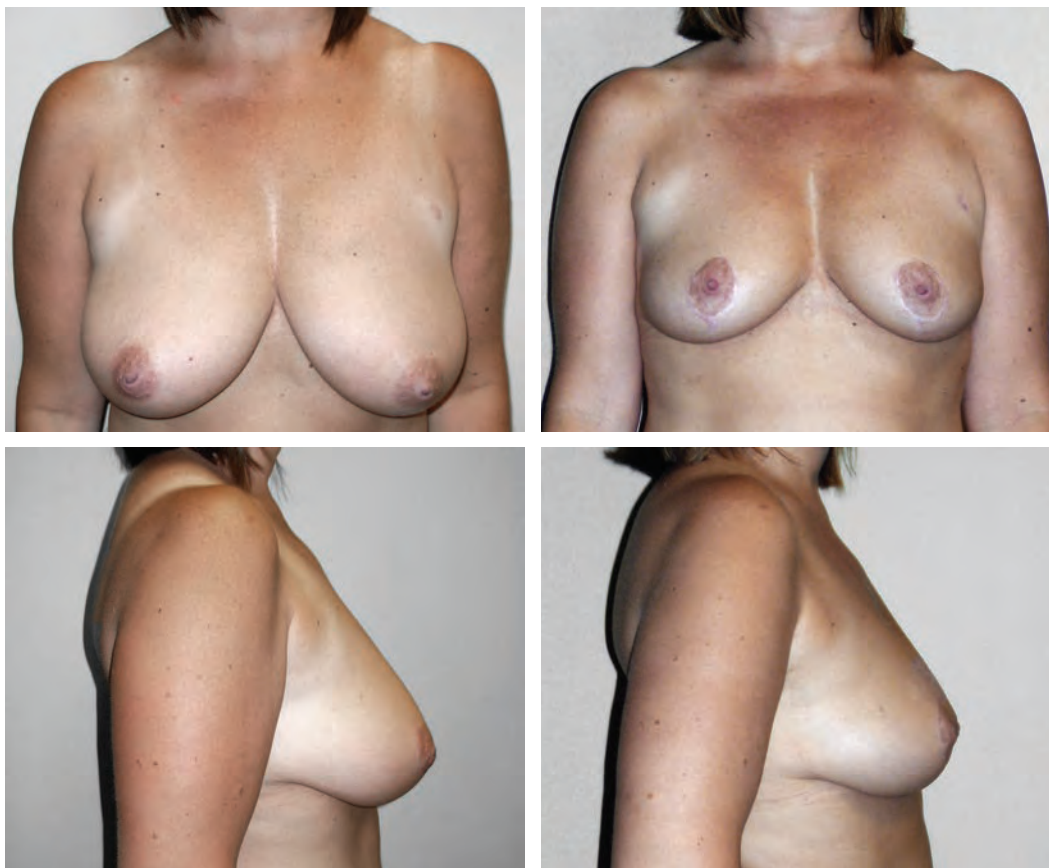
Outcomes

There is no question that all forms of breast reduction result in a significant improvement in back pain, neck pain, shoulder grooving, and even headaches. The rashes under the breasts can be reduced, and patients often report better exercise tolerance and psychological well-being. Patients often concentrate preoperatively on the symptoms, but postoperatively they concentrate on the cosmetic appearance.

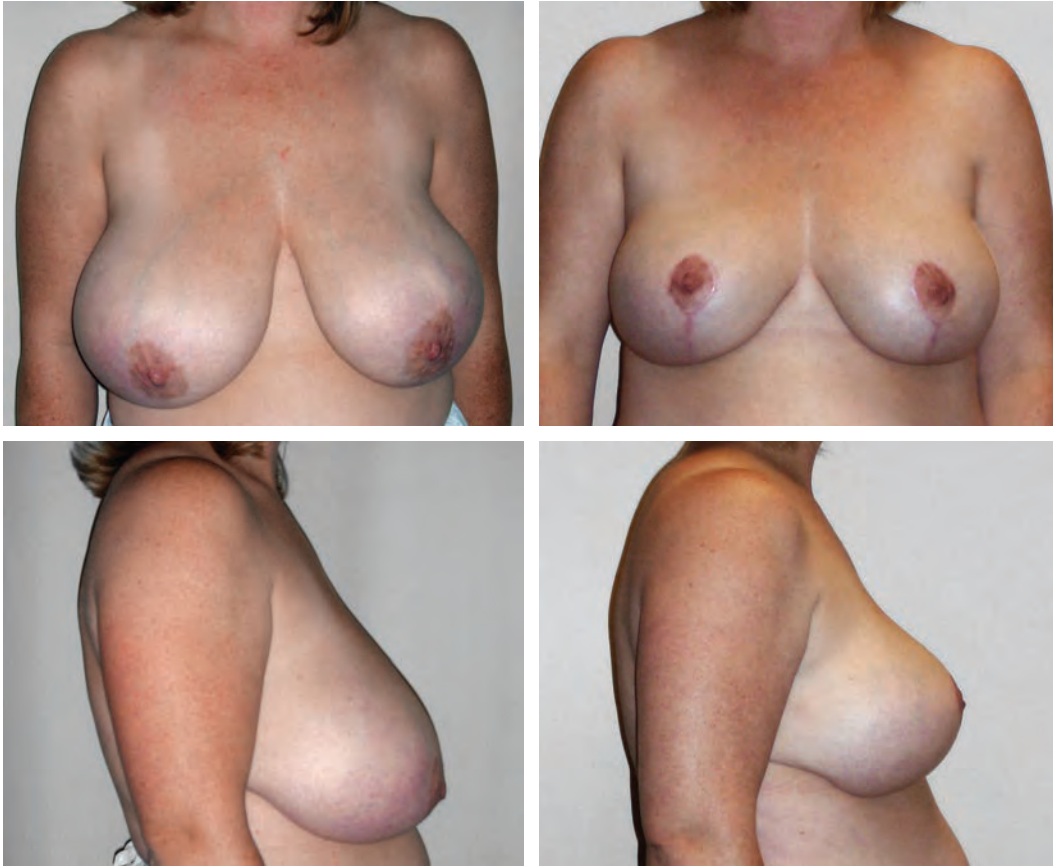
Results



This 59-year-old patient was 5 feet 4 inches tall, weighed 82 kg (180 pounds), and wore a 40 D brassiere. She had a medial pedicle vertical breast reduction in which 430 g was removed from her right breast and 530 g from her left breast. Another 525 cc of liposuction was performed mainly in the lateral chest wall, preaxillary areas, and just above the inframammary fold. She is shown at her 1-year follow-up. The extra preoperative markings were done only for study purposes, and these measurements showed at 1 year postoperatively that the nipple position stayed at the same distance from the suprasternal notch as it was measured to be preoperatively (23 cm). The vertical scars measured 8 and 7 cm, respectively, and the inframammary fold was raised slightly.



This 38-year-old patient was 5 feet 9 inches tall, weighed 79 kg (175 pounds), and wore a 38 D brassiere. She had a medial pedicle vertical breast reduction in which 300 g was removed from the right breast and 320 g from the left breast. Another 300 cc of liposuction was performed in the lateral chest wall, preaxillary areas, and above the inframammary fold. She is shown at her 1-year follow-up.



This patient had a medial pedicle vertical breast reduction in which 800 g was removed from her right breast and 645 g from her left breast. She had an additional 325 cc of liposuction performed in the lateral chest wall and above the inframammary fold. She is shown 9 months after surgery.



This woman had a medial pedicle vertical breast reduction in which 350 g was removed from the right breast and 325 g from the left breast. Another 200 cc of liposuction was performed in the lateral chest wall and above the inframammary fold.

Clinical Caveats

Surgeons should understand the concept of low-breasted and high-breasted.

The medial pedicle vertical breast reduction is not about the scars; it is about the concepts.

A vertical or inverted-T skin resection pattern can be used.

The advantages are a long-lasting shape with good projection.

The surgeon should leave behind parenchyma in a Wise pattern and excise or liposuction all tissue beyond that pattern.

The vertical wedge resection is a key concept: it narrows the breast base, uses parenchymal excision and shaping to maintain the result, removes the heavy inferior pole, and does not rely on the skin as a brassiere.

What is removed in a breast reduction should be moved in a mastopexy.

Patient education is essential to a good result.

Annotated Bibliography

Asplund O, Davies DM. Vertical scar breast reduction with medial flap or glandular transposition of the nipple-areola. *Br J Plast Surg* 49:507-514, 1996.

Vertical scar breast reduction is a well-accepted technique that the authors believe improves the shape and projection of the breast and leaves no horizontal scars. Lassus and Lejour described superiorly based nipple flaps; the authors describe a medially based flap or glandular transposition of the nipple in small reductions.

Berthe JV, Massaut J, Greuse M, et al. The vertical mammoplasty: a reappraisal of the technique and its complications. *Plast Reconstr Surg* 111:2192-2199, 2003.

The authors modified their previous Lejour superior pedicle vertical scar mammoplasty technique by decreasing the skin undermining and avoiding liposuction in the breast. Primary skin excision was performed in the submammary fold at the end of the operation if the skin could not be puckered adequately. However, the technical modifications did not significantly change the rate of secondary scar and volume corrections, which were still necessary in 22% of the operated breasts. In large breasts, the addition of a horizontal scar at the end of the operation did not change the rate of secondary revision, which does compare favorably with the figures obtained with inverted-T superior pedicle mammoplasty.

Corduff N, Taylor GI. Subglandular breast reduction: the evolution of a minimal scar approach to breast reduction. *Plast Reconstr Surg* 113:175-184, 2004.

The authors describe a modification of the breast reduction procedure. By means of an inframammary incision, the breast is mobilized from the chest wall, and a “doughnut” anulus of breast tissue is removed from the undersurface of the gland. No skin is excised. The nipple-areola complex is left attached to a central core of breast tissue that receives its blood supply from the subdermal plexus of vessels. When the resulting defect is closed within the breast by strategically placed sutures, the base of the gland is narrowed, the breast is projected forward, and the circumareolar and vertical scars of other techniques are eliminated.

Hall-Findlay EJ. *Aesthetic Breast Surgery: Concepts & Techniques*. St Louis: Quality Medical Publishing, 2011.

A comprehensive text based on the author’s extensive experience in breast surgery, covering her approach to analysis and technique, which is simple and provides consistent results.

Hall-Findlay EJ. Pedicles in vertical reduction and mastopexy. *Clin Plast Surg* 20:379-391, 2002.

The author, who performed a standard inferior pedicle Wise pattern technique for the first 11 years of her practice and has now used variations of the vertical technique, found that the medial pedicle gives the best breast reduction results in her hands. A lateral pedicle is used for mastopexies so that the inferior and lateral tissue can be rotated up under the areola. When faced with a re-reduction of a previous inferior pedicle, the vertical technique can still be used, and an adaptation of the inferior pedicle can be very acceptable.

Hall-Findlay EJ. A simplified vertical reduction mammoplasty: shortening the learning curve. *Plast Reconstr Surg* 104:748-759; discussion 760-763, 1999.

The author describes modifications to the standard Lejour vertical reduction mammoplasty that simplify the technique and make it more reliable and easier to perform. These modifications include using a medial (or lateral) dermoglandular pedicle, not undermining the skin, using liposuction only rarely to reduce breast volume, and not using pectoralis fascia sutures; the modified technique has been used in a series of 400 vertical breast reductions. In this series, scarring was reduced and the technique was easily learned and applied.

Hammond DC. Short scar periareolar inferior pedicle reduction (SPAIR) mammoplasty. *Plast Reconstr Surg* 103:890-901; discussion 902, 1999.

A method of breast reduction is presented that maintains the blood supply and innervation to the nipple-areola complex by means of an inferior pedicle, reduces the breast volume by removing tissue from the periphery of the breast, maintains breast shape with internal plication sutures, and limits the scar using a periareolar technique with a short inferior vertical-to-oblique extension.

Lassus C. A 30-year experience with vertical mammoplasty. *Plast Reconstr Surg* 97:373-380, 1996.

The author had previously used a vertical mammoplasty without a submammary scar for all breast reductions with a central wedge resection, an upper pedicle for the areola, no undermining, and a vertical scar. However, in large breasts, the inferior portion of the vertical scar showed below the submammary fold. Therefore he added a short horizontal scar, following the dogma of the time that the length of a vertical scar should not exceed 5.5 cm. However, he found that the horizontal scar moved upward. Convinced that it was possible to finish every mammoplasty with a vertical scar, he again modified the procedure to make the vertical scar stay above the inframammary fold in almost all patients. This has proved to be a safe, effective, and long-lasting procedure.

Marchac D, de Olarte G. Reduction mammoplasty and correction of ptosis with a short inframammary scar. *Plast Reconstr Surg* 69:45-55, 1982.

The main sequelae of mammoplasties are scars, particularly visible when they trespass the breast limits. If the new inframammary fold is located higher than the original, the horizontal limb of the T suture can be kept short and hidden beneath the breast. The glandular tissue is split vertically and overlapped for ptosis. For reduction, an inferior resection with medial or lateral remodeling is performed. The results are very satisfactory for ptosis and mild to moderate hypertrophy. High conical breasts with minimal scars are produced.

Palmer JH, Taylor GI. The vascular territories of the anterior chest wall. *Br J Plast Surg* 39:287-299, 1986.

Through a series of fresh cadaver injection, dissection, and radiographic studies, the authors defined the vascular architecture of the anterior chest wall and correlated it to the findings of previous writers in this area. Their findings confirmed that the dominant supply to this region is from the internal thoracic artery, which interconnects in all layers with the posterior intercostals, the lateral thoracic, acromiothoracic, and transverse cervical arteries.

Schlenz I, Kuzbari R, Gruber H, Holle J. The sensitivity of the nipple-areola complex: an anatomic study. *Plast Reconstr Surg* 105:905-909, 2000.

Although preservation of the sensitivity of the nipple and areola is an important goal in breast surgery, only scant and contradictory information about the course and distribution of the supplying nerves has been found in the literature. The authors dissected 28 female cadaver breasts and found that the nipple and areola were always innervated by the lateral and anterior cutaneous branches of the third, fourth, and fifth intercostal nerves. Their findings suggest that the nerves innervating the nipple and areola are best protected if resections at the base of the breast and skin incisions at the medial areolar border are avoided.

Spector JA, Kleinerman R, Culliford AT IV, et al. The vertical reduction mammoplasty: a prospective analysis of patient outcomes. *Plast Reconstr Surg* 117:374-381; discussion 382-383, 2006.

Although breast reductions based on a Wise pattern incision remain common, patient and surgeon dissatisfaction with this procedure because of unsightly scars and long-term bottoming out of the breast prompted a search for alternative methods of breast reduction. The authors studied patient outcomes after vertical reduction mammoplasty using prospectively collected data from questionnaires. The authors found that vertical reduction mammoplasty resulted in significant improvement in all quality-of-life factors analyzed, including problems in buying clothes and brassieres, and difficulty in playing sports and running.

Würinger E, Mader N, Posch E, Holle J. Nerve and vessel supplying ligamentous suspension of the mammary gland. *Plast Reconstr Surg* 101:1486-1493, 1998.

The authors first described anatomic findings (from 28 breast specimens of female cadavers) showing a thin, horizontal, fibrous septum originating from the pectoral fascia along the level of the fifth rib, heading toward the nipple. This fibrous septum lies between a cranial and a caudal vascular network, and being mesentery-like, is responsible for the supply of the nipple areola complex. The cranial vascular sheet is supplied by the thoracoacromial artery and a branch of the lateral thoracic artery, whereas the caudal sheet is supplied by perforating branches from anastomoses of intercostal arteries. The fibrous septum is also a guiding structure for the main supplying nerve of the nipple. Knowledge of this structure is of value and relevance in clinical applications.

Suggested Readings

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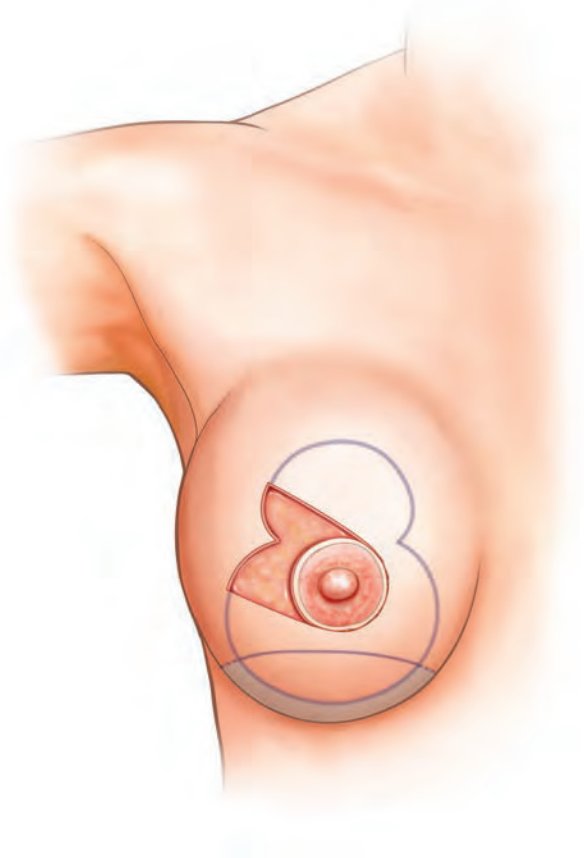
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CHAPTER 69



Breast Reduction: *The Lateral Pedicle Technique*

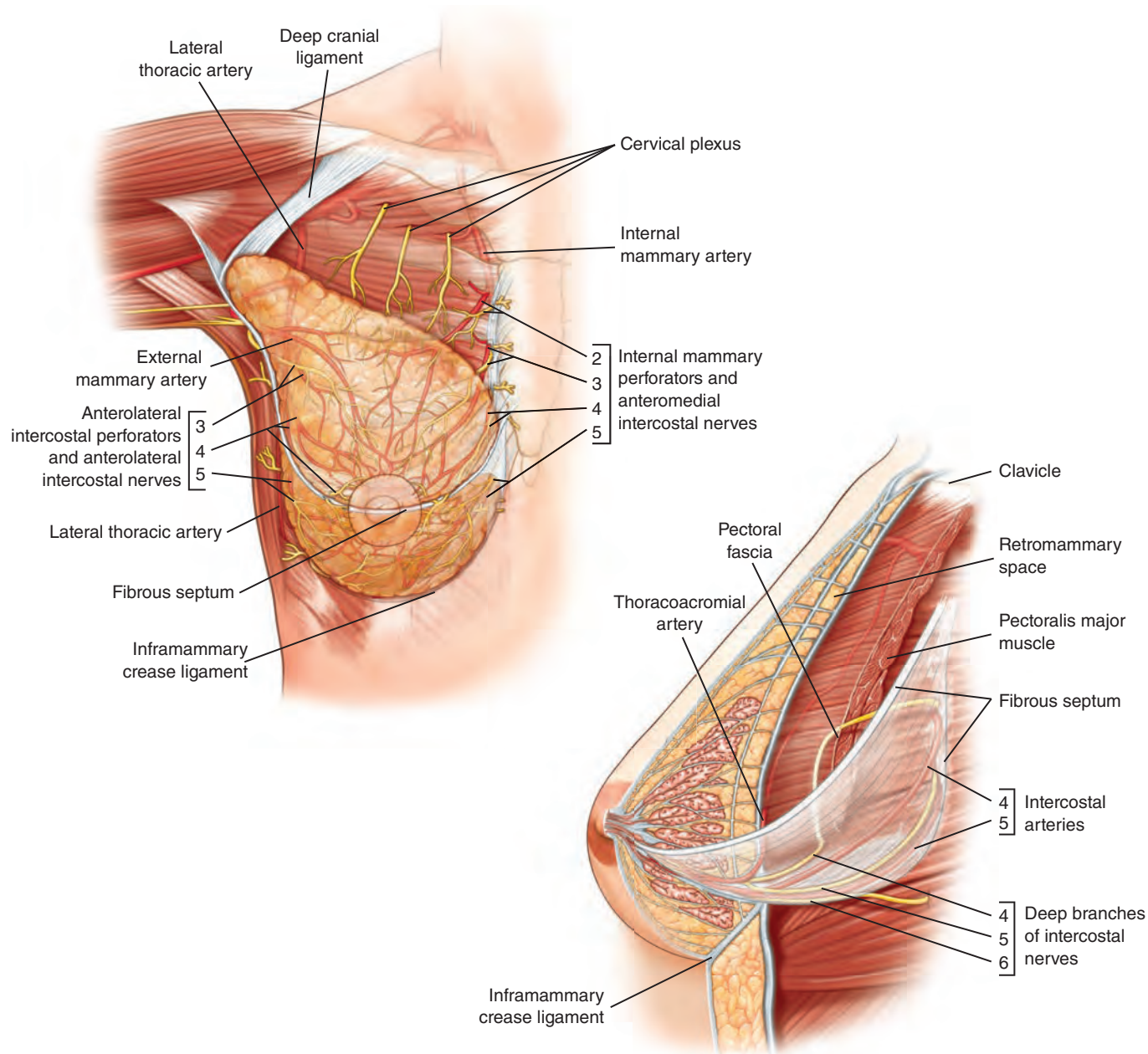
MOUSTAPHA HAMDI, ANNE DANCEY

The multitude of techniques described for reduction mammoplasty pays testament to the lack of consistent results across all patient groups. Good and bad results are often attributed to each specific pedicle, and, as with all surgical procedures, it is this dissatisfaction that drives the pursuit of new and improved techniques. However, it is difficult to assign primary responsibility for complications or unsatisfactory results solely to a certain pedicle type. The global outcome in breast reduction can be attributed to many factors, including skin quality, the patient's age and expectations, the degree of ptosis, and the surgeon's experience. Although a variety of technical refinements have been described over the decades, each breast reduction procedure addresses the following essential elements:

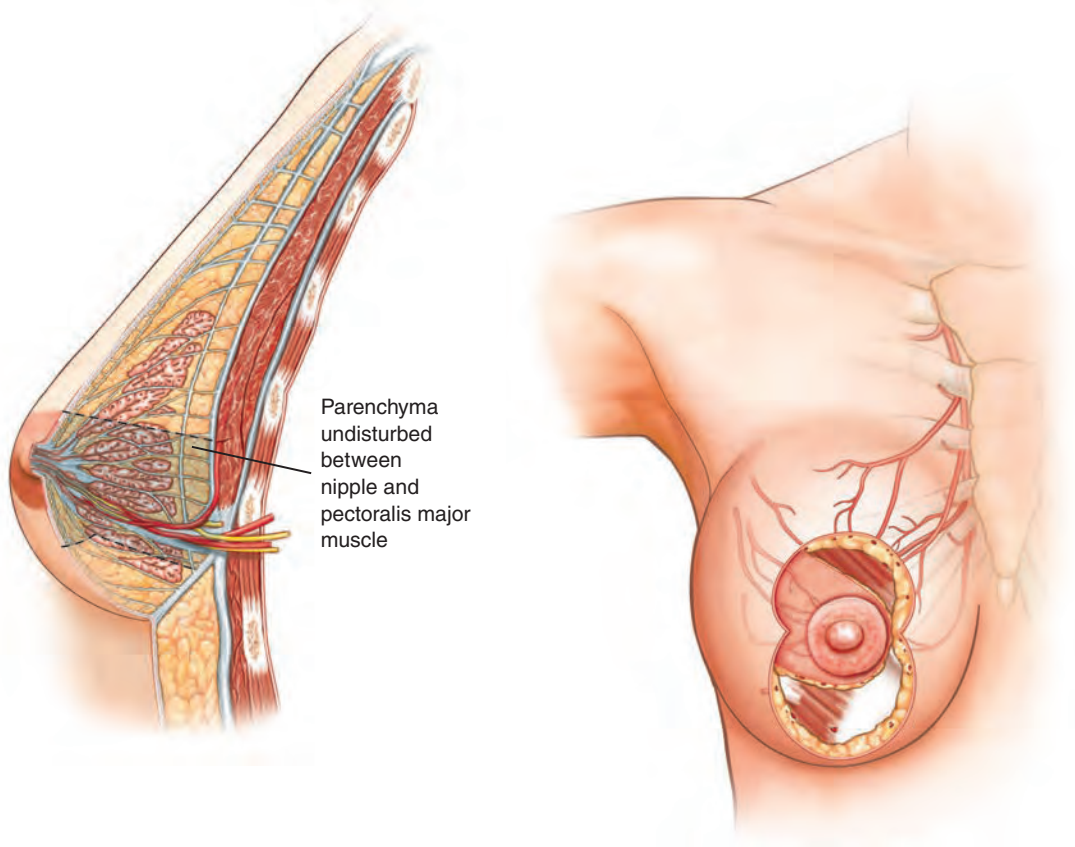
- Preservation of nipple-areola complex blood and nerve supply
- Removal of excess parenchyma
- Excision of redundant skin
- Reshaping of the breast parenchyma
- Redraping of the skin

The vogue has been to create a vertical scar, the superior pedicle technique popularized by Lejour. However, despite good results in the hands of many experienced surgeons, there have been numerous problems with this technique, mainly related to the steep learning curve associated with the method. Nevertheless, the vertical scar mammoplasty remains popular with many surgeons because it provides long-standing aesthetic results with minimal scars. We feel that it is important to consider the vertical technique as a concept rather than as a scar with a specific pedicle. Breast shaping and remodeling are the most important elements of this technique, and they can be modified according to an individual patient's needs.

Skoog is credited with being the first to describe the use of a lateral dermal pedicle breast reduction in 1963. In 1999 Hall-Findlay reported using a lateral or medial dermoglandular pedicle combined with a vertical scar. This produces minimal scarring, and the concept of pedicle rotation avoids kinking of the pedicle and the venous congestion sometimes encountered with the superior pedicle. Hall-Findlay pointed out that there should be no undermining of the pedicle to ensure continuity with the chest wall and maximization of perfusion. This technique was further described by Cárdenas-Camarena and Vergara. Many surgeons still detach the lateral dermal pedicle from the chest wall and maintain a thickness of approximately 2 to 3 cm. Thus resection of glandular tissue occurs in a plane dorsal to the pedicle itself, as well as in the remaining quadrants of the breast. This considerably limits perfusion of the pedicle.



Würinger described a horizontal septum traversing the breast that carries an identifiable neurovascular supply to the nipple-areola complex. The sagittal section of the breast above shows the horizontal septum described by Würinger. With knowledge of functional three-dimensional breast anatomy constantly evolving, we have further modified the previously described techniques to optimize the vascularity of the breast and innervation of the nipple-areola complex. We have called this a *septum-based lateral mammaplasty* (SLM) and consider it to be an evolution of the centro-lateral glandular pedicle. It is this improved vascularization of the nipple-areola complex that is responsible for a significant decrease in early and late postoperative complications in our hands.



Our lateral glandular technique maintains a column of parenchyma between the pectoralis major muscle and the nipple-areola complex at the level of Würinger's septum. Thus continuity is maintained not only with the lateral breast pillar, but also with the chest wall itself, resulting in maximum preservation of perforating vessels.

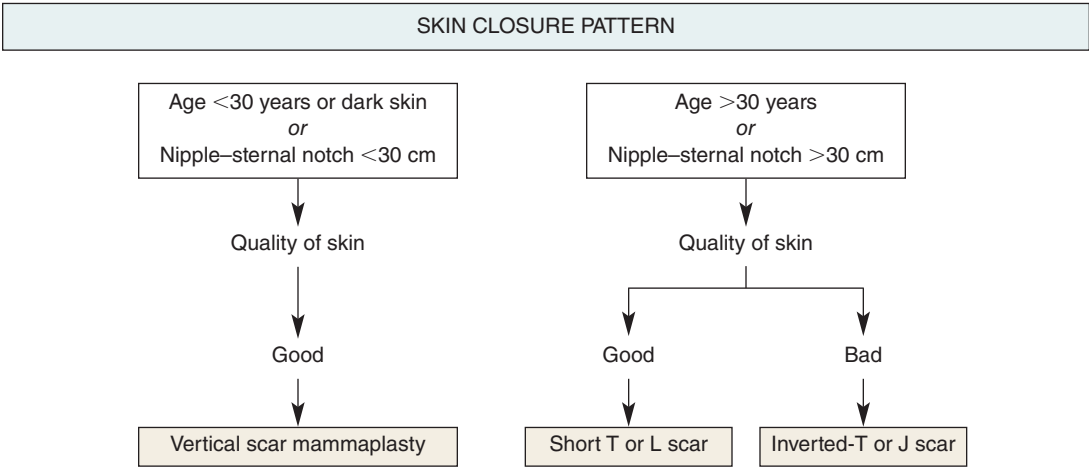
Preserving the ability to lactate is often a fundamental prerequisite for women of reproductive age who intend to undergo a reduction mammoplasty procedure. It is known that sculpture of the pedicle during mammoplasty can influence breast-feeding potential, and therefore it is important to maintain as much continuity as possible between the remaining glandular tissue and the nipple-areola complex. Although to date we have no definitive data on postoperative breast-feeding, we intuitively feel that the SLM procedure retains maximum glandular continuity to maximize the chances of lactating.

Indications and Contraindications

The SLM reduces the infralateral and central parts of the breast, while the nipple-areola complex is centered on the horizontal septum via a lateral pedicle. The choice of pedicle depends on different factors, such as the degree of hypertrophy, the position of the nipple-areola complex, lateral fullness, and the age of the patient. The key to achieving an acceptable result in reduction mammoplasty is flexibility in the choice of pedicle and skin resection. No single procedure can be prescriptive; the surgeon must be able to choose the most appropriate procedure for each patient. In our experience, small reductions or mastopexies are often more suited to the superior pedicle technique.

We think that the SLM is best suited to younger patients, in whom it is paramount to achieve maximum nipple-areola complex sensitivity, continuity of the nipple-areola complex and glandular tissue for breast-feeding, and good projection of the breast mound. By definition, any lateral pedicle technique limits resection from the lateral pillar and axillary areas. This persistent lateral fullness can be a drawback, particularly in obese patients with excess axillary fat in addition to the macromastia. Basing the lateral pedicle over Würinger's septum ensures optimal vascularization of the nipple-areola complex and enables the surgeon to remove more tissue laterally than would be possible with standard lateral pedicle techniques. However, even with this additional perfusion, we recommend a septum-based medial pedicle mammoplasty (SMM) in patients with extreme lateral fullness.

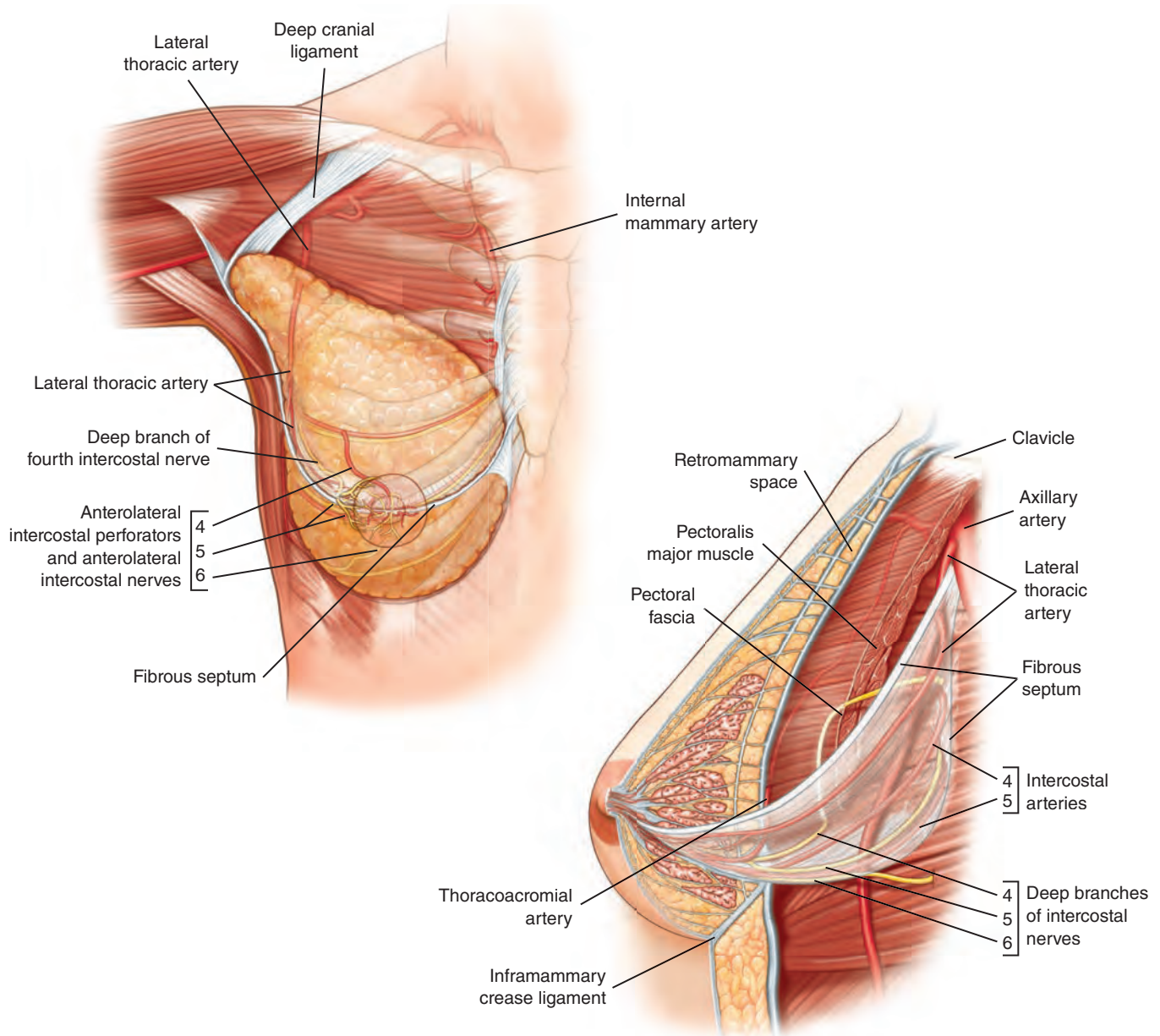
Having a dual blood supply, the lateral pedicle (lateral thoracic artery) and the septum (intercostal arteries), makes nipple-areola vascularization more robust. Therefore the SLM technique is widely indicated for patients with macromastia or major breast ptosis. The transverse circumference of the breast does not increase dramatically with macromastia, in contrast to the vertical circumference. Thus a laterally based technique is likely to have a shorter pedicle length than its superior or inferior counterpart. To date, the senior author (M.H.) has performed resections of up to 2100 g per side with no compromise of nipple perfusion. Thus we have no specific upper resection weight limit, although in cases of extreme gigantomastia, a free nipple graft procedure may need to be considered.



The choice of skin closure pattern is based on the patient’s individual characteristics. This can be better determined perioperatively than during preoperative marking. In general, the vertical scar mammoplasty is selected for young patients (less than 30 years of age), for those with dark skin, or for patients who have nipple-to-sternal notch distances of less than 30 cm with good skin quality. These patients would be expected to have adequate skin retraction and a good cosmetic result from a vertical scar. For older patients, or those with a nipple-to-sternal notch distance of more than 30 cm, an L- or J-shaped scar or a limited inverted-T is used. However, in patients at high risk for hypertrophic scarring, a vertical scar is advised, and the patient is told that a secondary revision procedure will be necessary. Patients who have poor skin quality with associated striae are best suited to an inverted-T procedure.

Although the excellent vascularity of the nipple-areola complex allows this technique to be performed in patients who smoke, we favor techniques that limit skin undermining with direct excision of excess skin. We have found that leeches are not a good option for a congested areola, and an extensive infection can occur, especially in patients with known risk factors. For inexperienced surgeons, we recommend converting any pedicle-based mammoplasty technique to a free nipple-areola complex procedure in high-risk situations, such as a combination of a very long pedicle (more than 15 cm) in patients who smoke or have other vascular or metabolic pathologic conditions.

Pertinent Anatomy



Würinger et al described a ligamentous suspension of the breast containing a horizontal septum that attaches the nipple-areola complex to the thoracic wall at the level of the fifth rib. The septum includes branches and perforators from the intercostal, thoracoacromial and lateral thoracic vessels, as well as the lateral branch of the fourth intercostal nerve. This horizontal fibrous septum is a thin lamina of dense connective tissue that traverses the breast from medial to lateral and extends to the center of the nipple. Thus it divides the gland, including the lactiferous ducts, into cranial and caudal segments. This separation of the glandular tissue is proportionally consistent in all patients, in that hypertrophy of breast tissue appears to occur mainly

in the cranial segment. A laterally based pedicle technique that has its foundation on Würinger's septum will therefore allow resection of the cranial parenchymal excess, thus permitting maximum reduction of the parenchyma while preserving sensation and vascularity. Würinger's description has confirmed the findings of other anatomic studies to further our knowledge of the nerve supply to the nipple-areola complex. The anterior ramus of the lateral branches of the fourth intercostal nerve can take a superficial or deep course toward the nipple-areola complex. In the deeper variation, the nerve runs on the serratus and pectoralis major fascia before penetrating the breast parenchyma after 3 to 5 cm to run obliquely toward the nipple-areola complex. These findings were in accordance with a more recent study by Schlenz and colleagues, who also found that the lateral cutaneous branch of the fourth intercostal nerve supplied the nipple in 93% of breasts by following a deep retromammary course. In the remaining 7%, the anterior cutaneous branches of the third, fourth, and fifth intercostal nerves took a superficial course in the subcutaneous tissue. Thus to ensure that sensation is maintained, it is necessary to include the entire parenchyma surrounding the nerve. In the 2 to 3 cm thick pedicle described in traditional lateral pedicle techniques, sensation will only be preserved in the superficial nerve variant, leaving a percentage of patients with a sensory deficit.

Preoperative Assessment

History

The symptoms of female breast hypertrophy are often related to muscular discomfort. Patients frequently report back pain, neck pain, shoulder discomfort, and occasionally headaches. They often develop poor posture to compensate for the excessive breast weight. Poor hygiene in the submammary crease leads to irritation, rashes, and even skin infections. Shoulder grooves develop over time from the pressure exerted by brassiere straps. However, if the patient does not wear a brassiere, activities and even sleep may be difficult. The excessive breast weight often prevents a woman from participating comfortably in sports and wearing any form of revealing clothing. Typically, once this affects the patient's activities of daily living, she will seek medical attention.

In addition to gathering details on the presenting complaint, it is important to obtain a thorough medical history that specifically includes baseline information about breast cancer risk factors, the patient's menstrual history, and reproductive plans. At this stage it is useful to ask what size breasts she is hoping to achieve.

Physical Examination

Physical examination confirms the diagnosis of breast hypertrophy and attempts to rule out the possibility of breast cancer. It is essential to note the patient's skin type, striae, and any evidence of keloids or hypertrophic scarring from previous surgery or injury. This will affect decisions on the skin closure pattern. A record should be made of the patient's height, weight, and BMI.

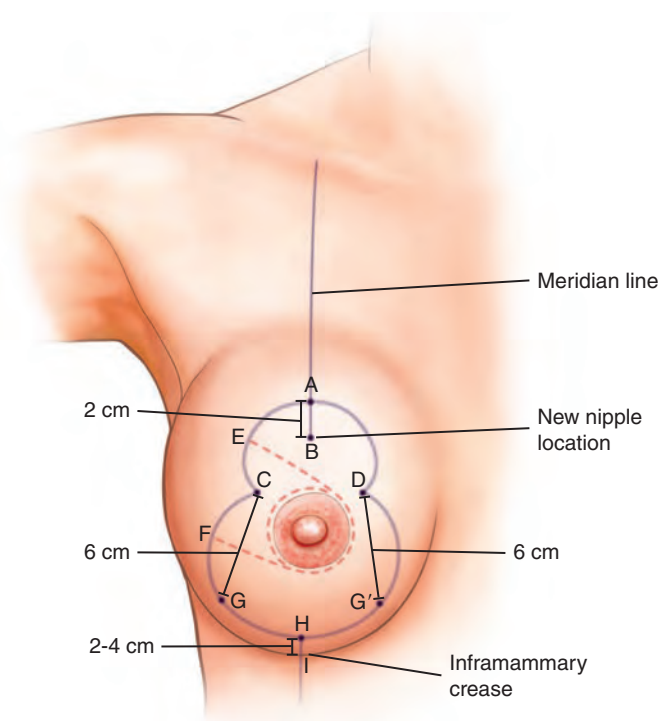
An aesthetic examination of the breasts is typically performed with the patient sitting up or standing with her arms at her sides. Brassiere-strap grooves are assessed for depth and skin breakdown. Intertrigo is assessed by lifting each breast and closely examining the skin for breakdown and rashes. A circumferential evaluation of the muscular and bony thorax is essential. The vertical alignment of the thorax, asymmetry, or differences in shoulder position or muscle mass are noted. The two breasts and their relationship to the chest wall are compared to define any breast asymmetry at an early stage. Excess lateral breast tissue with a poorly defined lateral breast border is particularly noted, because this may disqualify the patient for an SLM. The relative volume and shape of the breasts are compared and recorded. Nipple-to-sternal notch and nipple-to-midline are measured and recorded. The degree of ptosis is assessed from the position of the nipple-areola complex in relation to the rest of the glandular tissue and the inframammary fold.

The breast examination is then repeated with the patient in the recumbent position with her arms by her sides and then elevated over her head. The breasts are assessed for any lumps, masses, scars, skin dimpling, or nipple discharge. Preoperative photographs are taken to document mammary hypertrophy to complete the physical examination.

Recommendations

The consultation includes a discussion of breast size, a review of the patient's expectations, and reinforcement of realistic goals for surgical treatment.

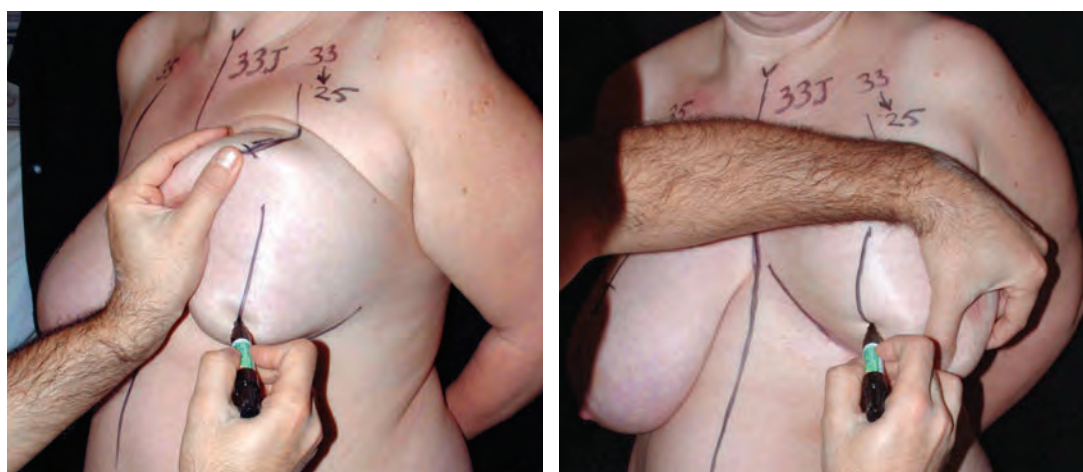
Preoperative Planning



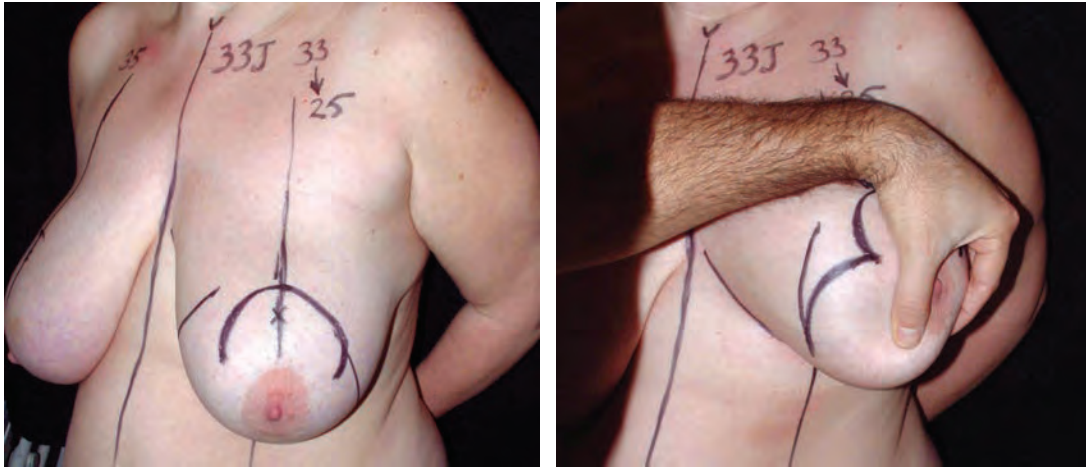
Precise marking is the key to obtaining the desired aesthetic result with optimal breast symmetry. The breasts are marked on the day of surgery with the patient standing. The midline, inframammary fold, and meridian of the breast are outlined. The meridian is best marked by hanging a tape measure around the patient's neck and letting it drop toward the nipples. The nipple distance from the suprasternal notch is then measured and marked. Point *B* is the future position of the nipple. The distance between the points are as follows: *A* to *B* = 2 cm; *C* to *G* = *D* to *G'* = 6 cm; and *H* to *I* = 2 to 4 cm.



The proposed new nipple position is marked with the two-finger maneuver—placing two fingers in the inframammary fold and projecting this onto the skin (*left, arrow*). In the second photo (*right*), one finger is in the inframammary fold and the second finger would be where the tip of the marker is shown. However, the nipple is lowered 1 to 2 cm more than its position, as determined by the two-finger maneuver. This results in a new position at a horizontal line drawn from the lateral fold of the breast at the anterior line of the axilla toward the breast meridian (*left, arrow*). This ensures that the nipple position will not be too high, since it will be expected to rise by a certain degree when the pillars are approximated.

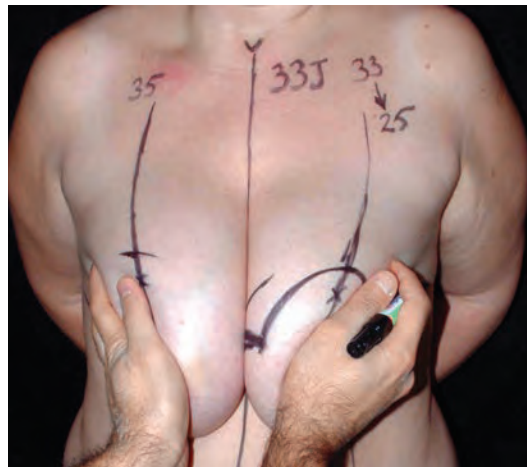


The vertical pillars are marked by rotating the breast superomedially and superolaterally to extrapolate the lines, as described by Lejour.



The mosque-shaped pattern of the areola, which varies from 14 to 20 cm in length, is adjustable to suit the size of the breast, the nipple distance from the sternal notch, and the new nipple position. The width of the mosque-shaped periareolar design, which is between 4 and 10 cm, should be larger for a greater resection and should also leave enough space for the pedicle to settle without compression.

The vertical, lateral, and medial lines are then connected in a curve to the periareolar line.



The medial line is marked first and can be transferred to the contralateral breast by pushing both breasts to each other (mirror effect), as shown. The medial limb has to be identical on both breasts to achieve good symmetry. The lateral limb position outlines the central segment of parenchyma and skin to be excised, which will determine the size of the reduced breast. The position of the lateral limb allows adjustment for any asymmetry between the two breasts. The vertical pillars are joined centrally at a level approximately 2 to 4 cm above the inframammary fold. The lateral pedicle is then marked with a 6 to 8 cm base.



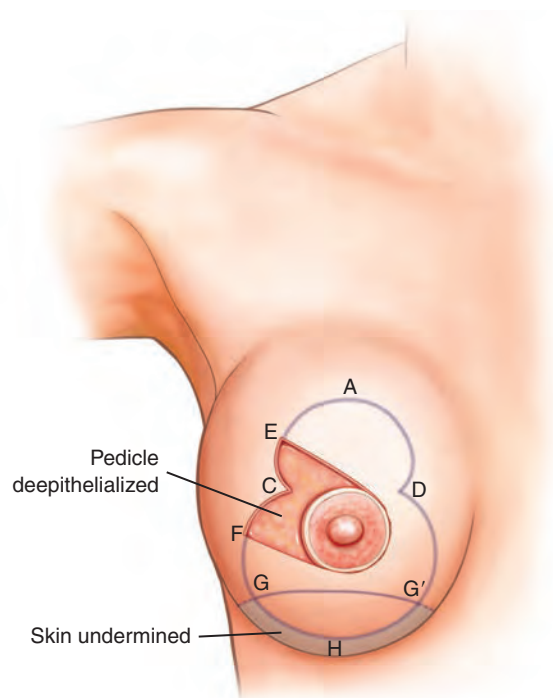
The base of the pedicle is marked to be three quarters in the lateral vertical limb and one quarter as the opening of the areola, respectively. The final skin closure decision will be made while the patient is on the operating table, with the aid of a tailor-tacking technique.

The procedure is performed with the patient supine and under general anesthesia. The operating table should have a break to permit flexion to the sitting position; the patient's arms are held securely adducted to the side. The incision lines and base of the breast are infiltrated with 40 ml of 1% lidocaine and 1:200,000 epinephrine, diluted with 40 ml of normal saline solution. The pedicle itself should not be infiltrated to ensure that perfusion is not compromised.

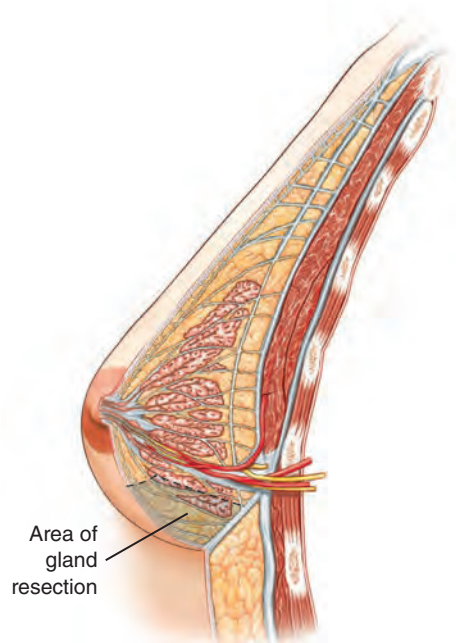
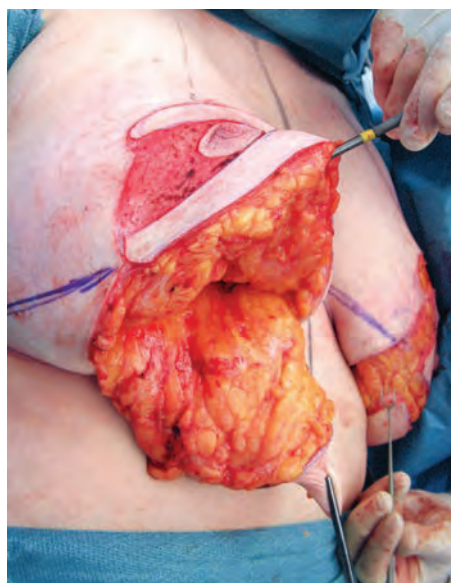
Operative Sequence

The operative sequence can be summarized as follows:

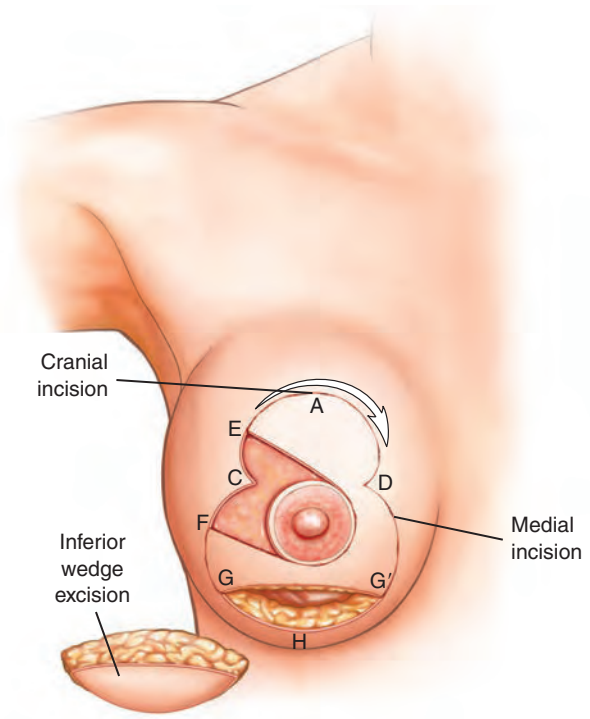
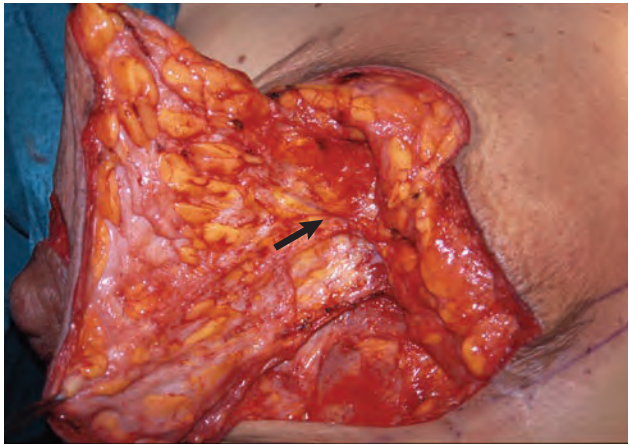
1. A laterally based pedicle is developed located over Würinger's septum.
2. A two-part gland resection is divided into a crescentoid resection caudal to the septum, and a larger C-shaped resection is done cranial to the septum, around the pedicle.
3. Breast pillars are sutured in the midline and to the pectoralis fascia.
4. The skin is closed with minimal undermining in a fashion determined peri-operatively (tailor-tacking technique).



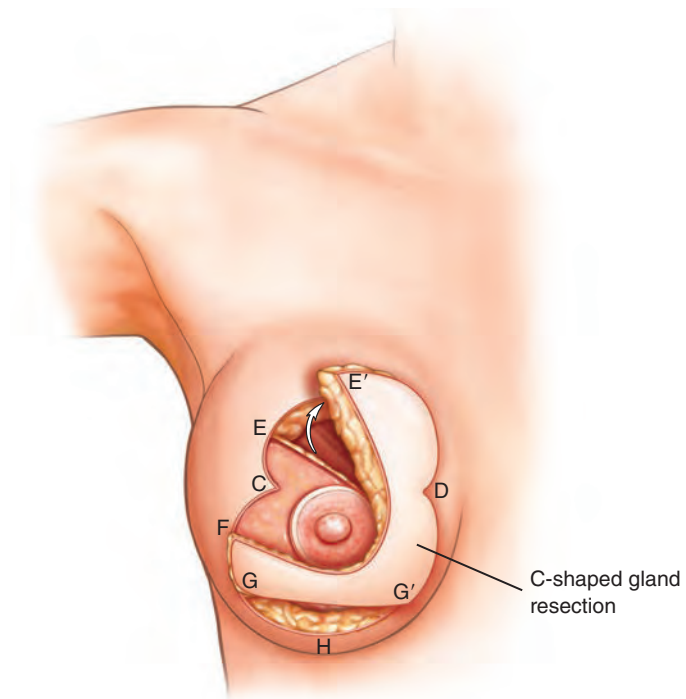
5. The lateral pedicle is deepithelialized and the inferior breast skin is undermined.



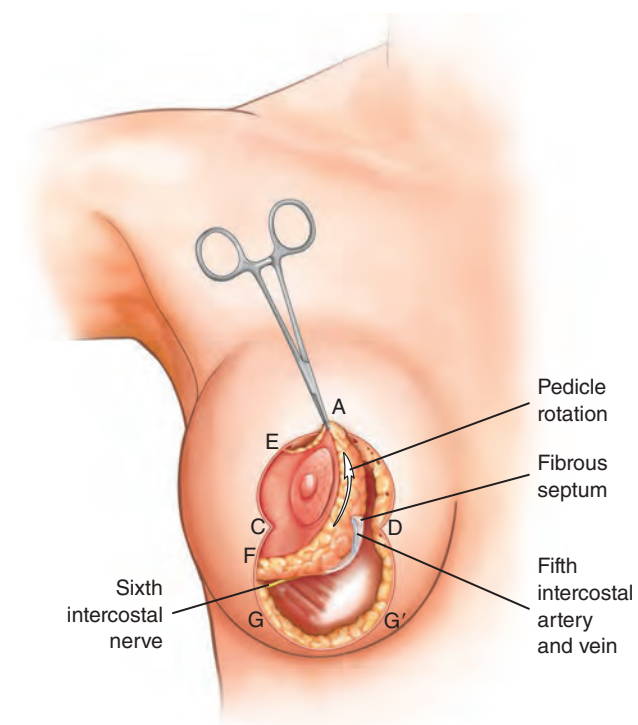
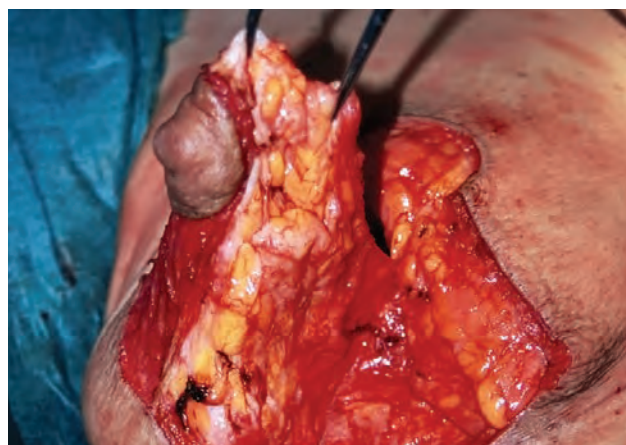
6. A C-shaped resection of the gland is done caudal to the septum.



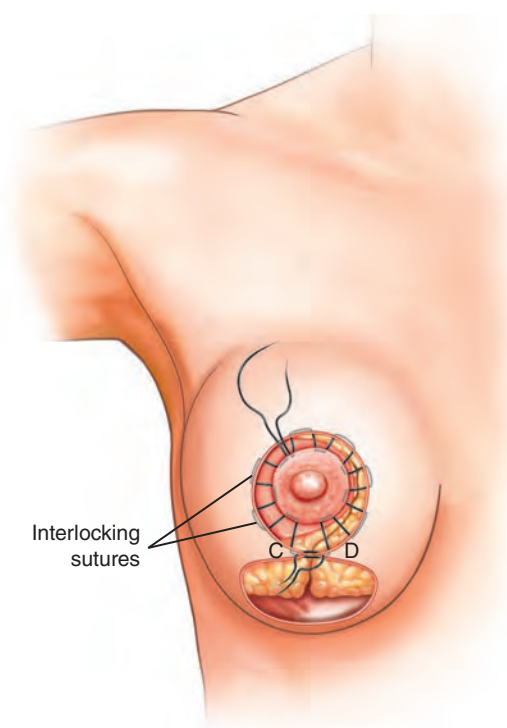
7. The medial and cranial skin and gland are incised and the septum is dissected. The arrow (*left*) indicates an intercostal perforator vessel within the septum.



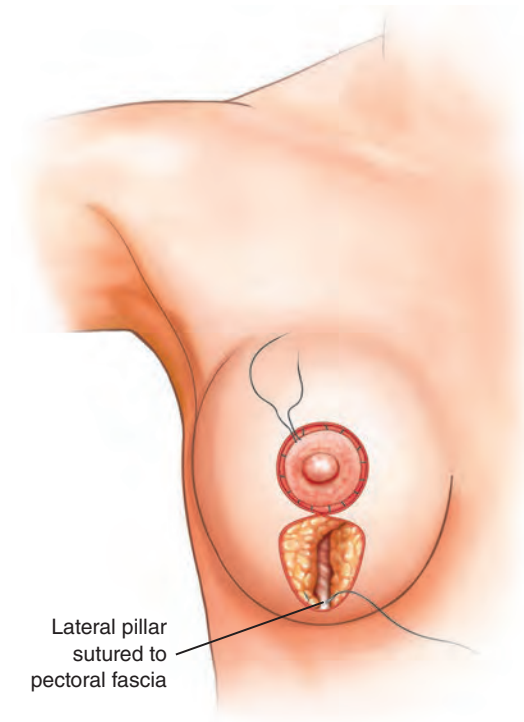
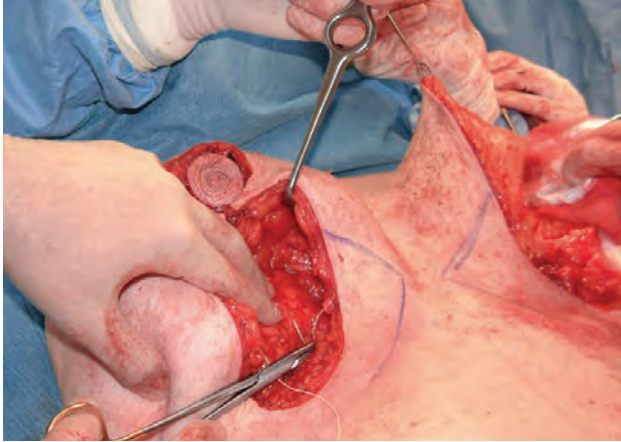
8. A C-shaped gland resection is done around the lateral septum-based pedicle.



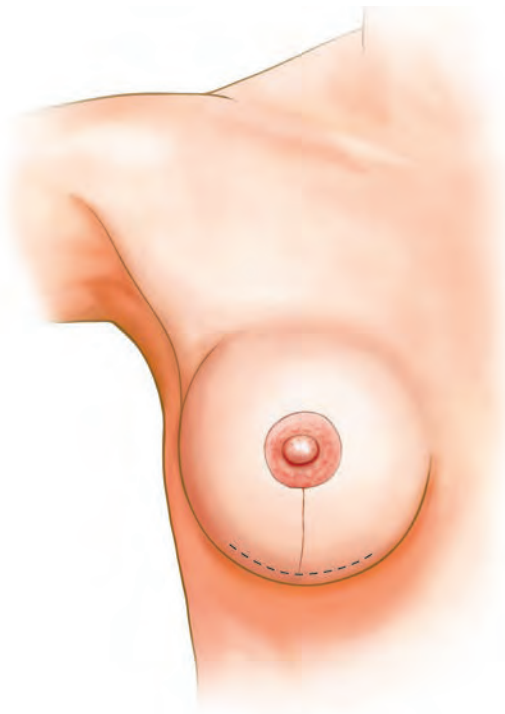
9. The septum-based lateral pedicle is rotated upward.



10. The areola is closed using an interlocking suture technique.



11. The lateral pillar is fixed onto the pectoral fascia.



12. The skin is closed according to the technique described in number 3, p. 2501.

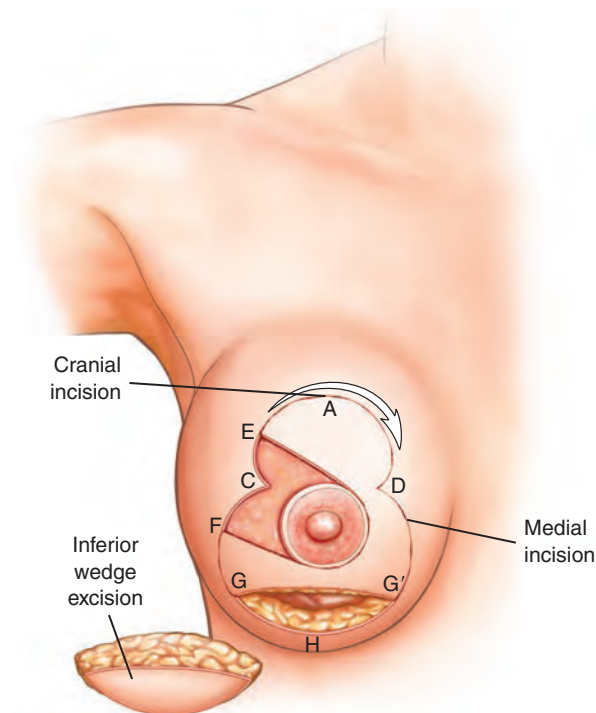
Operative Technique



69-1 Septum-based
lateral mammoplasty

The operative technique is as follows:

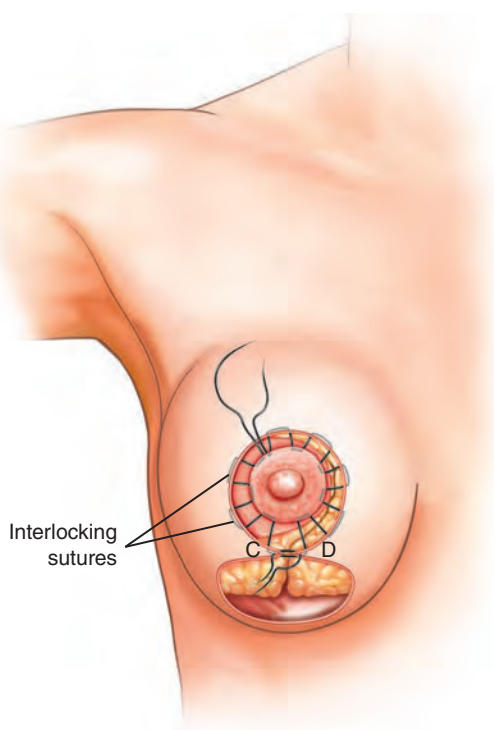
1. *Pedicle deepithelialization and skin incision:* All preoperative markings are checked to ensure that important landmarks have not been erased during patient preparation. The nipple-areola complex is marked with a 45 mm diameter areolar ring with no tension. Deepithelialization is performed on top of the glandular pedicle to the lateral vertical incision, leaving a 1.5 cm cuff of dermis around the areola. Skin incisions are completed with a scalpel.
2. *Pedicle dissection and glandular resection:* In preparing the inferior horizontal resection, the inferior pole of the breast skin is undermined, starting from the inferior limit of each vertical line (6 cm long) to 1 to 2 cm above the inframammary fold. The skin flap thickness is similar to that of the skin after a mastectomy. The superficial fascia is incised and dissected over the gland 2 cm above the inframammary fold.



This fascia remains attached to the inframammary fold and can be used to suspend the fold in a higher position at the end of the procedure, if needed. The gland is incised along the medial pillar (between points D and G') to the level of the pectoralis fascia. This line is then extended cranially along the new areolar marking toward point E, which lies at the upper edge of the base of the pedicle. Digital dissection superiorly, medially, and inferiorly permits good visualisation of Würinger's septum. The surgeon is careful not to dis-

sect laterally and centrally to prevent inadvertent undermining of the pedicle. Würinger's septum can be held and palpated to allow resection of the breast parenchyma under direct vision from around the pedicle. It is important to ensure that dissection inferior to the pedicle is minimal to avoid damaging the neurovascular bundles in Würinger's septum. Having excised the appropriate amount of parenchyma, the weight is noted to aid in symmetrization, and the specimen is sent for histopathologic evaluation. Meticulous hemostasis is maintained.

The dermis of the pedicle is carefully incised at the base to allow better upward rotation. The base of the lateral pillar is rotated superomedially and secured with 1-0 Vicryl to the pectoralis fascia. This maneuver transposes the pedicle to the midline of the breast without tension. In the majority of cases no further fixation is required, but fixation can be performed superiorly to the pectoralis fascia if additional support is needed. The inframammary fold is suspended if necessary and fixed onto the pectoralis fascia with heavy stitches using the superficial fascia that was dissected at the beginning of the procedure.



3. *Skin closure:* Points C and D at the new 6 o'clock position on the periareolar incision are closed with a 3-0 absorbable suture, and the lateral and medial pillars are approximated with 1-0 Vicryl sutures. The periareolar incision is closed in three layers: (1) a 2-0 PDS interlocking suture as described by Hammond, at the level of the deep dermis, beginning at the 12 o'clock position with a well-buried knot, (2) minimal interrupted 4-0 Vicryl suture to

approximate the dermis in a tension-free manner and ensure appropriate skin eversion, and (3) subcuticular 4-0 Monocryl. Attention is now turned to closure of the vertical incisions with one of the following modifications:

Vertical scar: If a vertical closure is advocated, then the skin is undermined to a very limited degree to permit closure with a small amount of wrinkling. The deep dermis is approximated with interrupted figure-of-eight sutures using 3-0 Vicryl, and a 3-0 Monocryl subcuticular purse-string suture is placed at the inferior edge of the scar. These sutures shorten the length of the scar and avoid migration over the inframammary fold. In the event of inadequate wound edge apposition, some interrupted 6-0 nylon can be used to achieve satisfactory approximation.

L or J scar: The skin excess is moved laterally at the inferior edge of the vertical scar to avoid crossing the inframammary fold or extending the scar medially.

Inverted-T scar: If an inverted-T closure is required, this is designed at the end of the operation. The vertical scar is tailor-tacked with staples and a horizontal ellipse is designed to excise the dog-ear. Thus the horizontal component is as short as possible. The skin is closed in two layers with subcuticular 3-0 PDS in the deep dermis and a subcuticular 4-0 Monocryl.

4. *Liposuction:* Liposuction is performed in selected cases once the skin has been closed. Indications include persistent asymmetry, lateral fullness, and the need for improved definition of the inframammary fold.

Postoperative Care

Suction drains are placed bilaterally, ensuring that the drains are in the retroareolar area before closure to prevent a hematoma that could compromise pedicle perfusion. Dermabond tissue glue is placed over the sutured incision lines as a waterproof dressing. This enables the wounds to be left free of dressings for monitoring, sterility, and patient comfort. The drains are removed after 24 to 48 hours and the patient is discharged. Patients are instructed to wear a nonwire sports bra day and night for a month to ensure optimal breast shaping and support.

Problems and Complications

The postoperative complications we experienced in a consecutive series of 110 patients are shown in the table. Scar-related problems, namely wound dehiscence, were the most common complication, occurring in approximately 8% of patients. Other complications included hematoma, skin necrosis and infection and occurred with a

frequency of less than 1%. Despite the fact that we wanted to use vertical and any other short-scar techniques to minimize scarring, we feel strongly that this should not be at the expense of a high rate of wound dehiscence and scar revision. Thus we have developed an algorithmic approach to skin closure.

Postoperative Complications in 110 Patients

Complications (N = 194 breasts)	Number (%)
Wound dehiscence	15 (7.7)
Wound infection	2 (1.0)
Unilateral retroareolar hematoma	3 (1.5)
Unilateral partial areolar necrosis	1 (0.5)
Unilateral total areolar necrosis	1 (0.5)

Outcomes

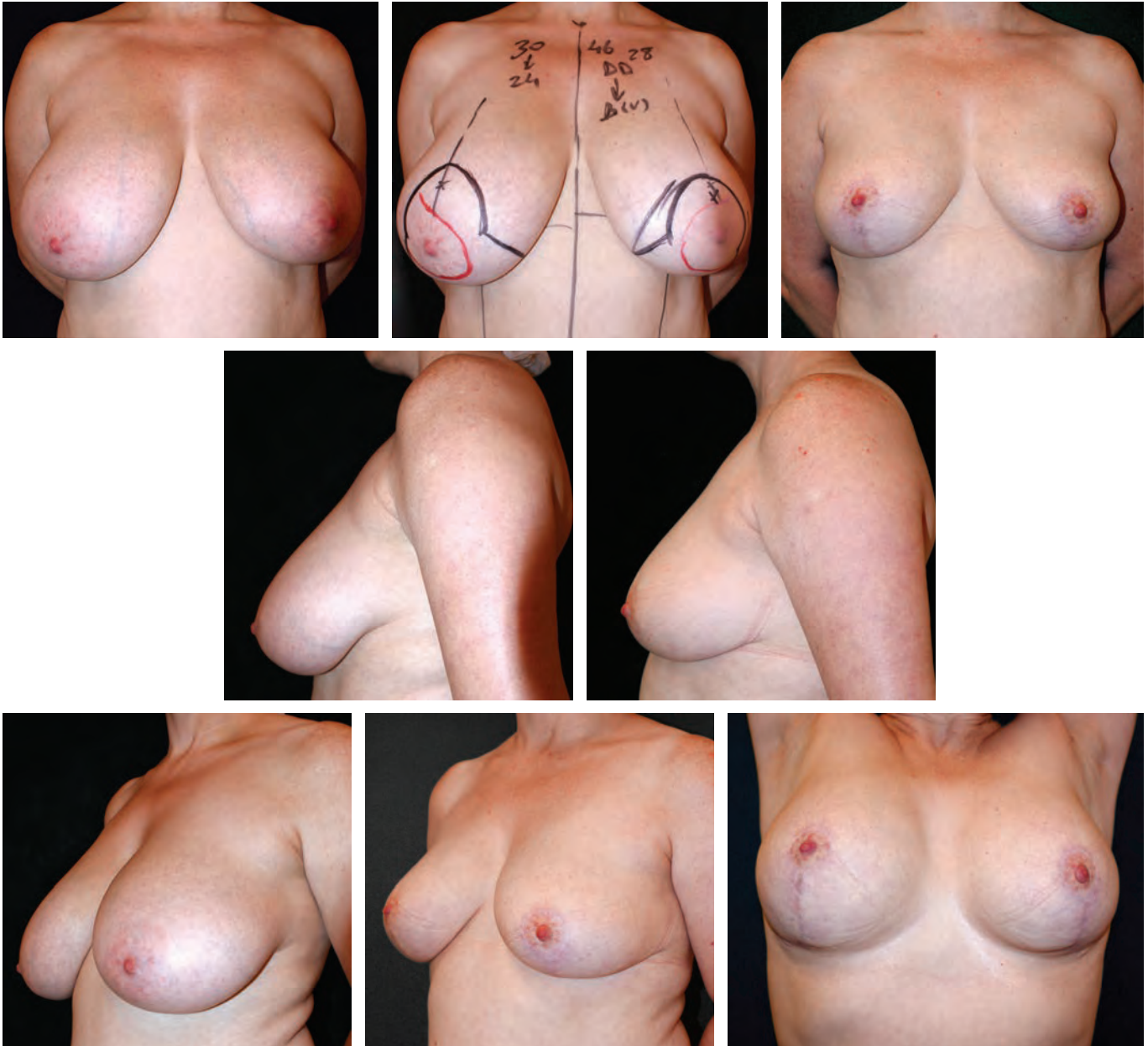
We have shown in a prospective study that the septum-based lateral mammaplasty maintains the sensitivity of the nipple-areola complex from the immediate postoperative period and that all patients had normal sensation at a 6-month follow-up. We have also observed excellent stability of breast shape, with an improved conical profile of the breast mound and projection of the nipple. By ensuring that the glandular pedicle remains attached to the pectoralis muscle, we preserve the original strength of the connective tissue support, which includes the attachments of the superficial fascia and Cooper's ligaments. Resection of glandular tissue superior to the pedicle and repositioning of the pedicle in a more cranial position result in improved nipple projection.

The key to preserving breast-feeding potential after reduction mammaplasty is preparation of the pedicle, sparing as many lobules and connected lactiferous ducts as possible; we also strive to maintain adequate nipple-areola complex sensitivity. We have no firm data on the possibility of breast lactation using our technique. However, several previous studies have shown the lateral dermal pedicle to be superior to many other reduction techniques in terms of successful breast-feeding. We feel that our technique is superior to many of the lateral dermal pedicle methods, because it preserves an intact column of glandular tissue, thereby leaving the functional unit of the breast undisturbed. Intuitively, this, combined with the total preservation of sensation to the nipple-areola complex we have demonstrated, should lead to successful breast-feeding.

Results



This 29-year-old patient presented for breast reduction. She had F cup breasts with a 31 cm nipple-to-sternal notch distance. The nipple was elevated to a 32 cm nipple-to-sternal notch distance. Following our algorithm, a vertical scar was indicated in this case. The breast was reduced using the SLM technique to create D cup breasts, as requested by the patient. At the same time, a fibroadenoma was included within the gland resection of the left breast. The vertical scar is shown at 6 months post-operatively.



This 46-year-old woman requested moderate breast reduction (from a DD cup to a B or C). A vertical scar closure was indicated by her preoperative nipple-to-sternal notch distance of 30 cm. Gland resection was 376 g on the right and 266 on the left. She is shown 1 year postoperatively.



This 55-year-old woman with a BMI of 35 had major breast hypertrophy. The nipples were located 42 cm (right breast) and 40 cm (left breast) from the sternal notch. An SLM procedure with an extended inverted-T scar was done. The scar was extended over the midline to immediately correct the dog-ears caused by the asymmetry of the inframammary folds and to the previous midline abdominal scar. The amount of gland resection was 1400 g on the right breast and 950 g on the left breast. The results are shown 5 years postoperatively.



This 44-year-old woman had undergone a gastric bypass procedure and had lost 60 kg (132 pounds) when she presented for a breast reduction/mastopexy procedure. In this challenging case, the nipples were located at 35 cm (right breast) and 38 cm (left breast) from the sternal notch. The skin quality was extremely poor; therefore the SLM procedure was done with a conventional inverted-T scar. The amount of gland resection was 850 g (right breast) and 1130 g (left breast). Preoperative views show the septum of the right breast. The septum became extremely thin as a result of the long-term breast hypertrophy and ptosis. The perforator vessels and nerves could still be seen through the septum that was transilluminated with the surgical light. Early results are shown at 4 months postoperatively.

Concluding Thoughts

We feel that the septum-based lateral mammaplasty technique is safe and valuable for breast reduction. This procedure provides resection of a large amount of breast tissue without compromising the viability of the nipple-areola complex. The main advantages are maintaining nipple-areola sensitivity and a good aesthetic outcome. The technique is strongly recommended for young patients with large breasts.

Clinical Caveats

The lateral pedicle technique is best suited to younger patients with a well-defined lateral breast border and no excessive lateral fullness. An alternative pedicle should be considered for patients who do not meet these criteria.

The technique offers increased viability of the nipple-areola complex, preservation of sensation to the nipple-areola complex, reduced rate of wound complications, and increased potential for breast-feeding. In addition, the support of the glandular tissue behind the nipple-areola complex improves the conical projection of the breast and prevents flattening of the nipple-areola complex.

Preoperative marking should be done on the day of surgery and is the key to achieving the desired result. The medial vertical incisions should be symmetrical, and any necessary adjustments can be made with the lateral incisions. The nipple should be sited 1 to 2 cm below the inframammary fold.

The dissection of the pedicle centers around Würinger's horizontal septum, which includes branches and perforators from the intercostal, thoracoacromial, and lateral thoracic vessels, as well as the lateral branch of the fourth intercostal nerve.

A two-part gland resection is performed as a limited crescentoid resection caudal to the septum and a larger C-shaped resection cranial to the septum, around the pedicle.

The lateral pillar is sutured onto the pectoralis fascia, thereby ensuring that there is no tension on the pedicle.

The final decision regarding skin closure is made while the patient is on the operating table:

- A vertical scar is best suited to patients with nipple-to-sternal notch distances of less than 30 cm and good skin quality. However, the vertical scar may also be appropriate in patients at high risk of hypertrophic scarring, although there is a high incidence of secondary revisions.
- An L- or J-shaped scar is suitable for older patients or those with a nipple-to-sternal notch distance greater than 30 cm.
- The inverted-T scar is used in patients who have poor skin quality with associated striae.

Liposuction can be undertaken to give better symmetry, reduce lateral fullness, and create better definition of the inframammary fold.

Annotated Bibliography

Chiummariello S, Cigna E, Buccheri EM, et al. Breastfeeding after reduction mammoplasty using different techniques. *Aesthetic Plast Surg* 32:294-297, 2008.

The authors review breast-feeding ability after four different pedicle techniques of breast reduction used in their unit. Breast-feeding was defined as more than 3 weeks of lactation not requiring nutritional supplementation. Breast-feeding was successful in 60.7% of patients with a superior pedicle, 55.1% with a lateral pedicle, 48% with a medial pedicle, and 43.5% with an inferior pedicle. No description was given of the technique used or statistical analysis of results. The authors conclude that the ability to breast-feed is adequately preserved in techniques that spare the connections between the lobules and milk ducts and vital nipple-areola complex.

Hamdi M, Van Landuyt K, Tonnard P, Verpaele A, Monstrey S. Septum-based mammoplasty: a surgical technique based on Würlinger's septum for breast reduction. *Plast Reconstr Surg* 123:443-454, 2009.

This paper describes the septum-based mammoplasty with use of a medial or lateral pedicle technique, as indicated. An algorithmic approach is used for decision-making, particularly in relation to the pattern of skin closure. The authors' experience with a series of 110 consecutive patients over a period of 7 years is outlined. Resections ranged from 160 g to 1980 g, and the postoperative complication rate included 0.5% areolar necrosis, 7.7% limited wound dehiscence, 9% secondary scar revision. The technique is considered to be safe and demonstrates ease of pedicle shaping and breast remodelling in patients undergoing reduction mammoplasty.

Hamdi M, Vande Sijpe K, Van Landuyt K, Blondeel PN, Monstrey S. Evaluation of nipple-areola complex sensitivity after the latero-central glandular pedicle technique in breast reduction. *Br J Plast Surg* 56:360-364, 2003.

The authors record the sensitivity of the nipple-areola complex in 20 consecutive patients undergoing a septum based lateral pedicle technique. Measurements are made pre-operatively, at 2 weeks and 3 months post surgery using a variety of validated sensory measurements. Results show that at 2 weeks all patients had reduced sensitivity, but by 3 months pressure and vibration perception were the same as the preoperative measurements. Temperature recognition on the nipple remains impaired in 27.5% of patients at 3 months. They conclude that the latero-central pedicle preserves sensitivity of the nipple-areola complex in all patients.

Schlenz I, Kuzbari R, Gruber H, et al. The sensitivity of the nipple-areola complex: an anatomic study. *Plast Reconstr Surg* 105:905-909, 2000.

The authors dissected 28 female cadavers to record the nipple and areola innervation. The most constant innervation pattern was by the 4th lateral cutaneous branch (79%) and by the 3rd and 4th anterior cutaneous branches (57%). The anterior cutaneous branches took a superficial course within the subcutaneous tissue. The lateral cutaneous branches took a deep course within the pectoral fascia and reached the nipple from its posterior surface in 93 percent of the dissected breasts. In 7% of the dissected breasts, the lateral cutaneous branches took a superficial course within the subcutaneous fat and reached the nipple from the lateral side. The authors suggest that resections at the base of the breast and skin incisions at the medial areolar border are best avoided.

Würinger E, Mader N, Posch E, et al. Nerve and vessel supplying ligamentous suspension of the mammary gland. *Plast Reconstr Surg* 101:1486-1493, 1998.

This paper gives an anatomic description of a thin horizontal septum of dense connective tissue in the breast, based on the authors' findings for 28 breast specimens. This septum is the basis for the neurovascular supply to the nipple and contains branches of the lateral thoracic artery, the thoracoacromial artery and intercostal arteries. The nerve supply runs along the septum, either following a deep course from the lateral cutaneous branch of the 4th and 5th intercostal nerves, or a more superficial course from the anterior and lateral branches of the 2nd to 4th intercostal nerves.

Suggested Readings

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Asplund OA, Davies DM. Vertical scar breast reduction with medial flap or glandular transposition of the nipple-areola. *Br J Plast Surg* 49:507-514, 1996.

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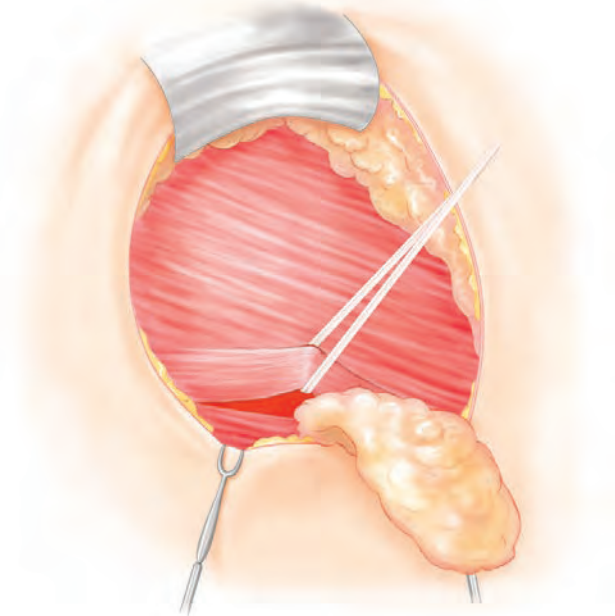
Cárdenas-Camarena L, Vergara R. Reduction mammoplasty with superolateral dermoglandular pedicle: another alternative. *Plast Reconstr Surg* 107:693-699, 2001.

Greuse M, Hamdi M, DeMey A. Breast sensitivity after vertical mammoplasty *Plast Reconstr Surg* 107:970-974, 2001.

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CHAPTER 70



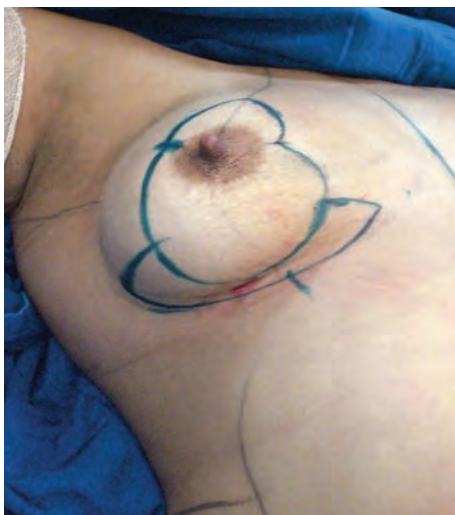
Short-Scar Mammoplasty With a Pectoralis Loop

RUTH MARIA GRAF,
ANDRÉ RICARDO DALL'OGGIO TOLAZZI,
MARIA CECÍLIA CLOSS ONO, THOMAS M. BIGGS

Breast surgery is ever evolving; the great advances of Wise, Pitanguy, Lassus, Lejour, Benelli, and others have given us techniques that not only simplify the operative plan for mammoplasty but also produce a shorter scar and a more aesthetic breast. In this chapter we will describe the short-scar mammoplasty with a pectoralis loop, a maneuver designed to give a pleasing and long-lasting contour to the breast. This maneuver involves the use of a chest wall–based flap of breast tissue that is moved into the upper pole of the breast and held in place by a loop of pectoral muscle, under which it is passed. The technique can be used with standard inverted-T incisions, vertical incisions with short transverse components, L-shaped incisions, or pure vertical incisions. Our choice, and the maneuver described in this chapter, is a vertical incision, with redundant skin removed from around the areola after excision of a vertical ellipse, and closure with a round block suture. If breast reduction is necessary, it can easily be carried out by removing the desired amount of tissue from the base and central part of the breast. A wide range of parenchymal reduction procedures can be performed.

Indications and Contraindications

It is possible to use this combination of techniques for mastopexy only, when there is no excess breast tissue to be removed, or for breast reduction, when resection of excess breast tissue is done in the columns or base of the breast, after the thoracic wall flap is fixed. With this technique we found that we removed less breast tissue than with other techniques that do not use the chest wall–based flap, and the breasts have a narrower base. In our experience, the average amount of breast tissue resected was 250 to 500 g, less than in other techniques we have used without the thoracic flap.

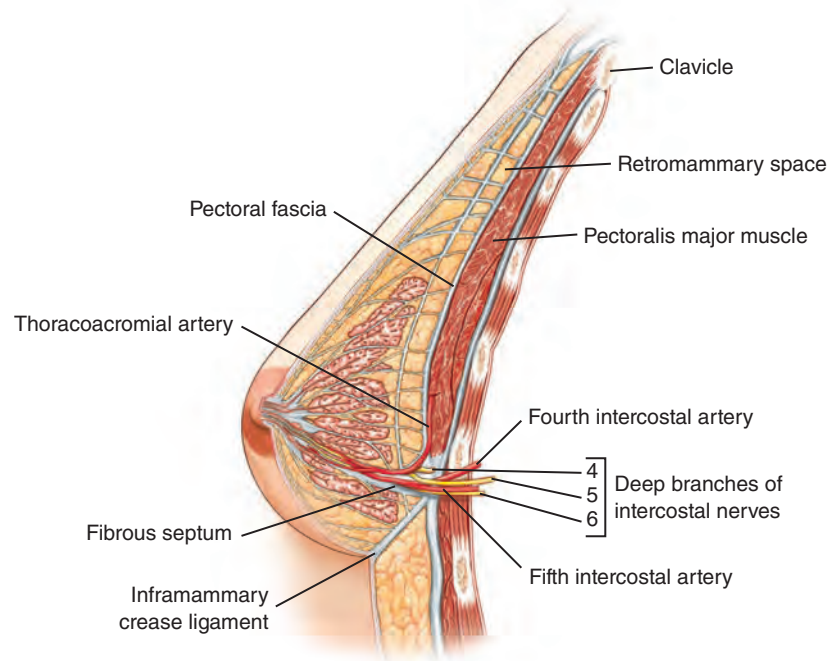


This technique is ideally indicated for mild and moderate cases of breast ptosis and hypertrophy, where less skin compensation is necessary. Significant hypertrophy and severe ptosis constitute relative contraindications to vertical mammoplasty. We prefer to use a short inverted-T incision in these cases to excise more skin and reduce skin compensation. This patient has significant breast ptosis, and the breast has been marked for the inverted-T pattern of skin resection.

Pertinent Anatomy

The mammary gland is anchored to the pectoralis major fascia by the suspensory ligaments (Cooper's ligaments), which help to maintain the shape of the nonoperated breast.

The breast is innervated by the second to sixth intercostal nerves. Lateral innervation is predominantly from the anterior rami of the lateral cutaneous branches of the third through sixth intercostal nerves. Medial innervation arises from the anterior cutaneous branches of the second through sixth intercostal nerves. The nerve supply to the nipple is from the third, fourth, and fifth anterior and lateral cutaneous nerves. The lateral cutaneous branch of the fourth intercostal nerve, which is considered to be the most important, innervates the nipple with two branches. The superficial branch passes up through the superficial parenchyma; the deep branch passes inferolaterally on the pectoralis major fascia before coursing up into the areola. This fact might give one pause in considering techniques that rely heavily on inferolateral resection of the gland.

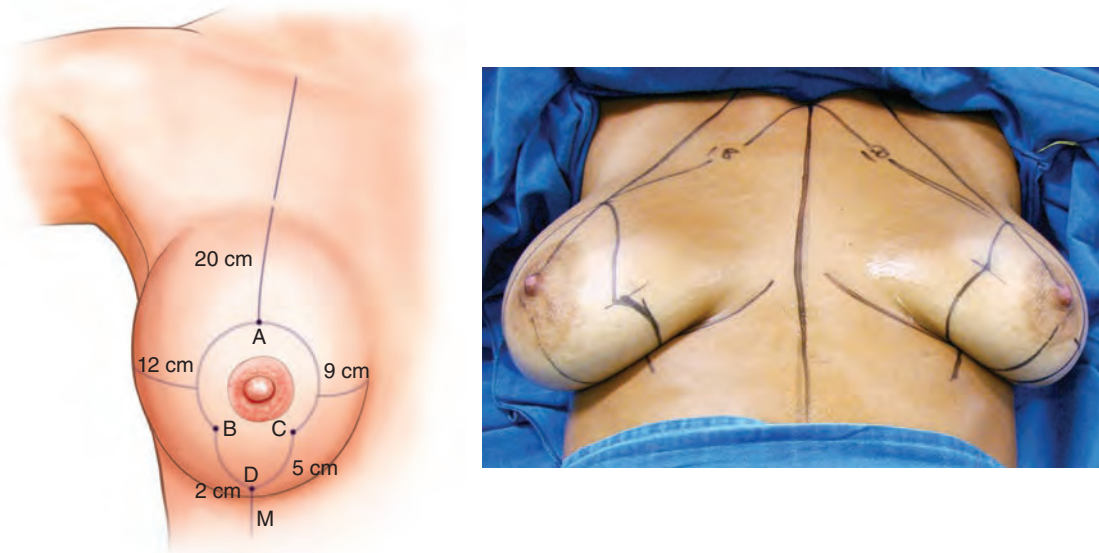


The blood supply to the mammary gland is from multiple sources, including the internal mammary perforators (most notably the second to fifth perforators), the thoracoacromial artery, the artery to the serratus anterior, the lateral thoracic artery, and the terminal branches of the third to eighth intercostal arteries. One important aspect, first described in 1998 by Würinger et al, is the concept of a mesentery-like fibrous septum that runs through the breast at the level of the fifth rib and contains perforator vessels responsible for the blood supply of the nipple-areola complex. We apply this concept when thinking about the dissection of a chest wall-based flap, which is important for achieving an ideal breast shape.

Preoperative Assessment

Each patient must be evaluated for the amount of breast parenchyma, the amount and quality of excess skin, and the scars that are acceptable to the patient. Local breast examination is performed to exclude masses, and any suspicious lesion should be fully investigated before surgery. It is advisable to obtain preoperative mammograms in all patients older than 30 years of age, and breast ultrasonography in younger patients.

Preoperative Planning



Markings are done with the patient in the upright position. The midline (*M*) is drawn from the suprasternal notch to the xyphoid process, breast meridians are marked from a point 5 cm lateral to the suprasternal notch over the clavicle to the nipple-areola complex. On the breast meridian line, point *A* is marked about 17 to 20 cm from the clavicle, at the top of the areola, and point *D* about 2 to 4 cm above the inframammary fold, depending on breast size. If the patient has significant hypertrophy or severe ptosis, point *D* should be marked higher, up to 4 cm above the inframammary fold. This leaves skin and subcutaneous tissue of the lower breast pole as part of the thoracic wall, with a higher new inframammary fold.

The breast is then gently displaced laterally (the technique described by Lejour) and a medial line is drawn connecting point *A* to point *D*. Similarly, a lateral line is drawn with the breast displaced medially. The tension resulting from these displacements should be firm enough to allow adequate skin resection, but not so tense as to create difficulty with closure. This distance varies, depending on the size of the breast. The

medial and lateral lines, points *B* and *C*, respectively, are marked about 5 to 8 cm above point *D*. A gently curved line is drawn from point *A* to point *B*, and again from point *A* to point *C*. Line *AB* should never be closer than 9 cm to the midline, and line *AC* never less than 10 cm to the anterior axillary fold.

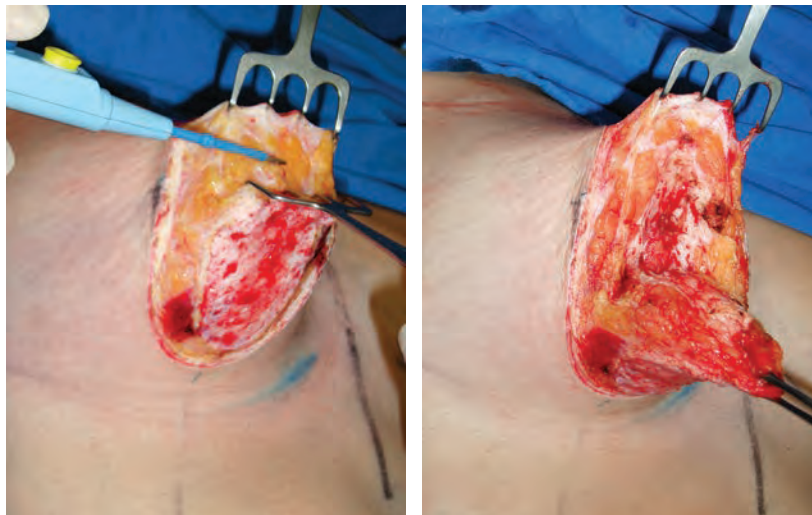
The variation in distances of point *D* to the inframammary fold and vertical lines *BD* and *CD* allows the surgeon the latitude to make adjustments, depending on the size of the breast. The larger the breast, the greater these distances, but never exceeding 4 and 8 cm, respectively. Points *B* and *C* are marked slightly closer to each other so they can be closed with less tension.

Operative Technique

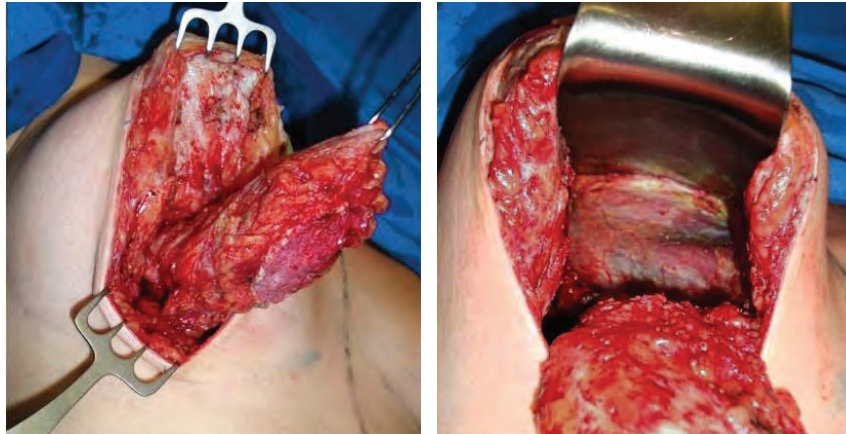
The patient is placed supine on the operating table and is prepared and draped. General or epidural anesthesia is induced (in some cases local anesthesia may be used), and the marked areas are infiltrated subdermally (except superior to the areola) with normal saline–epinephrine solution (1:100,000). The area of skin demarcated by *AB*, *AC*, *BD*, and *CD* is deepithelialized by a Schwartzman maneuver, leaving the nipple-areola complex (4.5 to 5.0 cm in diameter) in place. To start creating the chest wall–based flap, the dermis is incised along the lines *BD* and *CD*, as well as *BC*, passing 1 cm below the nipple-areola complex.



70-1 Vertical
mammoplasty

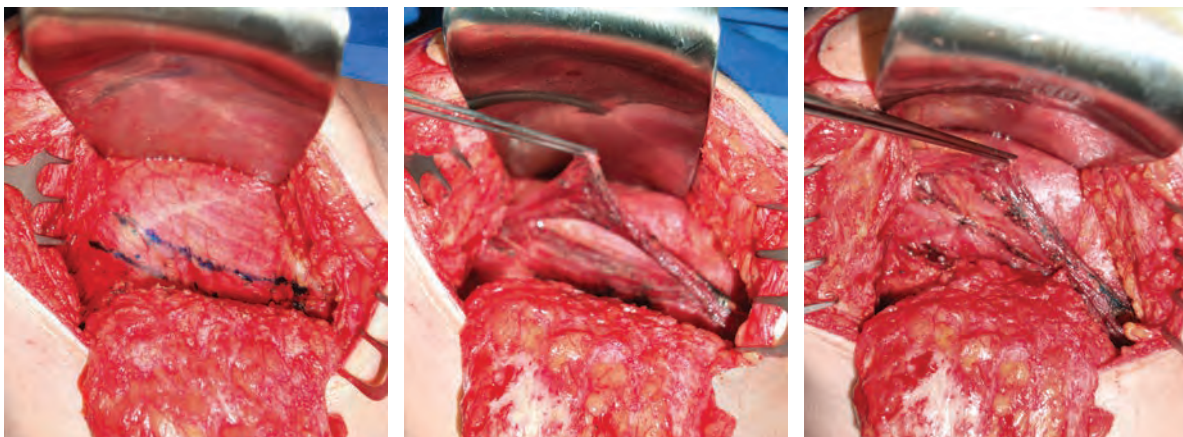


Along the vertical lines, the incision is beveled inward for 1 to 2 cm to preserve tissue on the medial and lateral pillars for later closure. The incisions continue inward and away from the flap so that the base is broad. This dissection is carried to the chest wall, with a minimal amount of subcutaneous tissue being left on the skin as dissection is carried to the inframammary fold.



After this dissection has been completed laterally and medially, a large hook is placed in the nipple-areola complex to lift the breast straight up and help with the dissection of the breast tissue from point *B* to *C* down to the pectoral fascia. Great care must be taken at this point not to undercut the flap. The flap is now mobile and based on vessels from the fifth and sixth intercostal spaces as a perforator flap. It is very important that the flap is unrestrained; otherwise, continuous dissection should be extended to the pectoral fascia to better release it. This freely mobile, totally chest wall-based flap is made up of the tissue that in other procedures bottoms out, but in this procedure it is being transposed into the upper pole, where it will be permanently fixed.

The breast tissue is retracted upward and cephalad and dissected off the pectoral fascia up to the second intercostal space, creating a space in the upper pole of the breast into which the flap will be fixed.



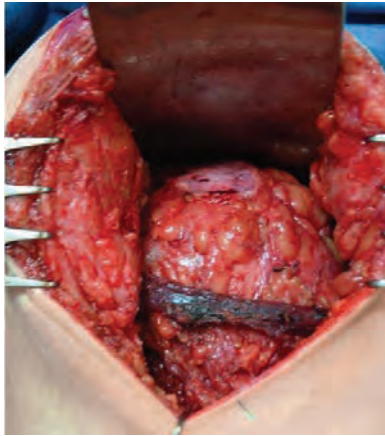
Markings

Dissection

Closure

A strip of pectoral muscle approximately 8 to 10 cm long and 1.5 to 2.0 cm wide is marked with methylene blue. The caudal or inferior line is marked at the cephalad end of the flap base. This muscle strip is elevated, incorporating no more than half of

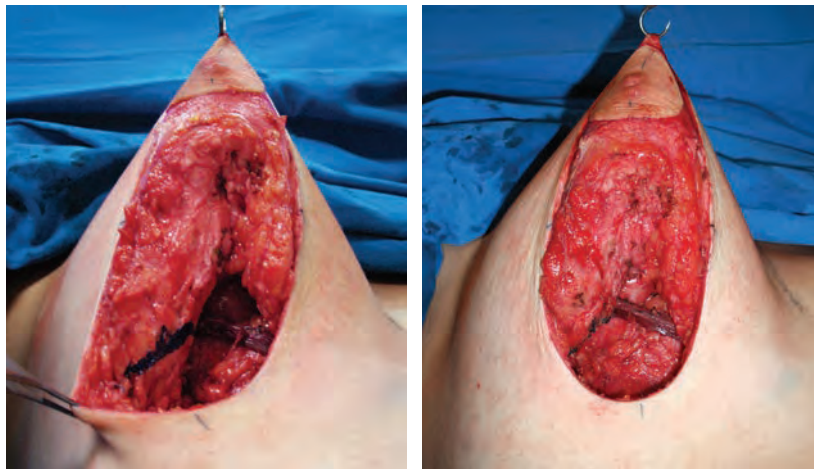
the muscle thickness (the posterior fascia of the muscle is not violated), and the donor site is close with 2-0 nylon. This loop will be used to help hold the flap in the upper pole of the breast.



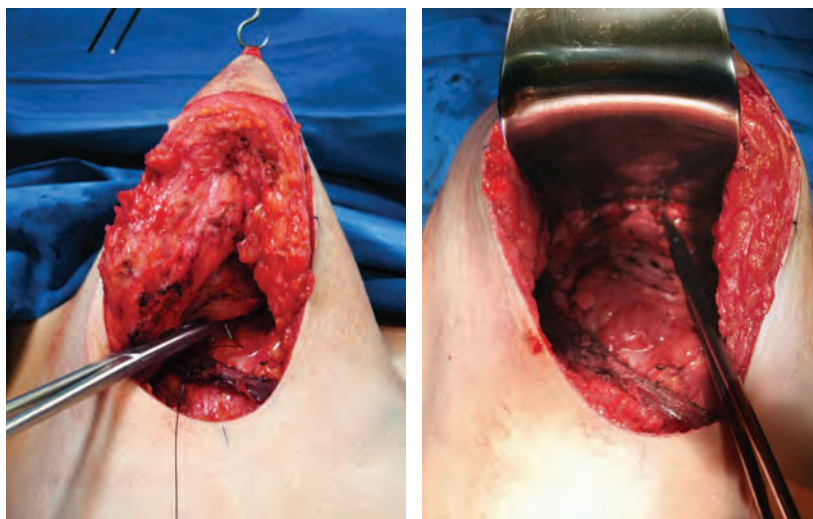
The mammary flap is then passed under the pectoral loop into the space created in the upper pole of the breast. It is very important that all dermal elements on the flap be completely passed under this loop.

A running suture of 2-0 nylon, starting laterally and finishing medially, is placed to fix the breast tissue of the flap to the pectoral fascia. The dermis of the flap is then sutured to the pectoral flap, superiorly only.

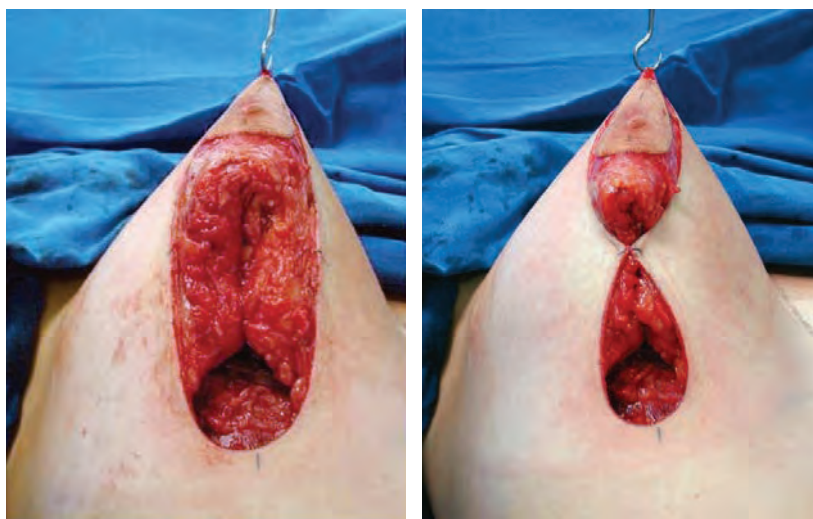
If after passing the flap under the loop there seems to be excess tension on the loop causing pressure on the flap, the loop can be released laterally, since medial dissection could disrupt the origin of the muscle.



With the flap in the correct position, the breast tissue excess can be resected. Equalization of breast tissue pillars is shown. Breast reduction is performed, depending on breast size and the desire of the patient. Most of the tissue is removed as a central inverted-V excision pattern to narrow the base of the breast, and, if necessary, from the base to reduce breast projection. One should avoid overreducing the medial part of the breast—the tissue under the nipple-areola complex—to produce more projection of the complex. Significant reductions with this technique (vertical incision and circumvertical closure) remove about 800 to 1000 g, including the liposuction in the lateral aspect of the breast, which is in average 300 cc of fat. The chest wall-based flap can be used in any breast size.



After reduction of excess breast tissue, and with the hook still holding the breast straight up, one interrupted stitch of 2-0 nylon is placed from the superior part of the breast parenchyma to the pectoralis muscle, just superior to the chest wall-based flap, at the level of the second intercostal space to aid in upper pole definition.



The pillars are then closed with 2-0 nylon in several layers. It is preferable to place the needle deeper laterally than medially to preserve more fullness medially. Closure of mammary pillars and the deep dermis union of points *B* and *C* are shown.



Deep dermis of the vertical wound is sutured, starting with subareolar points *B* and *C*. To reduce the outer circumference and wound tension, and to compensate the periareolar skin around the areola, a round block suture is made all the way around the periareolar skin with 3-0 colorless nylon. Eight cardinal points are marked in the outer and inner circumferences to spread the periareolar skin uniformly around the areola. The running suture passes through the deep dermis of the outer skin and the areolar deep tissue. In the external skin the suture follows the markings, taking a large bite of tissue; in the areola the suture is passed between the markings, taking a small amount of tissue. Tensioning the suture reduces the outer circumference down to the desired diameter for the nipple-areola complex (about 4.5 cm).

Starting from point *D*, the skin is closed with a subdermal interrupted suture of 3-0 Monocryl, anchoring the vertical wound on the deep pillars of tissue, so the vertical scar is kept at the same level as the new inframammary crease.



In patients with significant skin redundancy, it is possible to excise a small horizontal ellipse of skin in the new inframammary fold, ending with a short inverted-T scar. This can better adjust the skin envelope without jeopardizing the youthful breast shape achieved with vertical principles associated with chest wall-based flap. A running intradermic suture with 4-0 Monocryl finally closes the skin. No drains are used. An excision of a horizontal ellipse of skin is shown above, which ends with a short inverted-T scar in selected cases.

Postoperative Care

A compressive, molding brassiere is recommended for 1 to 2 months to reduce postoperative swelling and tension on scars. It also helps to support the breasts while internal tissues are healing and until the final shape is more stable.

Massage and ultrasound therapy for lymphatic drainage are indicated from the second postoperative day, three sessions per week for the first postoperative month or two. Significant reduction in swelling and pain and increased comfort have been reported by patients who received these treatments.

Special care of scars is necessary to improve healing. A topical antibiotic ointment maintains local moisture and helps with cell migration to accelerate wound healing. After the first week, when all the wounds are healed, and for 2 to 3 months postoperatively, Micropore tapes are used over the scars to prevent stretching and widening them. Silicone gel or sheets can also be used to help prevent hypertrophic scars.

The patient is encouraged to walk the first day after surgery; driving and other physical activities can be resumed after 3 weeks.

Patients are closely followed in the postoperative period and are clinically evaluated at 5 to 7 days, 2 weeks, 1, 3, 6, and 12 months, and yearly thereafter. The patient's results are documented photographically at each follow-up visit.

Problems and Complications

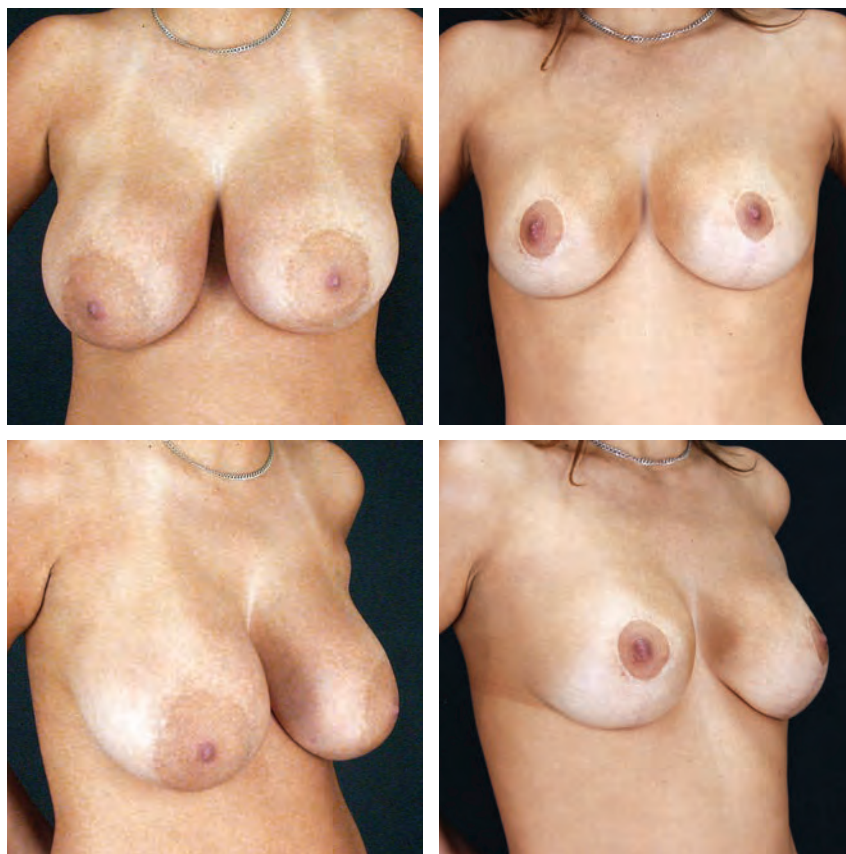
The major drawback to this procedure is the length of time before the final result can be appreciated. The surgeon and patient must be patient while the skin retracts, wrinkles flatten, and the overcorrected breast, with its superior bulge and inferior flatness, evolves to an aesthetically pleasing contour.

Wound-healing problems such as dehiscence, widening, and irregularities are sometimes seen as a result of the vertical and periareolar skin-gathering suture. Eventually some skin redundancy remains in the new inframammary fold, which necessitates excision by a horizontal approach. Although this horizontal incision is small, it does add a horizontal component to the resulting scar. It is important not to elongate the scar out of medial and lateral limits of the breast to avoid hypertrophic scars.

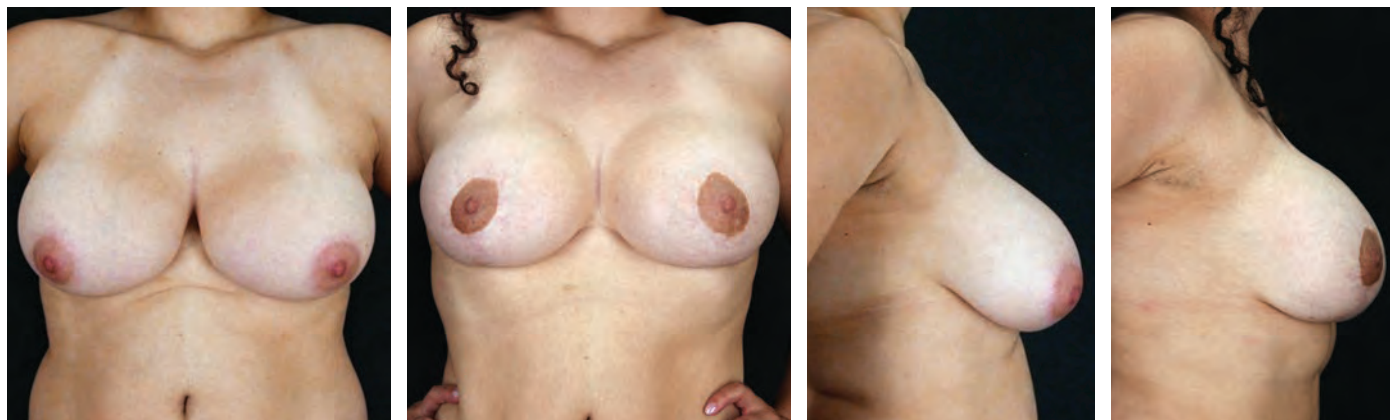
Outcomes

Better and long-term upper pole fullness (second, third, and fourth costal rib) has been observed with the patient in the erect position. Breast shape and projection have been stable when the patient is lying supine. The areola maintains its upward projection, with little lateral tilting. Vertical and periareolar scars are usually of good quality, because there is less tension in the closure. Approximating the pillars and the round block suture reduces wound tension and improves the final scar. Narrowing the base of the breast is observed in all cases.

Results



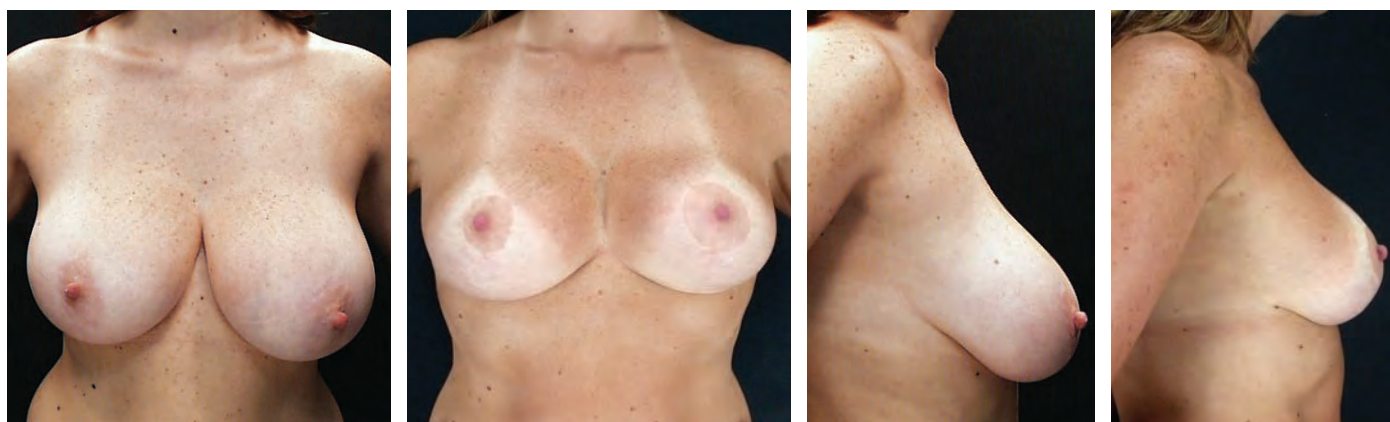
The patient is seen preoperatively and 2 years postoperatively.



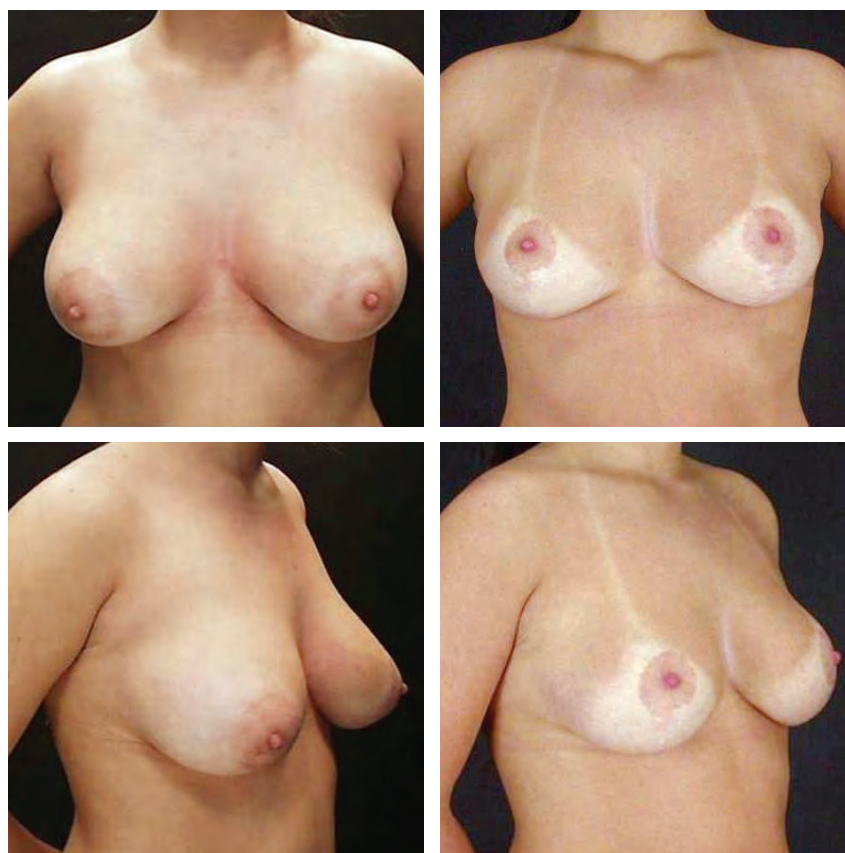
The patient is seen preoperatively and 1 year postoperatively.



The patient is seen preoperatively and 2 years postoperatively.



The patient is seen preoperatively and 3 years postoperatively.



The patient is seen preoperatively and 10 years postoperatively.

Concluding Thoughts

Long-term breast projection and upper pole fullness remain goals of mammaplasty. The chest wall–based mammary flap held by the pectoralis loop helps to achieve these goals and results in a youthful-looking breast. The flap can be performed in any kind of reduction mammaplasty or mastopexy. Short scars, such as those in the periareolar vertical technique, are good for mild and moderate breast hypertrophy and ptosis.

Clinical Caveats

The vertical principles associated with a chest wall–based flap held by a pectoralis strip promote better and long-lasting breast upper pole fullness with the patient in both upright and supine position. The areola remains in a good location and very little breast descent occurs, with no bottoming out.

The absence of a scar in the inframammary fold is a major advantage. The circumvertical scar does not cross the new inframammary crease and has a better quality because of the reduced skin tension, achieved through the round block suture and internal sutures of breast tissue.

A youthful appearance of the breast is achieved as a result of better projection and a narrower base.

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CHAPTER 71



Alternative Approaches to Breast Reduction

ELIZABETH J. HALL-FINDLAY, FOAD NAHAI

Breast reduction can be immensely satisfying for both the patient and the surgeon. This is the only procedure that we perform on the female breast that treats symptoms. Outcome studies have repeatedly shown high patient satisfaction, along with significant improvement in back pain, neck pain, shoulder grooving, skin rashes, and even headaches. It is equally important to document the real improvement in self-esteem with improvement in posture, exercise tolerance, and psychological well-being.

Surgery is the only real option available for breast reduction. Medical treatment, such as hormone therapy, is not effective. Supportive brassieres can help to a relatively minor degree, because they transfer the discomfort to other areas, such as the shoulders.

The goals of breast reduction surgery are to reduce volume while achieving an aesthetically pleasing shape and maintaining breast function. For improved shape, the nipple-areola complex must be moved superiorly. Surgical approaches should preserve blood supply not only to the nipple and areola, but also to the remaining parenchyma and skin. Sensation and breast-feeding potential are also considered.

As famously stated by Sir Harold Gillies, much that we do in plastic surgery involves a battle between beauty and blood supply. Breast reduction is no different. Patients request improvement in symptoms and they are rarely disappointed. On the other hand, the rate of lawsuits for breast reduction is high, proving that aesthetics are just as important. Patients request the surgery for medical reasons, but they seek legal advice for the cosmetic result (see Chapter 8).

Evolution of Technique

Before 1900, attempts to reduce breast size were limited to volume reduction without much regard to nipple position or viability. In the first part of the twentieth century, multiple techniques were described to move the nipple-areola complex and to reduce bulk. To maintain viability, two-stage procedures were often recommended.

As time progressed, surgeons focused on better preservation of nipple and skin flap circulation and shape. Various pedicles and resection techniques were described, each with advantages and disadvantages.

The following principles of breast reduction became clearer with experience:

1. The dermoglandular pedicle is considered preferable for the nipple-areola complex to maintain blood supply, preserve sensation, and increase the potential for lactation. (At least, this is true in North America.)
2. Extensive skin undermining should be avoided to reduce problems of skin necrosis that were common in the Biesenberger type of procedure (which was the most popular mammaplasty procedure between 1930 and the 1980s).

In North America the inferior pedicle technique combined with an inverted-T closure proved most effective for accomplishing these principles. This method proved safe, reproducible, and relatively easy to teach. Minor wound-healing problems occurred at the T junction, but the technique provided relative safety for the nipple-areola complex. Sensation was good, and lactation was certainly possible in many patients. The trade-off of extensive scarring was undesirable but certainly thought to be justified. The boxy shape, along with lateral and medial dog-ears, was an issue that could not always be solved. The development of pseudoptosis or bottoming out with time was thought to be an inevitable consequence of gravity acting on skin with poor elasticity.

The inferior pedicle eventually became the workhorse of the inverted-T approach. McKissock's initial description of a vertical bipedicle was revolutionary at the time, but it was soon realized that either the superior or inferior pedicle alone was sufficient. One pedicle made inset of the nipple easier and thereby avoided some of the tension on the nipple-areola complex. Strombeck's horizontal bipedicle had similar problems. Skoog advocated a lateral or medial pedicle instead.

Many of the pedicles for the inverted-T procedure suffered because they had to be thinned and converted to a dermal pedicle to allow ease of inset. This approach was unfortunate because it reduced blood supply, innervation, and breast-feeding potential. Only the inferior and central pedicles were full thickness and stood the test of time. Some surgeons adopted the central mound technique, despite the skin undermining, because it had a good blood supply and was thought to provide better potential for lactation. Grading became a champion of either free nipple grafts or a superior pedicle combined with an inverted-T skin pattern.

On the other hand, Europeans and South Americans obtained good results with various types of vertical skin closure and circumareolar techniques. The circumareolar techniques proved difficult to reproduce and tended to flatten the breast, resulting in widening of the areolar scar and the areola itself. These procedures have been restricted to small reductions and mastopexies.

The vertical reduction mammoplasty techniques were slow to gain popularity in North America. The superior pedicle (as described by Lassus, Marchac and de Olarte, Lejour, Berthe, Nahai, and Hidalgo) can be difficult to inset and often requires aggressive thinning. Otherwise, the pedicle could be compressed by the excessive folding required.

Various other pedicles for the vertical approach have been described in an attempt to make the procedure easier and more applicable to larger breast reductions. American surgeons were initially intimidated by the odd shape at the end of the procedure and were nervous about leaving an inferior pucker that could take months to settle.

In U.S. surgical practices, patients with smaller breast reductions tend to be more critical of their results. Most surgeons continue to use the technique with which they are comfortable (inferior pedicle with inverted-T closure), especially to avoid potential lawsuits in a country that has become increasingly litigious. However, surgeons keep circling back to previously described techniques to combine the best aspects of the older methods with newer approaches that incorporate shorter scars.

Indications for and Advantages and Disadvantages of Various Techniques

Breast reduction techniques are sometimes divided arbitrarily into long- and short-scar techniques. Often the term *Wise pattern* is used to describe the inverted-T inferior pedicle technique, but care must be taken to separate the skin resection pattern from the pedicle design. Wise described only a skin resection pattern. It is not reasonable to compare one skin pattern using one pedicle with another skin pattern using a different pedicle.

Many surgeons who have now adopted the vertical skin resection pattern approach have stayed with it because of the improvement in the scarring, breast shape, and longevity of shape. However, it is not the skin pattern that makes the difference; it is the nature of the parenchymal resection and the pedicle design that resists gravity. Some surgeons add a short horizontal scar to remove redundant skin, but this approach is still different from most procedures that use an inverted-T skin pattern. It can be confusing, because people are often comparing apples with oranges.

Although the skin and dermis help shape the breast with the inverted-T designs, there is likely to be more bottoming out or pseudoptosis with time if the weight of the pedicle and the remaining breast are left inferiorly. Advantages of the so-called ver-

tical techniques should not be attributed to the skin pattern; rather, they result from the fact that the breast parenchyma is resected inferiorly and the pedicle weight is carried superiorly. Skin and dermis are elastic structures that adapt to stress; they are not particularly good at resisting deforming forces.

To properly evaluate the advantages and disadvantages of the different approaches to breast reduction, we must separate the approach to the nipple-areola complex from the skin and parenchymal resection patterns.

Skin Resection Patterns

Historically, one skin resection pattern is often associated with a particular pedicle, but the two should be considered separately. Most of the skin and parenchymal resection patterns can be combined with most of the pedicles. The final scar should reflect the pattern of skin resection chosen to deal with the excess skin once the breast shape has been established. The skin brassiere can no longer be relied on to shape or support the breast. How much breast tissue is removed, where it is removed from, and how the remaining tissue is brought together shapes the breast, not the skin.

Inverted-T Skin Resection Pattern

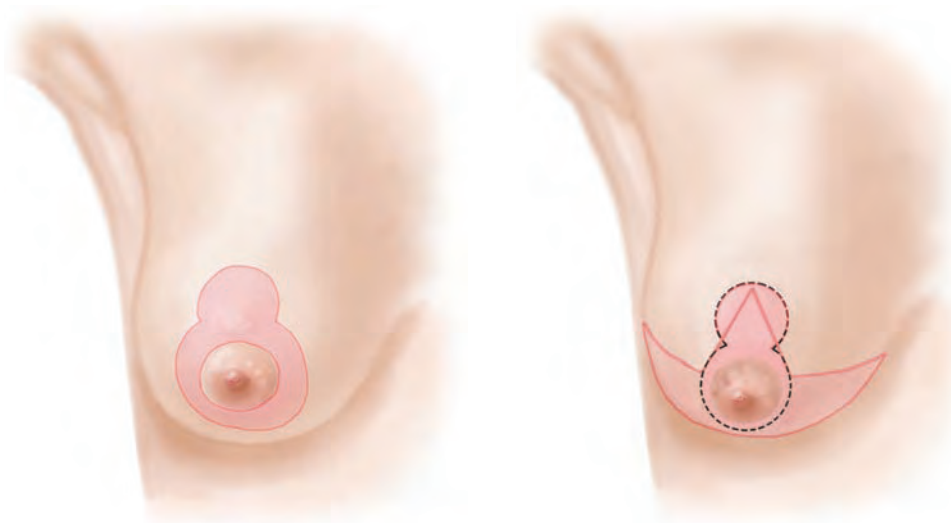


The inverted-T skin resection pattern has become the mainstay of breast reduction and usually is associated with the inferior pedicle. This approach relies on the skin brassiere to shape and hold the remaining breast parenchyma. With the advent of vertical techniques, it has become evident that it is not always necessary to remove all the skin above the inframammary fold. The inverted-T skin resection is best for patients with very large breasts or for massive-weight-loss patients who have a large amount of loose, inelastic skin.

Vertical Skin Resection Pattern

The vertical skin resection procedure has taken some time to gain wide acceptance. It is not for all patients, but it can be applied to a wide variety of breast sizes. Whereas inverted-T patterns rely on the skin to shape the breast, vertical patterns rely on the breast to shape the skin.

Initially the vertical skin resection was limited to smaller breast reductions, but now surgeons are using it for reductions up to 2000 g and above. Some surgeons prefer to use the vertical approach for the parenchymal resection because it cones the breast better than the inverted-T. For the larger reductions, they will add a short T or an L to remove the excess skin, but retain the shape advantages of the vertical approach. Berthe and colleagues showed that adding a T during the initial surgery did not change their revision rate. It can be difficult to know exactly where to place the T. The problem then becomes one of chasing lateral and medial dog-ears again.



Because vertical patterns are often associated with superiorly based pedicles and because the inverted-T usually is associated with an inferior pedicle, the vertical method may retain its shape longer, because it avoids the deleterious effects of gravity. The reduced incidence of bottoming out, or pseudoptosis, may be attributed to the nature of the parenchymal resection rather than the skin pattern. Several authors noted that the weight of the inferior pedicle stretches the skin and causes bottoming out with time. It is probably a combination of removing breast parenchyma inferiorly and not relying on the skin to hold the shape that has given the vertical pattern a better reputation for longevity. The illustration above compares the inverted-T and vertical skin resection patterns.

Lateral Skin Resection Pattern

Lateral skin and parenchymal resection patterns alone, as described by Dufourmentel and Mouly, result in medial displacement of the nipple-areola complex. This shape is unacceptable in larger reductions. When designed separately from the skin, parenchymal resection can achieve an acceptable result. The tissue is resected using various pedicles, and the skin excision is tapered laterally. Lateral skin resection avoids the unsightly medial inframammary scar that can occur with the inverted-T resection but still sometimes results in medial displacement of the breasts and an unattractive shape.

The B technique (Regnault) was a variation on the lateral resection. It used a superior pedicle and tapered the skin resection laterally, leaving a B-shaped scar. This method did not achieve general acceptance, because the design is somewhat complicated.

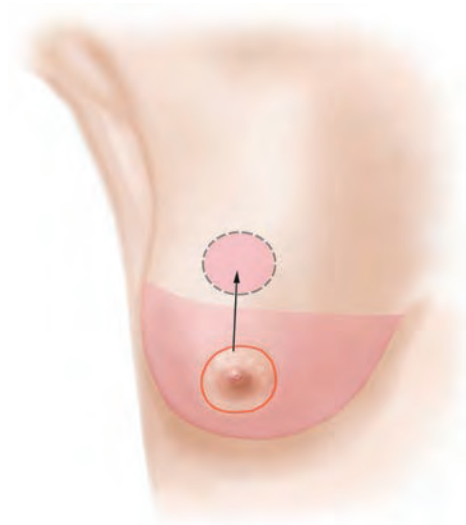
Circumareolar Skin Resection Pattern



Small breast reductions can be performed through a circumareolar skin excision where the “donut” is sutured to the “hole” during closure. Benelli has described a “round block” technique, but it has not achieved wide acceptance. With this technique the skin must be separated from the gland first so that there is minimal tension on the skin closure. A permanent suture is still required to prevent scar widening. This method can be applied to small reductions and mastopexies with minimal ptosis.

Sampaio Goés has used absorbable and permanent mesh to help hold the shape of the rearranged gland, but this mesh is not available in North America. Surgeons also have used dermis as a sling or support mechanism, but skin and dermis are well known for their elastic properties; they both stretch when placed under tension.

Pattern With No Vertical Scar



For a skin resection pattern that avoids the vertical scar, most surgeons use a form of broad-based inferior pedicle. This works well for very large breast reductions, but even with parenchymal rearrangement, the breasts tend to be flattened and lack upper pole fullness. Many surgeons believe that the vertical scar is less of a problem aesthetically than the long scar in the inframammary fold. The vertical incision may be more visible in frontal view, but it is less prone to develop hypertrophic wide scars than the inframammary fold incision.

Liposuction-Only

Liposuction alone can be an effective technique, but it relies on skin elasticity and retraction. The nipple can rise to a higher position if liposuction is performed above the areola, but this can lead to loss of upper pole fullness. The breasts tend to be flatter and have residual ptosis.

Liposuction has a lower risk of complications. Nipple necrosis is less likely, and sensation and breast-feeding potential are more likely to be preserved. The procedure is more easily performed in a fatty breast, such as the already ptotic perimenopausal breast. This procedure does not work well in the most ideal indication: a teenager who is of normal body weight. Teens can have thick, fibrous, glandular breasts with minimal fat. This approach has been advocated for medically compromised patients, because it is a relatively fast procedure and some consider it less invasive.

Blood Supply to the Nipple-Areola Complex

Pedicles can have many different variations, but they are generally classified as horizontal, vertical, inferior, superior, central, lateral, and medial.

Horizontal Bipedicle

The horizontal bipedicle (Strombeck) combined a laterally based circulation to the areola with a medially based circulation. A dermal pedicle was usually sufficient but often caused nipple retraction. The more robust dermoglandular pedicle was also more difficult to mobilize and inset. This approach fell out of favor because of these difficulties.

Vertical Bipedicle

The vertical bipedicle (McKissock) offered a significant improvement because it provided sufficient circulation to the nipple and was not as difficult to inset. It remained the mainstay of breast-reduction surgery in North America in the 1970s but has since been abandoned by most surgeons.

Inferior Pedicle



The inferior pedicle was embraced by many surgeons when it was discovered that the superior portion (which was difficult to inset) of the vertical bipedicle was not necessary for circulation to the nipple-areola complex and that the inferior pedicle alone satisfied many of the goals of breast reduction: adequate circulation, good sensation, and breast-feeding potential.

Superior Pedicle



Although many surgeons embraced the inferior pedicle, the superior pedicle was still being used, especially in Europe and South America. Some surgeons strongly believed that the superior pedicle caused less ptosis, because it involved removing the heavy inferior tissue. The superior pedicle alone also had good circulation but was not as easy to inset. This pedicle often had to be thinned to allow for inset, causing concerns about the blood supply, sensation, and breast-feeding potential. When the anatomy is clearly understood, however, the only drawback is in breast-feeding potential, as it would be with any dermal (rather than dermoglandular) pedicle.

Central Pedicle



Some surgeons modified the inferior pedicle and instead removed the dermal component and based the nipple-areola complex on a central or posterior pedicle. This pedicle is based on the same blood supply as the inferior pedicle—the perforating artery through the pectoralis muscle that enters the breast usually just medial to the breast meridian a few centimeters above the inframammary fold. The perforating ar-

tery has accompanying venous drainage, which meant that surgeons did not need to rely as much on the dermal bridge for venous drainage as was needed with other pedicle designs.

Lateral Pedicle



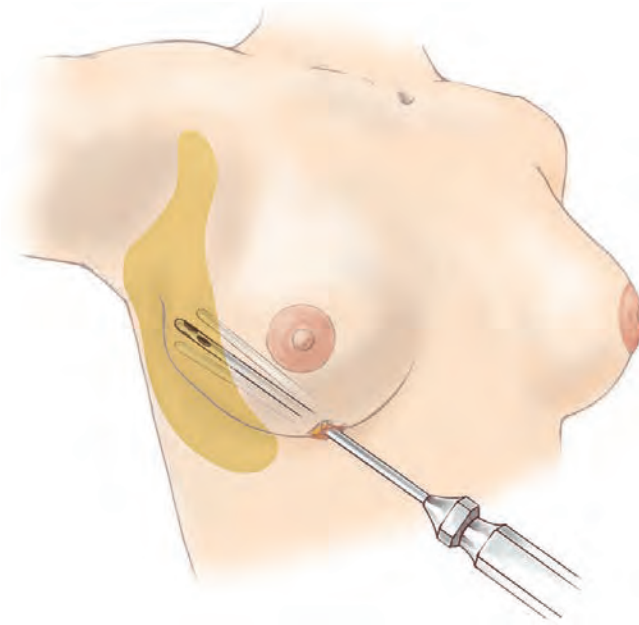
Just as it became evident that the dual circulation through the vertical bipedicle was unnecessary, it also became evident that the dual circulation through the horizontal bipedicle was unnecessary. These bipedicles were not easy to inset without depressing the nipple-areola complex. The lateral pedicle was used, but it was overshadowed by the successful application of the inferior pedicle.

Medial Pedicle



The medially based pedicle was also discovered to have a good blood supply, but again, it was relatively ignored. Because surgeons mistakenly thought that the only innervation to the nipple came superficially through the lateral fourth intercostal nerve, they believed the medially based pedicle would interfere with sensation.

Liposuction-Only



Liposuction alone for breast reduction does not require a pedicle for the blood supply to the nipple. The nature of liposuction is that it leaves major vessels and nerves intact and thus revolutionized our approach to body contouring surgery in the 1980s and beyond. Liposuction does not work well when the breast tissue is mainly glandular. Because no skin is removed, the shape is limited by the ability of the skin to retract.

Free Nipple Grafts

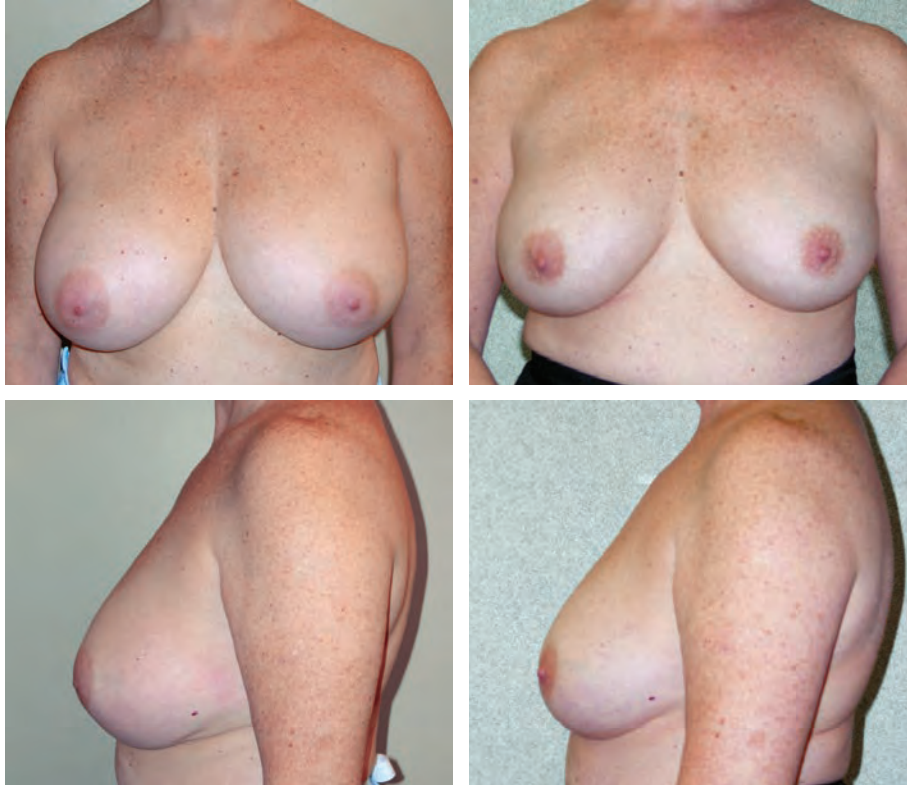
Removing the nipple-areola complex completely and replacing it as a graft has not gained the popularity it probably deserves. It is a good method, especially in large breasts where neither sensation nor breast-feeding potential is an issue. Although free nipple grafts will lose some projection of the nipple and can result in some patchy depigmentation, the cosmetic result is usually good. The use of free nipple grafts allows unparalleled parenchymal resection. They are a good option in the very large breast or in a breast where the pedicle to the nipple-areola complex is particularly long.

**5**

71-1 Free nipple
graft technique

Patient Profiles

The following patient examples demonstrate a range of problems, with indications for different breast reduction techniques.



This 49-year-old patient was quite pleased with the results of her liposuction-only breast reduction. She was 4 feet 11 inches tall, weighed 52 kg (115 pounds), and wore a 34 D brassiere. Preoperative preparation included marking her for a vertical reduction in case the liposuction did not succeed. From the right breast 600 cc of fat was aspirated and from the left breast 575 cc was aspirated. Postoperatively, her nipple position was elevated by 1.5 cm on each side.



Although it would be ideal to perform liposuction-only breast reduction in young patients of normal weight, the breast tissue in these young women is often too thick and fibrous for liposuction. For example, liposuction alone in this 24-year-old patient would not be applicable. She was 5 feet 2 inches tall, weighed 54 kg (118 pounds), and wore a 34 DD brassiere. A vertical approach was used with 475 g removed on the left and 350 g on the right. The postoperative photos were taken at 6 months, when the scars were still hypertrophic.



This 37-year-old patient, who requested a liposuction-only breast reduction, was a better candidate than the previous patient shown, because she was older and slightly overweight. She was 5 feet 8 inches tall, weighed 77 kg (170 pounds), and wore a 38 DD brassiere. Because she had a relatively high nipple position, she underwent liposuction alone. Volumes removed were 625 cc from the right side and 675 cc from the left side. The patient lost upper pole fullness and was not happy with the shape. She returned at 1 year requesting a mastopexy.



This 22-year-old patient had breast reduction with an inverted-T skin resection pattern with an inferior pedicle for the nipple-areola complex. Unfortunately, because she was prone to hypertrophic scar formation, this was not the best approach for her. All the scars were noticeable, but the scar along the inframammary fold was particularly thick. Perhaps a vertical skin resection pattern would have been more appropriate for her.



This 37-year-old patient might have had too long a pedicle (18 cm [7 inches]) for the vertical approach with a medial pedicle. An inverted-T inferior pedicle would have been a good choice, but I decided to use free nipple grafts with a vertical skin resection pattern. A T was added because the length of the vertical scar exceeded 18 cm. She had 1355 g removed from the right breast and 1325 g from the left breast. She was 5 feet 5 inches tall, weighed 104 kg (230 pounds), and wore a 42 F/G brassiere. A further reduction, especially of the lower pole, would improve the result.



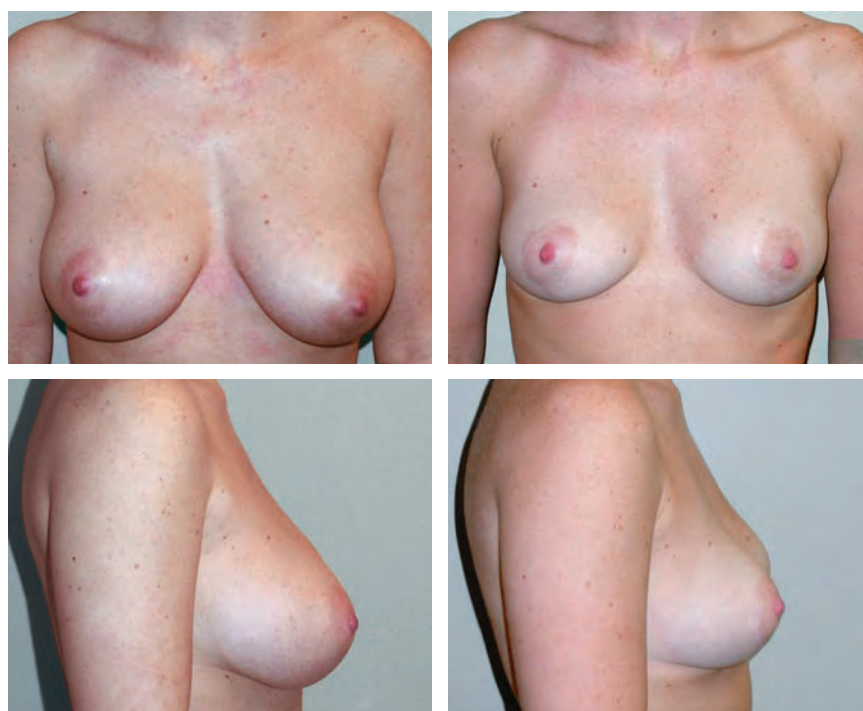
This 15-year-old patient is also a poor scar-former. She had surgery with the vertical pattern and a medially based pedicle for the nipple-areola complex. She was pleased with the result of the breast reduction and, fortunately, did not need an inframammary scar.



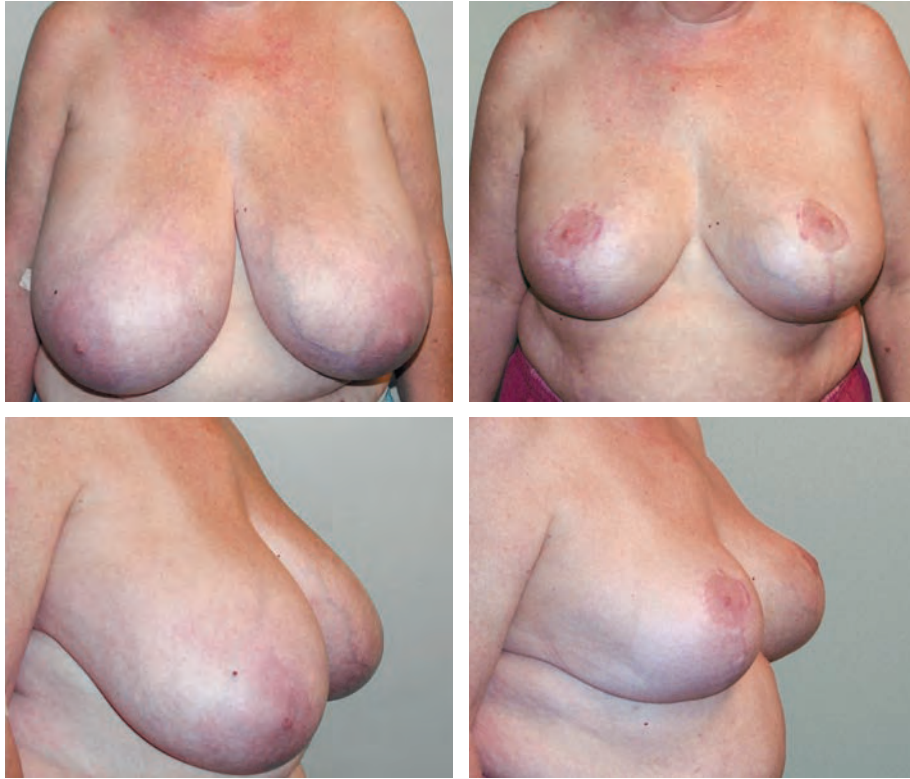
These images show how little fat was present in her breasts. Liposuction alone would not have been successful.



Most patients are appropriate candidates for the vertical approach. This 34-year-old patient had 625 g removed from the right breast and 720 g removed from the left breast. She was 5 feet 7 inches tall, weighed 84 kg (185 pounds), and wore a 36 F brassiere.



A vertical approach was successful for this 24-year-old patient. She was 5 feet 4 inches tall, weighed 56 kg (123 pounds), and wore a 34 D brassiere. She had 295 g removed from the right breast and 315 g from the left breast.



Most surgeons have the impression that the vertical approach does not work well for large breast reductions, but this patient shows the vertical technique's versatility. This 56-year-old woman was 5 feet 2 inches tall, weighed 82 kg (180 pounds), and wore a 38 H brassiere. From the right breast 1475 g was removed and 1400 g from the left breast. Photos taken 3 years postoperatively show maintenance of projection and shape.

Physical Examination and Preoperative Planning

Much of preoperative planning depends on a thorough understanding of breast aesthetics and the patient's goals. Photographs and digital imaging can be helpful to the patient when determining the desired size and shape.

The breasts are examined for masses or unusual shapes, asymmetries, or problems. Scoliosis, pectus deformities, and rib prominence need to be assessed. The chest circumference is measured at a level under the axilla. This measurement is the closest to bra size. If the chest measures 38 inches, then the patient is told to try a 38 size bra first. (Patients have often been wearing too tight a bra. Otherwise the breasts fall under the band or the back rides up too much.) The size along the inframammary fold is also measured. The inframammary fold is marked while the measuring tape is held along the fold. Next the distance between the suprasternal notch and the inframammary fold in the midline is measured. These measurements are for postoperative analysis. We also document that we discussed nipple sensation levels.

Inverted-T Technique

It is important to mark the breast preoperatively and determine the new nipple position. The key landmarks are the breast meridian, the inframammary fold, and the upper breast border. The surgeon should make the following determinations:

- Position of the inframammary fold (using the tape measure)
- Transposition of the inframammary fold to the front of the breast to determine the new vertical nipple position while being aware that the upper breast border will not change postoperatively
- Breast (chest wall) meridian to determine the new horizontal nipple position
- Breast meridian markings using the Wise pattern
- Distance of the vertical limbs
- Design of the areolar opening (either preoperatively or using a triangle if done intraoperatively)
- Pedicle design (usually superior, inferior, or central)
- Areas to be suctioned

The following measurements are also taken:

- Distance from the suprasternal notch to the nipple on both sides
- Distance from the inframammary fold to the nipple on both sides
- Suprasternal notch to the new nipple position on both sides (should be lower on a larger breast)

The following photographs demonstrate how the markings are made. These are the same initial markings as made for the inverted-T inferior pedicle.

Position of the Inframammary Fold: Using the Tape Measure



A good way to determine the new nipple position is to use the method described by Grading. He places a measuring tape along the fold under one breast and over the top of the other breast. He also uses a weighted tape measure around the neck to determine the true breast meridian. It is helpful to put the tape under both breasts and mark the position at the inframammary fold at the midline.

Determining the New Vertical Nipple Position



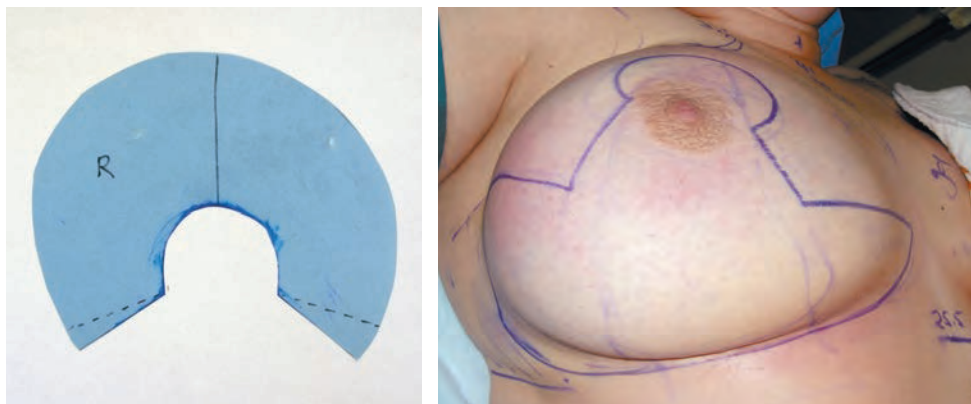
The fold level can vary from one patient to another. It can be marked with the tape measure, as shown above, or with the transposition of the marking anteriorly from the finger placed under the breast in the inframammary fold (left). Descriptions exist in which an arbitrary distance is marked from the suprasternal notch, or a point is marked in reference to the midpoint of the humerus. Unfortunately, these can be misleading, and reliance on anything but the level of the inframammary fold preoperatively can be disastrous. Sometimes the fold is abnormally high or low; in this case, the upper breast border is a better landmark because it does not change postoperatively. This patient's fold was almost at her elbow crease.

Determining the New Horizontal Nipple Position



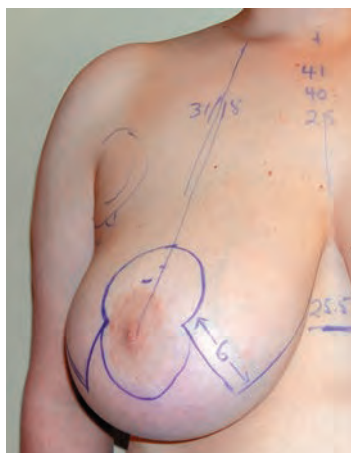
The vertical breast meridian is marked by dropping a line from the midclavicle to the midbreast or midchest position. The line does not necessarily go through the nipple, but should be drawn for an ideal nipple position on the chest wall. If excessive lateral tissue will be removed, the true meridian would fall on the chest midline rather than the midline of the existing breast.

Breast Meridian Markings Using the Wise Pattern



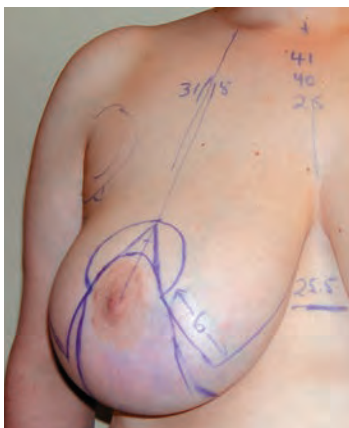
This is the Wise pattern and is taken from his article and transferred onto x-ray film. The areola circumference measured 14 cm. The dotted lines show how the vertical limbs can be positioned differently, depending on how much skin is to be removed. The distance of the vertical limbs measured 5 cm.

Distance of the Vertical Limbs



In this patient, a superior pedicle was designed, and the distance of the vertical limbs was 6 cm. The vertical limbs of the resection are limited to 5 to 6 cm to prevent bottoming out of the breast postoperatively. The angle of separation between the vertical limbs depends on the amount of tissue to be resected, while trying to match the distance of the resulting skin length between the upper flaps and the lower incision along the inframammary fold.

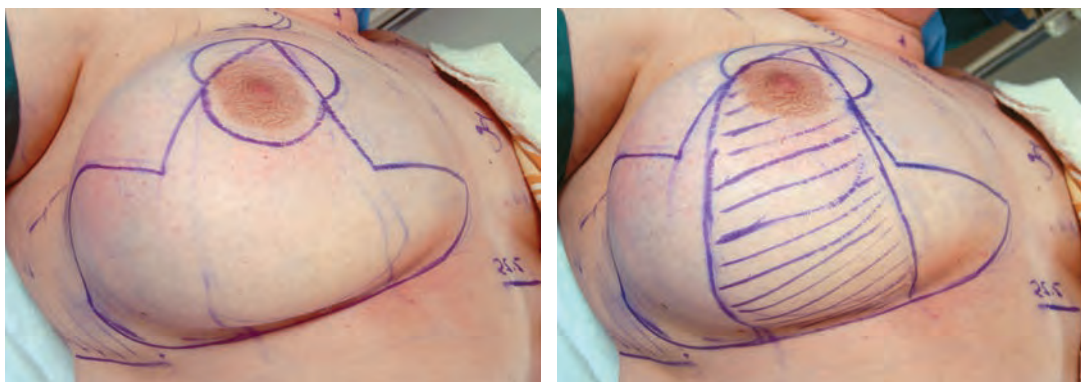
Design of the Areolar Opening



The design of the areolar opening is determined either preoperatively or by using a triangle if done intraoperatively. The design in this patient was drawn as an inferior pedicle (a superior pedicle would be a better choice because of the short distance). Here the areolar opening has been drawn according to the Wise pattern and as a triangle in which the design will be determined intraoperatively after the resection.

The skin resection follows the Wise pattern with a keyhole opening for the nipple-areola complex and an excision that gives an anchor-shaped skin closure. Some surgeons design the keyhole preoperatively, whereas others prefer to incorporate an areolar opening once the resection has been performed. The areola itself is reduced and the new areola diameter is designed usually between 3.5 cm and 4.5 cm. This means that the skin opening should measure about 14 cm in circumference to avoid scar widening.

Pedicle Design



The pedicle design (usually superior, inferior, or central) is separate from the skin resection pattern. The patient above would be best served with a superior pedicle (as shown on the left) because the inset would be relatively easy. An inferior pedicle is also marked for comparison. The areas to be suctioned are the preaxillary fullness and the lateral chest wall fat.

Vertical Technique

The surgeon should make the following determinations and then mark the breasts accordingly:

- Position of the inframammary fold (using a tape measure) while being cognizant of the level of the upper breast border
- Breast (chest wall) meridian to determine a new horizontal nipple position
- Transposition of the inframammary fold to the front of the breast to determine the new vertical nipple position
- Breast meridian by rotating the breast laterally and medially (as shown by Lejour)
- Inferior extent of skin resection: 2, 4, and 6 cm above the inframammary fold
- Design of the areolar opening
- Design of the pedicle (usually superior or medial, sometimes inferior)
- Areas to be liposuctioned

These additional measurements are also made:

- The distance from the suprasternal notch to the nipple on both sides
- The distance from the inframammary fold to the nipple on both sides
- The suprasternal notch to the new nipple position on both sides (should be lower on the larger breast)
- The distance from the suprasternal notch to the inframammary fold in the midline
- The circumference of the new areolar opening (16 to 20 cm)
- The circumference around the skin resection pattern (divided in half, it should be the vertical scar length while standing)

The photographs that follow show how the markings are developed (these are the same initial markings as made for the inverted-T inferior pedicle).

Position of the Inframammary Fold: Using the Tape Measure



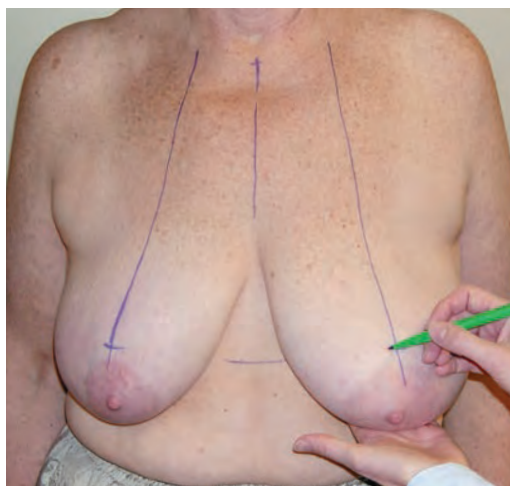
This photograph shows placement of the tape measure beneath the breasts and marking of the inframammary fold position. The level of the inframammary fold can vary considerably from patient to patient.

Determining the New Horizontal Nipple Position



Note that the meridian marking is independent of the current nipple position. The marking should be at the chest wall and breast meridian. If there is a significant amount of lateral breast tissue, select the chest wall meridian rather than the breast meridian. It is easy to be misled into marking the meridian through the nipple, but the surgeon should be careful to ignore the actual nipple position and mark where the nipple should be.

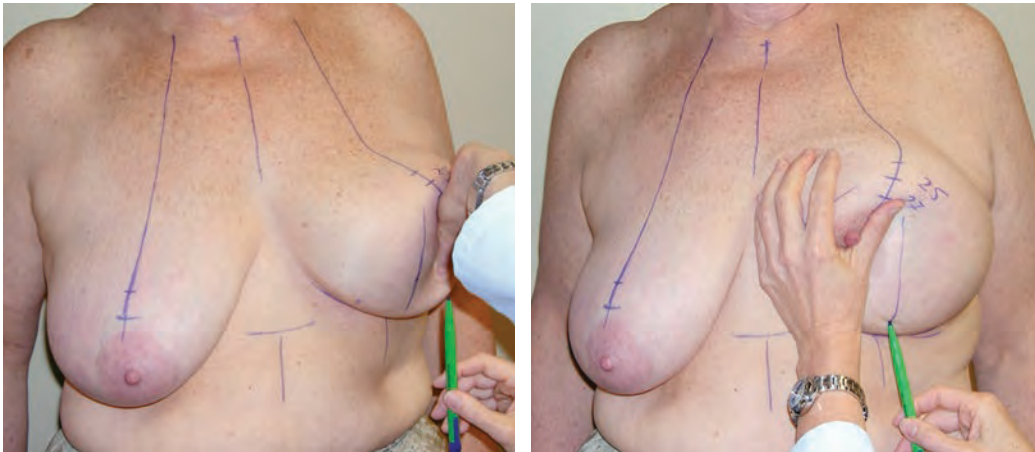
Determining the New Vertical Nipple Position



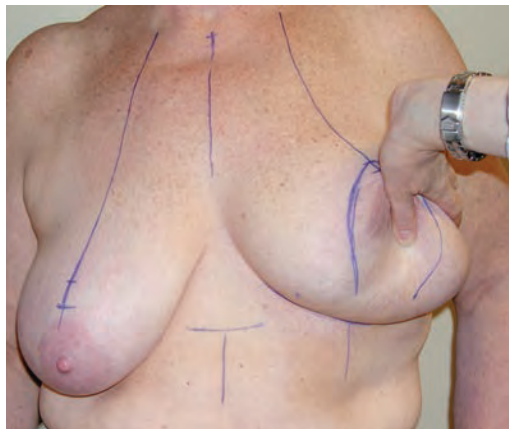
Transposition of the inframammary fold to the front of the breast will assist the surgeon in determining the new vertical position for the nipple. Placing the finger in the inframammary fold can be used alone, but marking the inframammary fold first with the tape measure helps considerably. With the finger maneuver, the tendency is to place the nipple position much higher than the true inframammary fold level. When the patient has a good deal of upper pole fullness, the surgeon can make the mark higher—the nipple should be at the most projecting part of the breast. But if the patient has little upper pole fullness, care must be taken to keep the new nipple position low. It is important to be aware that the upper breast border is an important landmark.

The new nipple position must be placed about 2 cm lower than what the surgeon is used to when performing an inverted-T procedure. This lowering is important to accommodate the increased projection that results with this procedure. It is also necessary because closure of a vertical ellipse tends to push the nipple even higher. (It is for this latter reason that the new nipple position needs to be lowered in the larger breast to achieve a symmetrical result.) If the patient does not have much upper pole fullness, this lowered nipple position is essential.

Marking the Breast Meridian by Rotating the Breast Laterally and Medially

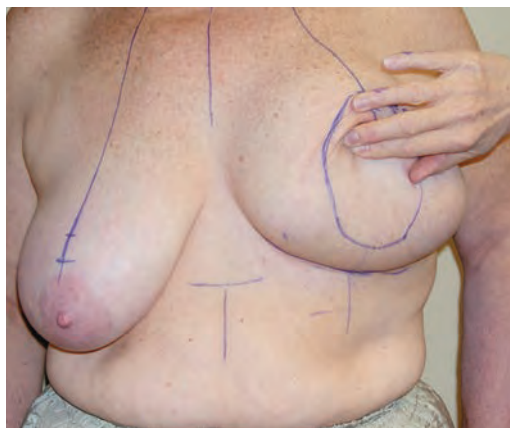


Lejour marked the breast meridian resection pattern by rotating the breast upward and outward and then upward and inward to join the meridian marked on the upper breast to the meridian marked on the chest wall below the inframammary fold.



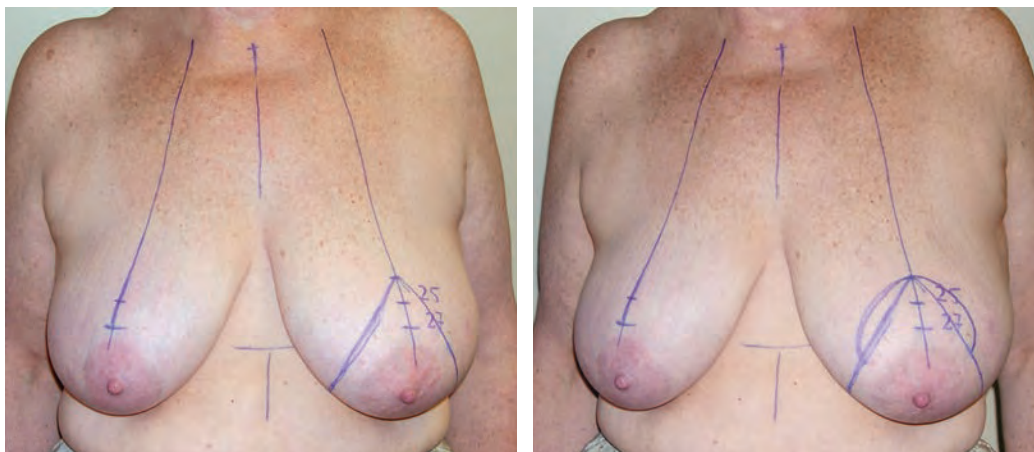
The design does not remove much skin. The closure should not be under tension. In fact, the skin can be quite loose at closure because the skin is not being used to hold the shape. We are so accustomed to using the skin brassiere to hold the shape with the inverted-T that many surgeons put lateral tension on the vertical closure. Not only is this unnecessary, but it can lead to wound-healing problems.

Inferior Extent of the Skin Resection

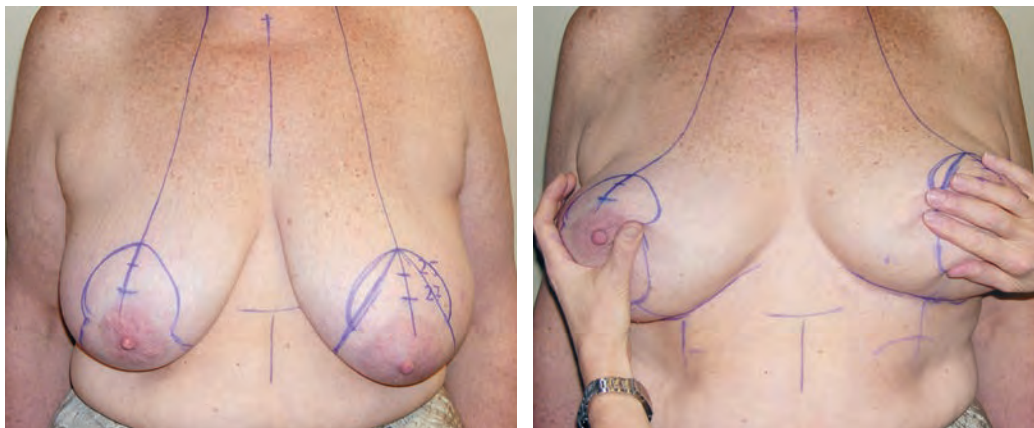


The vertical lines are then joined well above the inframammary fold. In a small reduction (less than 300 g) the lower portion of the U should be at least 2 cm above the inframammary fold. In a larger reduction (300 to 600 g), at least 4 cm of a skin bridge should remain. For a larger resection 6 cm and more should be left. This extra skin is important; otherwise the scar will go below the fold as the ellipse is closed. Some surgeons believe that a V closure is less likely to cause the scar to extend below the fold onto the chest wall, but the U is essential to encourage adequate removal of the excess subcutaneous tissue that causes a postoperative pucker.

Design of the Areolar Opening



Some surgeons prefer to design the areolar opening at the end of the resection. In this case the new nipple position was initially marked at the level of the inframammary fold, which was 27 cm from the suprasternal notch. Because the inframammary fold was low, it was decided to elevate the fold during the surgery (*above right*) and the new nipple position was elevated to 25 cm from the suprasternal notch. The vertical incisions were then joined as a triangle for a later areolar opening design.



For surgeons who prefer to mark the areolar opening before surgery, an opening is designed that will close as a circle. Lejour drew a mosque-shaped design, but I prefer a design that does not extend horizontally. The important aspect of the areolar opening is that it is a circle when closed. I usually make the areola about 5 cm in diameter. The ideal circumference of the areolar opening would be 16 cm but can be extended to 18 to 20 cm without significant areolar or scar widening.

The symmetry of the areolar design and skin resection pattern is checked.

Design of the Pedicle

The medial and laterally based pedicles have already been discussed in previous chapters (see Chapters 68 and 69).



With the superior pedicle, the areolar opening becomes the base. For most moderate-sized breasts this is a purely glandular pedicle. For larger breasts or for the nipple-areola that is significantly displaced inferiorly, a dermal component extending beyond the areolar opening is necessary. Insetting of these long glandular dermal pedicles can be challenging as the pedicle has to be folded in order for the nipple to be inset in the appropriate position. This is perhaps the major shortcoming of the superior pedicle and has led many to choose the medial pedicle over the superior for these patients.

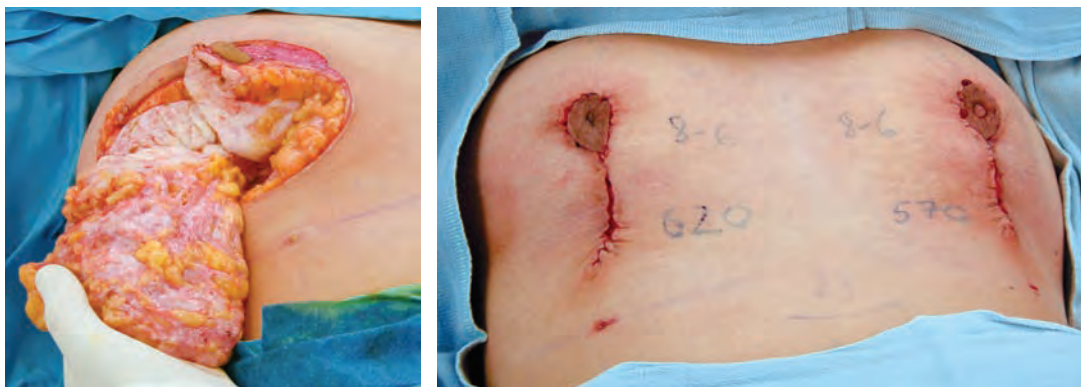
Liposuction-Only

Preoperative planning for liposuction depends only on whether the patient wishes to undergo a definitive procedure if the liposuction alone does not produce much aspirate. The breast is marked preoperatively to indicate the areas of increased fullness and to determine which areas will need the most concentration.

The patient is usually marked for a vertical approach and then the areas to be suctioned are also marked. If the patient does not have much upper pole fullness, this area is avoided. On the other hand, if this area is not suctioned, there will be little upward movement of the nipple-areola complex. Some superficial liposuction above the areola is needed for upward migration.



This patient had a high nipple position and lots of upper pole fullness. She wanted to try liposuction-only breast reduction, but she was 18 years old and not overweight at 55 kg (122 pounds). She was 5 feet 2 inches tall and wore a 38 C brassiere. She agreed to have the vertical approach if liposuction failed. Unfortunately, only a minimal amount of fat was removed with liposuction-only.



She then underwent a vertical breast reduction with a medial pedicle; 620 g was removed from the right breast and 570 g from the left breast. The photograph on the left shows how little of the breast tissue was fat.

Operative Technique

Inverted-T Breast Reduction

Inferior Pedicle



Care must be taken not to undermine the full-thickness pedicle when incising it down to the chest wall. The pedicle is “floppy,” so care must be taken not to disturb the perforating artery branch from the internal mammary system through the pectoralis muscle. This perforating artery is not visualized during the dissection. Although vessels from the dermal bridge inferiorly are not as robust, they still can contribute significant arterial inflow and venous drainage to the inferior pedicle. This can be important when the perforating artery is negligible, especially because there is no way to determine this preoperatively. The inferior pedicle is therefore probably more reliable than a purely central pedicle.

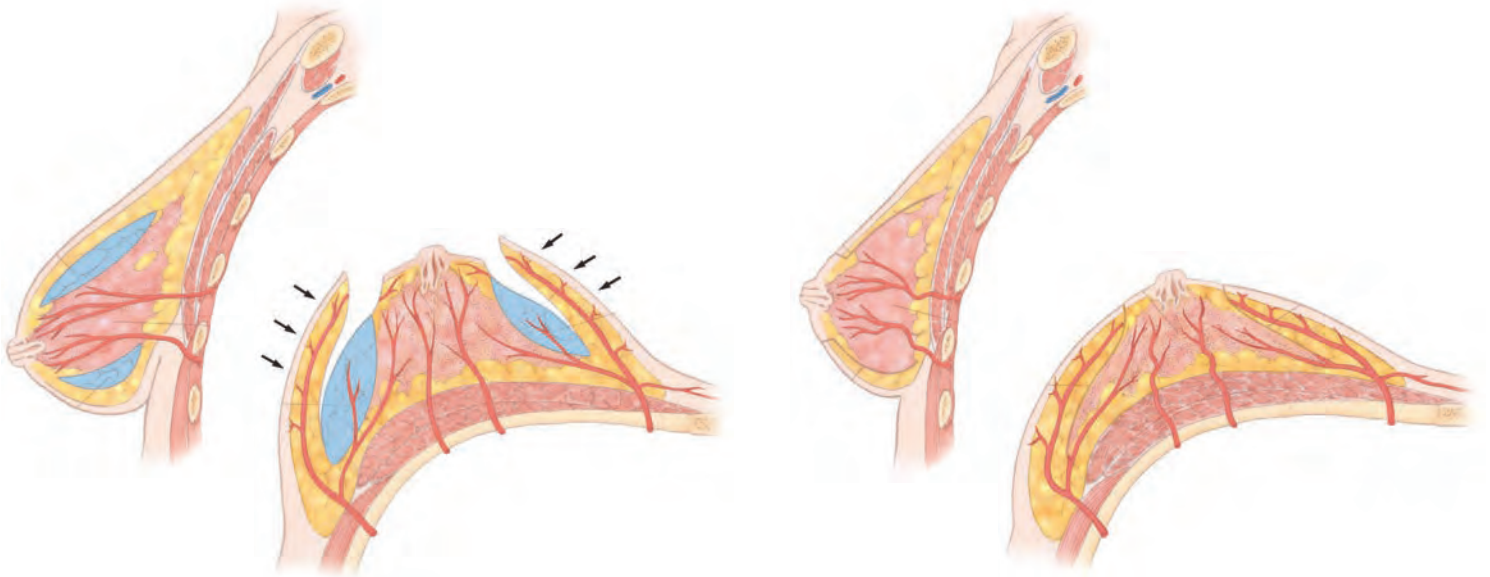
The parenchymal resection follows the skin resection pattern. With the inferior pedicle, the flaps are drawn together over the pedicle after resecting breast tissue superiorly, inferiorly laterally, and inferiorly medially. An inferior pedicle has a relatively broad base of at least 6 to 10 cm and is a full-thickness pedicle. Care must be taken because it is not difficult to inadvertently undermine the pedicle.

A skin-length discrepancy often occurs horizontally. An attempt is made to bring the tissue toward the meridian to try to avoid a boxy shape, while trying to flatten the resultant dog-ears as they are chased medially and laterally. The result is a breast shape held together by the skin brassiere. The use of drains and antibiotics varies from surgeon to surgeon.

Central Pedicle



The illustrations below and on p. 2562 are derived from John Bostwick's description of the central pedicle. His concept of the arterial blood supply is clearly outlined, showing how arterial input is preserved with the central pedicle incisions.



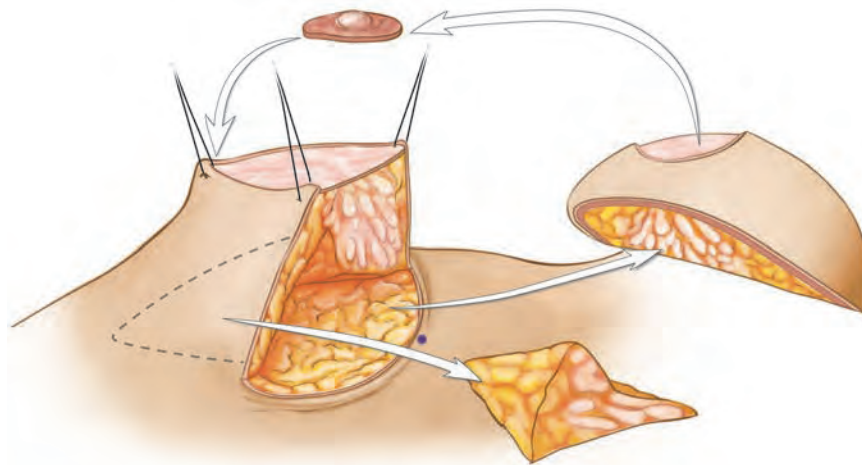
Medial and lateral resections narrow the breast. Central pedicle vascularity is preserved by the central and peripheral vessels. Superior and inferior resections permit lifting the breast and removing ptotic tissue while shifting the breast parenchyma upward. The central pedicle is nourished by musculofascial perforating arteries and by flow coming from the periphery via the medial and lateral intercostal perforating and external mammary arteries. The central mound must not be resected to such a degree that the underlying perforating vessels coursing into it and into the areola are compromised.



The central pedicle surmounted by the nipple-areola complex is moved to its new position, and the incisions are closed in a lateral to medial direction. The excellent mobility of the pedicle and the nipple-areola make this technique especially good for large ptotic breasts.

Free Nipple Grafts

Free nipple grafts may be used independently of the skin resection pattern chosen. Some form of pedicle must be retained as a bed for the graft; this usually involves leaving some tissue attached to the areolar opening. Since no significant length is involved, maintaining blood supply to this tissue is not an issue. It is usually superiorly based with a triangle of tissue removed inferiorly to create a circle.



This resection will permit some narrowing of the breasts during closure. The inferior and lateral resected portions of the breast parenchyma are shown.

Vertical Breast Reduction

This technique is described in Chapters 68 and 69.

Liposuction-Only Breast Reduction

Since no pedicle is needed for the nipple-areola complex and there is no skin undermining, liposuction poses fewer risks to blood supply. Nor does it typically impair sensation and breast-feeding potential.

Some claim that liposuction-only is good for patients with medical problems because it is less invasive. Liposuction should be treated as a major surgical procedure, however, and the recovery is not necessarily easier.

The breast is infiltrated with tumescent-type fluid. Liposuction is performed through one or two small incisions. If the surgeon wants to achieve some skin retraction and nipple elevation, then some form of superficial liposuction must be performed above the areola. Care must be taken not to suction too much so as to avoid reducing upper pole fullness to any significant degree. Unfortunately, it is difficult to achieve much reduction in the upper outer quadrant because this tissue tends to be fibrous rather than fat.

Perimenopausal women have more fat tissue in the breasts than do teenagers. If a young woman is thin, it is unlikely that much tissue can be removed with liposuction. It is important to mark her for an open reduction if the liposuction does not remove much fat. As with other liposuction procedures, it can take about 6 weeks for the swelling to decrease and about 6 months for the breast to soften and for the lumpiness to settle.



This patient successfully underwent liposuction-only breast reduction. She had pre-operative markings for a vertical breast reduction in case liposuction alone was unsuccessful. Once the fluid settled, approximately 600 cc of fat was removed from each breast.

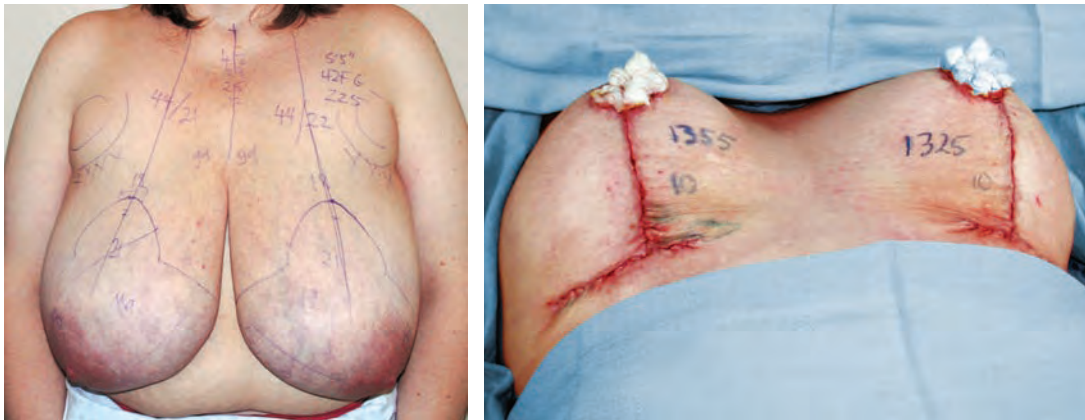
Postoperative Management

Inverted-T Skin Resection

Complications with inverted-T techniques usually consist of minor wound-healing problems, especially at the T junction. Nipple-areola necrosis can occur, and patients must realize that all breast reductions involve some reduction of blood supply to the nipple-areola complex. Patients rarely complain about the scars and shape because they are so pleased with the reduction in volume. On the other hand, it is difficult to prevent and treat the boxy shape and dog-ears that are early problems or the pseudoptosis and bottoming out that occur with time.

Free Nipple Grafts

With any skin resection pattern, free nipple grafts are covered with a bolus tie-over type of dressing that is left in place for approximately 1 week. Once the dressing is removed, the areola will look dusky, and portions of the nipple may look dark and desiccated. This is allowed to declare itself; over time the outer surface of the skin separates. Some depigmentation may occur, especially in dark-skinned individuals. Depigmentation may take more than 6 months to settle and repigment.



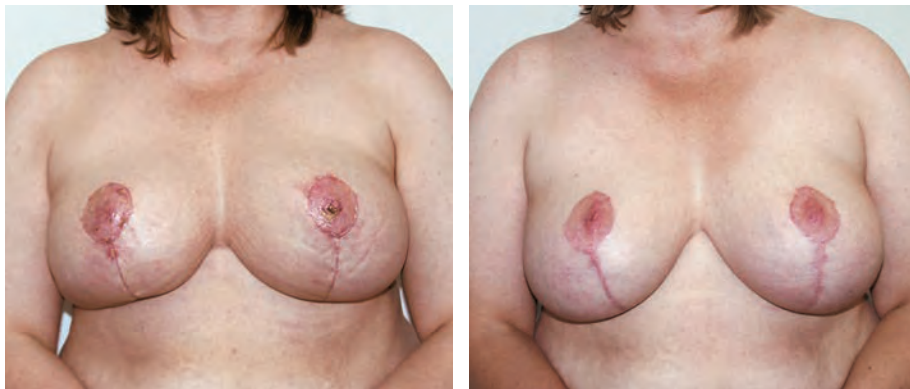
This 37-year-old patient had a vertical reduction designed, but the pedicle would have been excessively long (18 cm [7 inches]). It was therefore decided to convert to free nipple grafts.

In this patient a vertical skin resection (with a T to remove redundant skin) and free nipple grafts were used. The photograph shows the bolus dressings at the end of the procedure. Although 1355 g was removed from the right breast and 1325 g from the left breast, that was probably not enough and more should have been removed.



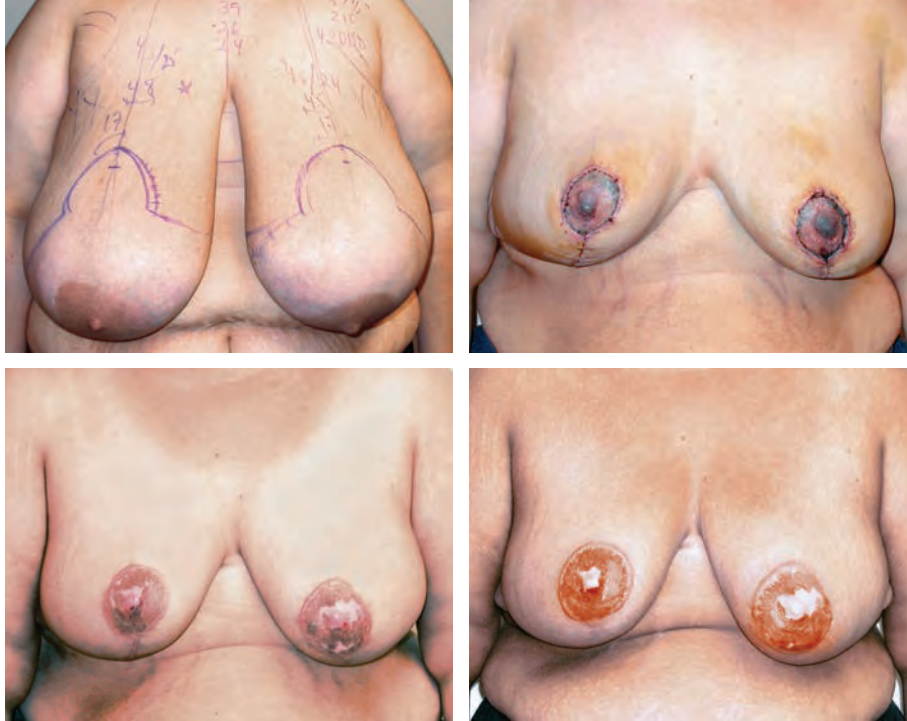
Six days after surgery, the nipple-areola complex looked a bit frightening. This is actually typical for free nipple grafts in the initial postoperative period.

Patients need to be informed preoperatively so that they can accept this stage. These photographs can help to reassure patients in the postoperative period.



This photograph of the same patient 3 weeks later shows a bit of blistering, but good color and nipple projection.

Four months after surgery the breasts appear underresected, but the free nipple grafts healed well.



This 27-year-old woman had problems with depigmentation. She had 2025 g removed from the right breast and 1770 g from the left breast. The result was less than satisfactory. The photographs were taken 7 days, 3 months, and finally 14 months postoperatively. She is scheduled for a revision.

Vertical Skin Resection

Vertical skin resection has a higher revision rate, possibly because the problems (most often puckers) can be more easily treated with the vertical approach than the problems (dog-ears and bottoming out) with the inverted-T techniques.

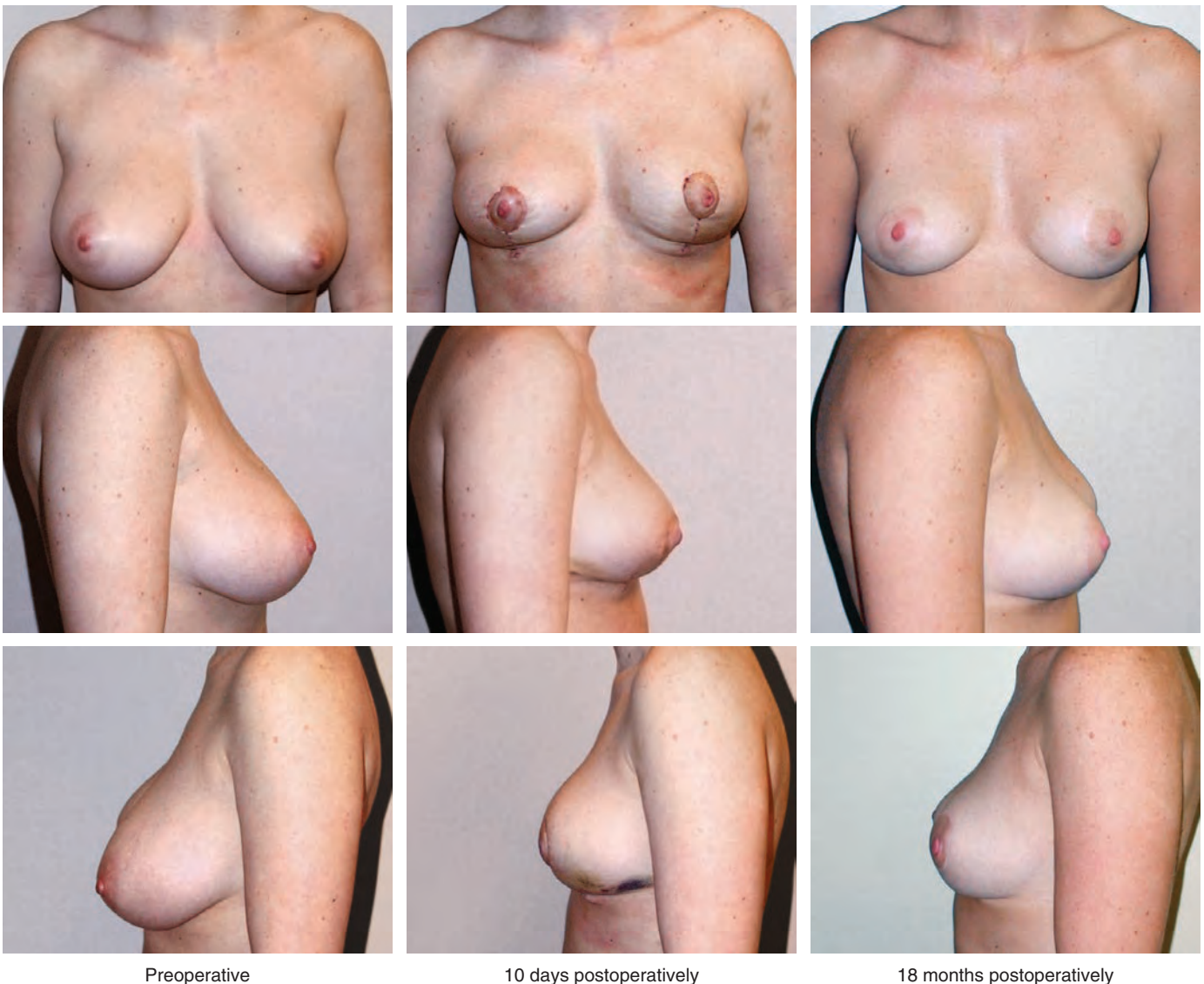
The vertical approach has a definite learning curve; it is best for surgeons to start with the opposite breast in a reconstruction patient or with relatively small reductions. Patients requiring larger reductions may be more accepting of irregularities. Patients who are well informed preoperatively understand that it may take weeks or even months for the shape to settle. The inverted-T technique has a learning curve as well, but practicing these techniques in residency reduces anxiety.

Puckers often can be revised under local anesthesia in the office. It is important to advise patients that a revision will not be considered until a full year has elapsed. Large puckers, correction of asymmetry, or further volume reduction may require general anesthesia.

Nipple necrosis is a serious complication. When it occurs, little can be done. Breast reduction is a blood supply-reducing operation. Although new nipples can be made (as in breast reconstruction), they do not look as good as the original.

Wound-healing problems still occur, especially at the lower end of the vertical incision, with larger breast reductions, and in the more obese patients. Again, patients are asked to leave these areas open to heal and to return for removal of any exposed deep sutures.

As nipple and areola sensation returns, patients may experience hypersensitivity, along with tingling and discomfort. Sensation may not return completely.



Preoperative

10 days postoperatively

18 months postoperatively

This 24-year-old patient is shown preoperatively, as well as at 10 days and 18 months postoperatively. She had a vertical approach with a medial pedicle; 295 g were removed from the right breast and 315 g from the left breast. Puckers that are evident initially usually settle and disappear. Patients are informed before surgery that they must wait at least 1 year before any kind of revision is considered. Preoperative counseling advises that 95% of patients worry about puckers, swelling, and asymmetry and that only 5% actually need a revision.

Liposuction-Only

Liposuction-only breast reduction does not require much in the way of postoperative care. Compression dressings are indicated, but it takes weeks for the swelling to settle and months for the induration to soften. Too much compression has been shown to cause skin necrosis.

Outcomes and Complications

Multiple studies have shown that breast reduction is outstanding in terms of outcomes research (something insurance providers seem to ignore). Back pain, neck pain, shoulder grooving, rashes under the breasts, and even headaches are significantly relieved. Patients feel much more comfortable, and they can more easily participate in sports and other physical activities. They sit, stand, and walk with better posture and have better exercise tolerance.

Many patients comment on how much better they feel immediately after surgery—the evening of the same day. Patients have the surgery as day procedures, or they may stay over one night in the hospital. The vertical approach has reduced operating time in half. It now takes us about 90 minutes to complete a breast reduction, whereas it used to take about 3 hours for an inverted-T inferior pedicle approach. Both pain levels and recovery time are also significantly reduced.

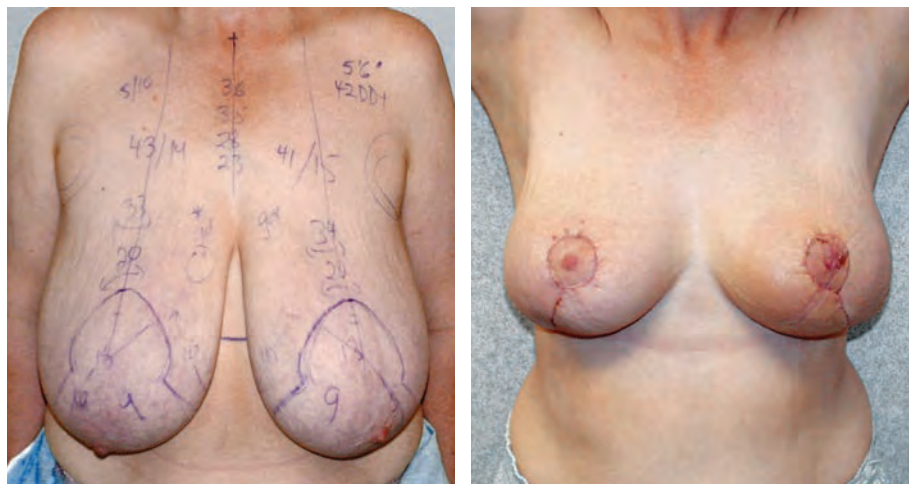
Immediate Complications

Immediate complications may include hematoma, seroma, circulation problems, and infection.

Hematoma



Hematoma had not been a problem until I (E.H.-F.) started using tumescent-type infiltration. It is clear that some of the vessels (the perforating artery from the pectoralis muscle) were in spasm from the infiltration in at least two of my cases. One must actively find these vessels and cauterize them.



This 52-year-old patient was 5 feet 6 inches tall, weighed 76 kg (168 pounds), and wore a 42 DD brassiere. She had 740 g removed from her right breast and 700 g from her left breast. She was taken back to the operating room that evening to evacuate the hematoma. The postoperative photograph shows her result at 6 weeks.

Seroma

Seromas can occur after breast reduction surgery but do not necessarily need to be aspirated. Some surgeons place drains and others do not. I (E.H.-F.) no longer use drains unless the operation has been particularly “wet” or the reduction has been large.

Nipple-Areola Necrosis

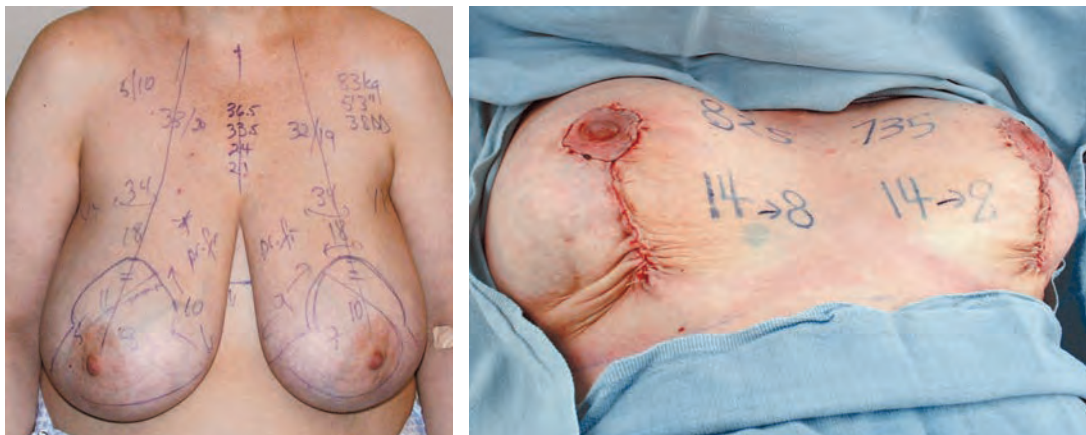
The nature of breast-reduction surgery is such that in removing a significant amount of breast tissue we reduce the blood supply. Often the nipples look pale or dusky at the end of the operation. Recovery is expected, but the course is unpredictable. The literature contains numerous suggestions as to how the nipple-areola complex may be salvaged. The problem is that there is no good way of evaluating which areolae will completely recover, blister, develop a necrotic edge (that heals uneventfully), or progress to frank necrosis. Examination does not reveal the answers. Clear engorgement and congestion could herald venous trouble that might respond with reoperation. But for those of us with significant experience, venous problems are rarely the cause. The areola usually is somewhat pale and dusky. Capillary refill testing may not be clear. Tissue oxygenation assessment is not accurate.

Active intervention is fraught with difficulty and potential complications. Removing sutures may delay healing. We have all seen those patients who healed well and in whom intervention could have caused more complications. Is it worth removing the nipple and areola and converting it to a free graft when the result could be less than satisfactory (with decreased projection, patchy hypopigmentation, loss of sensation, and loss of breast-feeding potential)? If we could judge the difference between the “normal” pedicle and compression or kinking, reoperation might be of value. All we

know now is that clear venous congestion would probably benefit from surgery. But this is rare. For the same reason, applying leeches would only treat venous congestion; most of us believe that nipple necrosis develops from lack of arterial inflow. This inflow restriction is caused by the surgery, and intervention has little to offer.



This patient developed necrosis that healed without intervention. The first postoperative photograph shows the patient 4 weeks after surgery. The second postoperative photograph is at 6 weeks, and the final photograph is at 4 months. Intervention would probably result in a less satisfactory outcome.



These photos show an example of complete necrosis. The right areola is slightly dusky at the 1 and 2 o'clock positions, but this is quite common in the immediate postoperative period. It is difficult to decide whether to observe or intervene.



The first photograph was taken at 10 days postoperatively, and the final photograph was taken at 3 months postoperatively. The necrotic tissue was removed in the office. The patient declined any form of reconstruction.

Flap Necrosis

Flap necrosis occurs more often with the inverted-T techniques, especially at the T junction itself.



Postoperatively this patient had an unusual pattern of necrosis accompanied by an infection in the right breast. Necrosis at the T on the left breast is fairly typical of the inverted-T techniques (although it is not usually associated with this degree of redness).



She healed well after debridement and healing by secondary intention. The final photographs are shown at 15 years postoperatively.

Infection

Infection can occur with any operation. It remains controversial as to whether to treat breast surgery patients prophylactically with antibiotics and, if so, for how long.

Late Complications

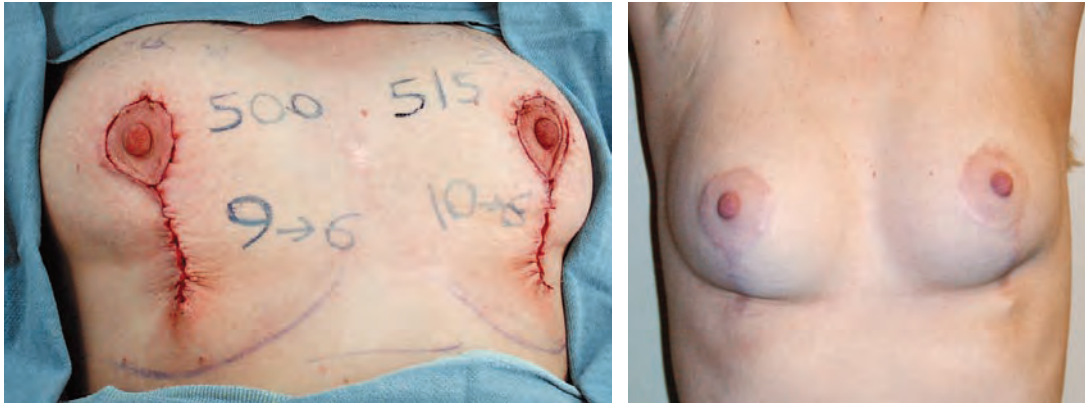
Late complications are related more to shape. Problems with the inverted-T techniques are related to the inframammary scar and the problem of medial and lateral dog-ears. The shape can be somewhat boxy and projection compromised.

Scars

This patient was a bad scar-former, but she convinced me to accept Lejour's challenge to try to improve scarring in my procedures.



With the vertical approach, the scar may fall below the inframammary fold if the markings are carried down to the fold initially. The lower end of the vertical skin excision should end about 2, 4, or 6 cm above the inframammary fold. This is important not only because the inframammary fold tends to rise with the vertical approach, but also because of the ellipse effect: the scar becomes longer in a vertical direction when the ellipse is closed.



Even 2 cm above the fold was not enough in this patient. Her inframammary fold was raised more than I expected.

Shape

Until the vertical approach became a routine technique in our practices, we were not aware that the results with the inverted-T were somewhat unsatisfactory. We had become accustomed to the boxy shape resulting after the inverted-T and had accepted it as inevitable. Fortunately, the coning of the breast tissue that occurs with the vertical approach has eliminated this problem. The problem of chasing lateral and medial dog-ears has also disappeared because the vector of pull is horizontal.



Although many patients have satisfactory scars with the inverted-T approach, it is not uncommon for patients to request correction of the medial and lateral puckers. However, there is really no good solution for these dog-ears.

Initially, when using the vertical approach, I (E.H.-F.) had a higher revision rate, about 5%, for persistent puckers at the inferior end of the vertical scar. Once I realized that the pucker resulted from excess subcutaneous tissue rather than excess skin, the revision rate decreased.

With the vertical approach the shape is better, with narrowing of the breast base and more projection, and lasts longer. The result at 1 year is the same as the result at 2, 3, and 10 years. With the inverted-T approach, the shape deteriorates to some degree each year, particularly when a patient became pregnant after surgery.



This patient initially had a good result with the inverted-T technique using an inferior pedicle. After having two children, her breast skin stretched and the shape bottomed out (*right*).



Much depends on skin elasticity and genetics. This patient had one pregnancy and the shape held.

It is unfair to attribute results to one skin resection pattern versus another, and it is probably even more unreasonable to compare techniques with different pedicles. The first patient had an inferior pedicle and the second patient had a medial pedicle. Was it the patient, the skin resection pattern, or the pedicle weight that made the difference? Probably a combination of the three influences the result, but the pedicle weight is a significant factor. With the medial or superior pedicle, the heavy inferior breast tissue is removed, leaving the desired superior breast tissue. With the inferior pedicle, we are leaving what we want to remove and removing what we want to leave. The skin resection pattern is partly to blame. Skin and dermis are notoriously unre-

liable at holding anything when stress is applied. In fact, both skin and dermis will adapt and deform with stress. The vertical approaches use the breast to shape the breast, and the inverted-T approaches use the skin to shape the breast. Shaping works best when it relies on inelastic tissues to take the stress.

Underresection

Recurrent ptosis is the result of leaving too much inferior breast tissue. Underresection is a particular problem in vertical breast reductions because it is difficult to gauge how much breast tissue should be removed. Surgeons who are comfortable preoperatively evaluating the amount of breast tissue to be excised should make certain they actually remove that amount and are not fooled into thinking that the breasts are smaller than they are at the end of surgery.



This patient did not have enough tissue removed in the lower pole (and her nipples were placed too high). She was marked for further excision, both by direct excision and liposuction.



This patient needed removal of lateral breast tissue and chest wall fat. The problem here was not one of underresection; rather, it was the result of not recognizing that the inframammary fold rises—especially laterally—and that the fat between the old and new inframammary fold should be removed.

Asymmetry



Asymmetry usually occurs in patients whose breasts are asymmetrical to start with. This series of images shows how the asymmetry was corrected. The solution did not rely on skin resection but on adjustment of the parenchyma with removal (both directly and with liposuction) of the areas of excess.

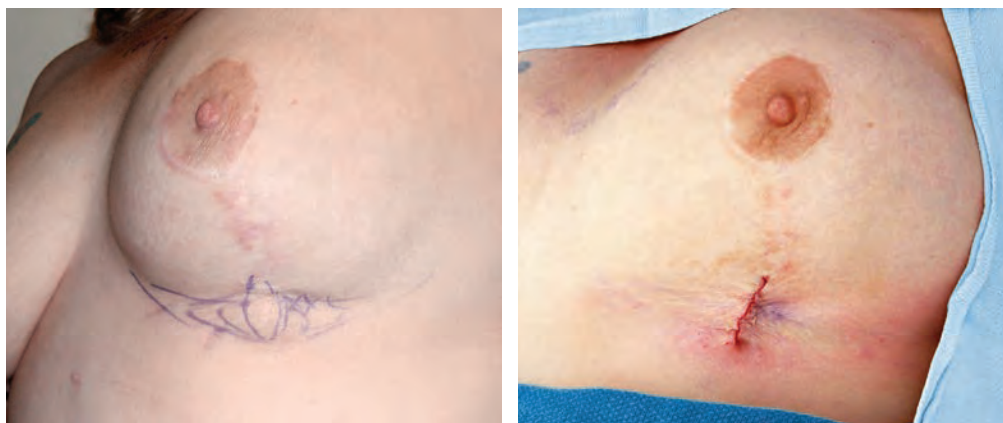
Puckers

Puckers are more common in the vertical techniques, whereas medial and lateral dog-ears are more common in the inverted-T skin resection patterns.

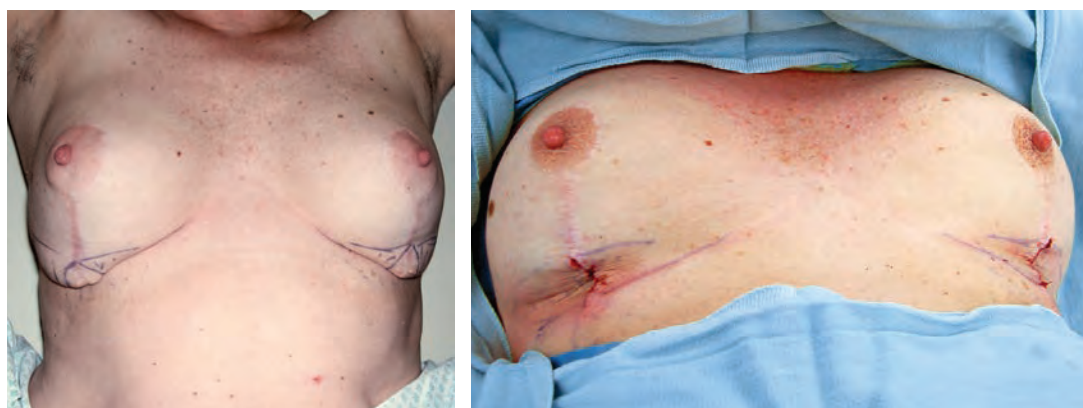
It is tempting to try to remove the puckers with a T incision, but a vertical (small) skin excision is better. The key is to recognize that the problem is caused by excess subcutaneous tissue rather than excess skin.



In this patient, puckers were removed through a short transverse or T excision. The initial result was acceptable. This example shows that a surgeon's revision rate will depend on his or her threshold for revision.



This patient's pucker (mostly subcutaneous tissue) was excised through a vertical incision. It is important to mark the inframammary fold first to make sure that the scar does not go below the fold. With a horizontal excision it can be difficult to know exactly where to put the transverse scar. The problem also then becomes one of chasing dog-ears horizontally.

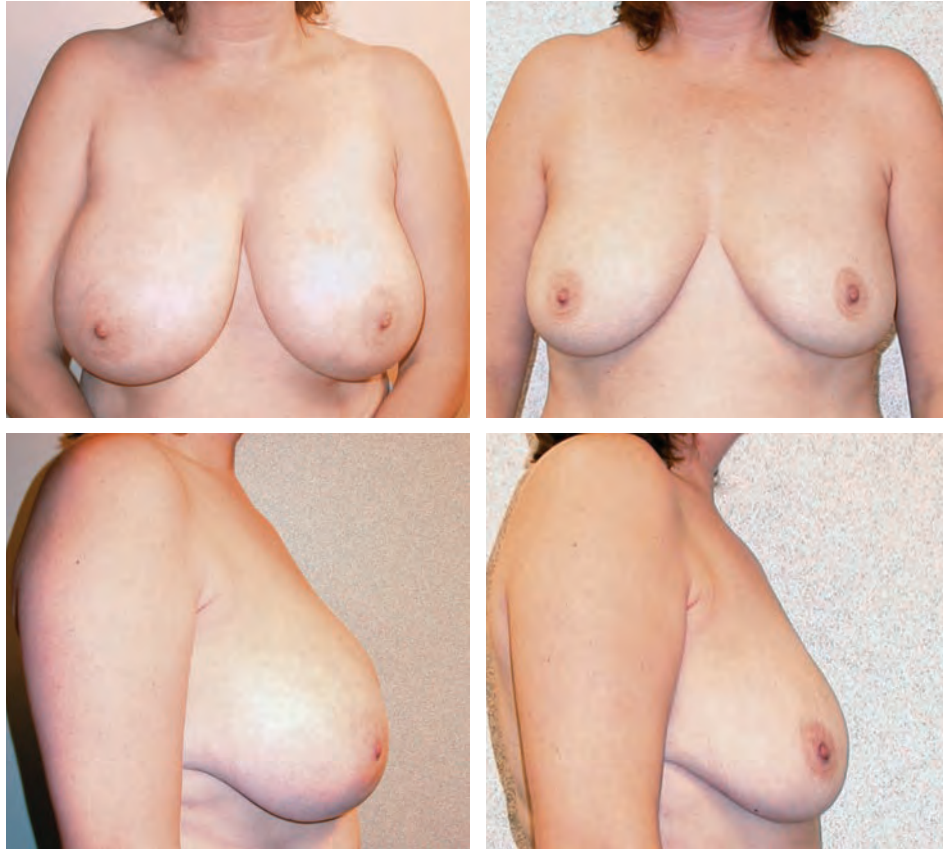


This patient had more extensive problems with puckers. Cross-hatching shows the area of excess subcutaneous tissue. The skin excess is marked vertically. Puckers are less a problem of excess skin than an excess subcutaneous tissue.

It appears that this patient would require a T closure to correct puckers. In fact, a small vertical excision, not extending past the marked inframammary fold, with horizontal excision of underlying subcutaneous tissue is the procedure of choice.

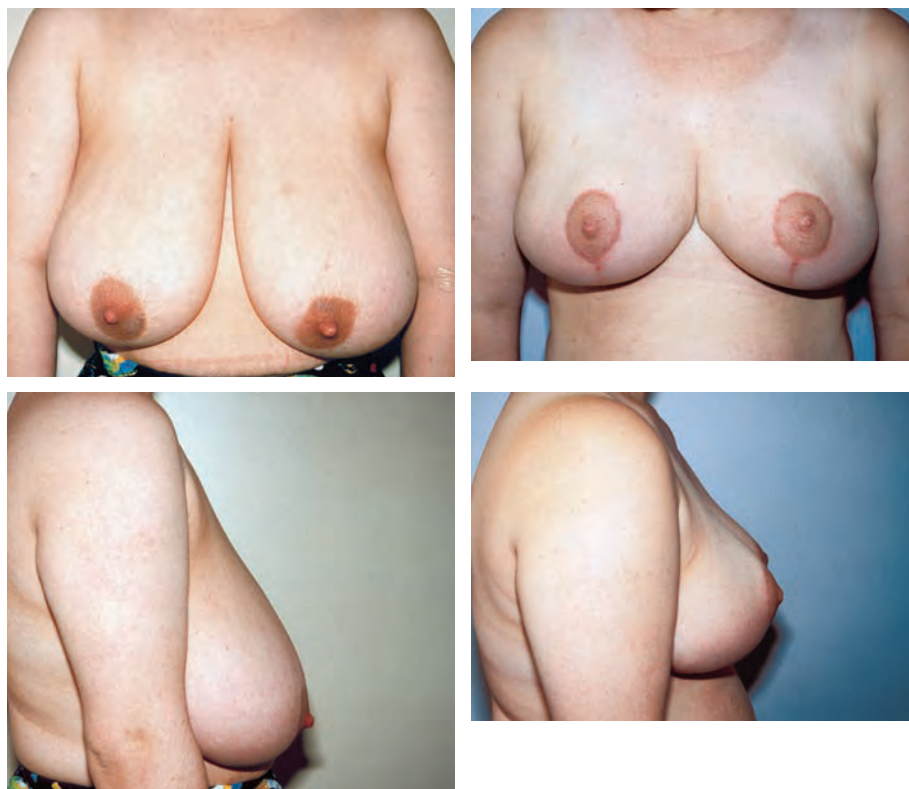
Results

Liposuction-Only

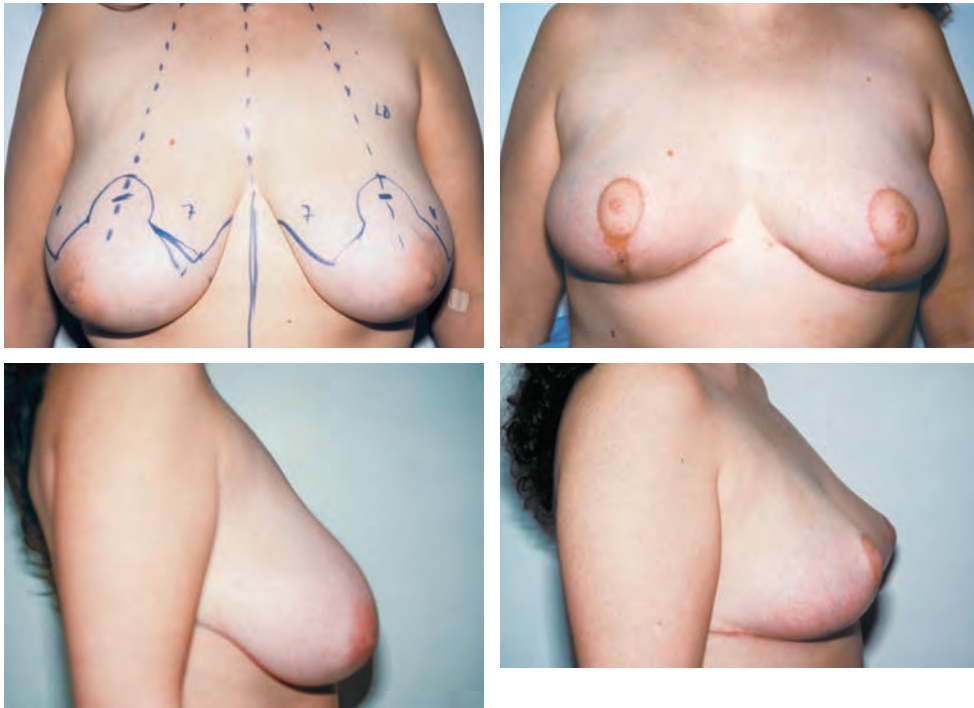


This 45-year-old patient was 5 feet 7 inches tall, weighed 73 kg (160 pounds), and wore a 38 DD brassiere. She had 1000 cc of fat aspirated from the right breast and 900 cc of fat aspirated from the left breast. She is shown here at 2 months postoperatively. The right nipple rose 2.5 cm and the left nipple rose 2 cm. Note the elevation of both the breast and the nipple in relation to the patient's elbow crease. The result will be acceptable to some patients and not acceptable to others; the loss of upper pole fullness makes the shape appear to be more ptotic, even though there is a measurable elevation.

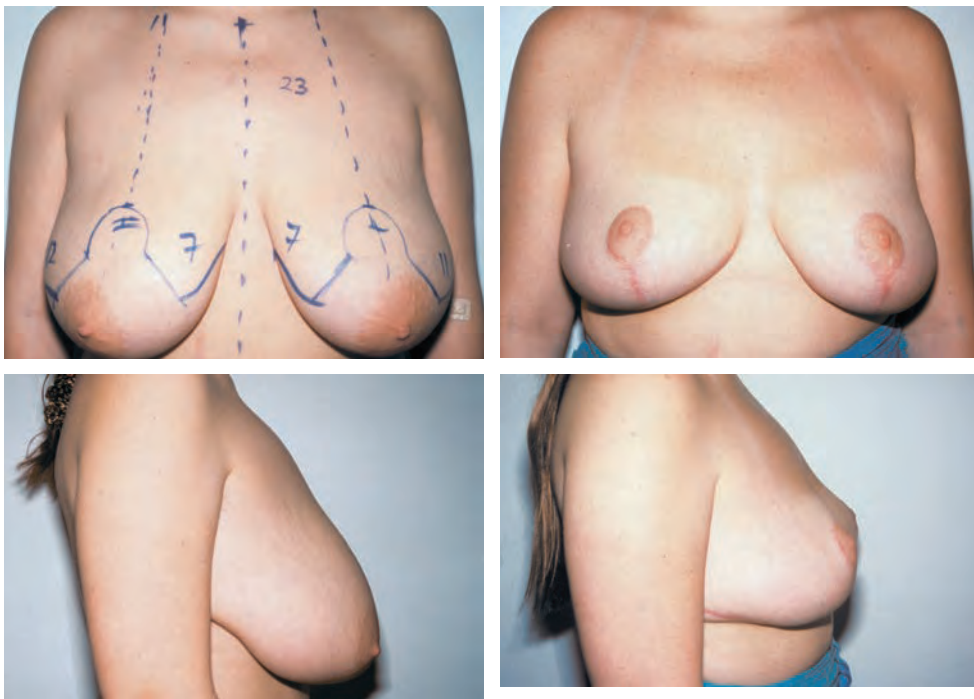
Inverted-T Techniques



This 26-year-old patient underwent a breast reduction using the inverted-T technique and an inferior pedicle. She was 5 feet 1 inch tall, weighed 88 kg (193 pounds), and wore a 42 DD brassiere. She had 910 g removed from the right breast and 1050 g from the left breast. The patient is shown 2 months after the procedure. The result is somewhat boxy and the cleavage is narrowed, because the breast cannot be coned as easily as it can with the vertical approach. The inverted-T techniques tend to result in a wider breast base than the vertical techniques, because the skin and parenchyma are closed using a horizontal elliptical excision of skin and breast tissue, whereas the vertical approach uses a vertical elliptical excision of skin and breast tissue.



This 26-year-old patient had a breast reduction with an inverted-T skin resection pattern and an inferior pedicle for the nipple. She was 5 feet 8 inches tall, weighed 77 kg (170 pounds), and wore a 38 D brassiere. She had 640 g removed from the right breast and 525 g from the left breast. Note the wide breast base.



This 20-year-old patient had an inverted-T skin resection with an inferior pedicle for the nipple. She was 5 feet 5 inches tall, weighed 73 kg (160 pounds), and wore a 40 DD brassiere. She had 600 g removed from the right breast and 540 g from the left breast.



Preoperative

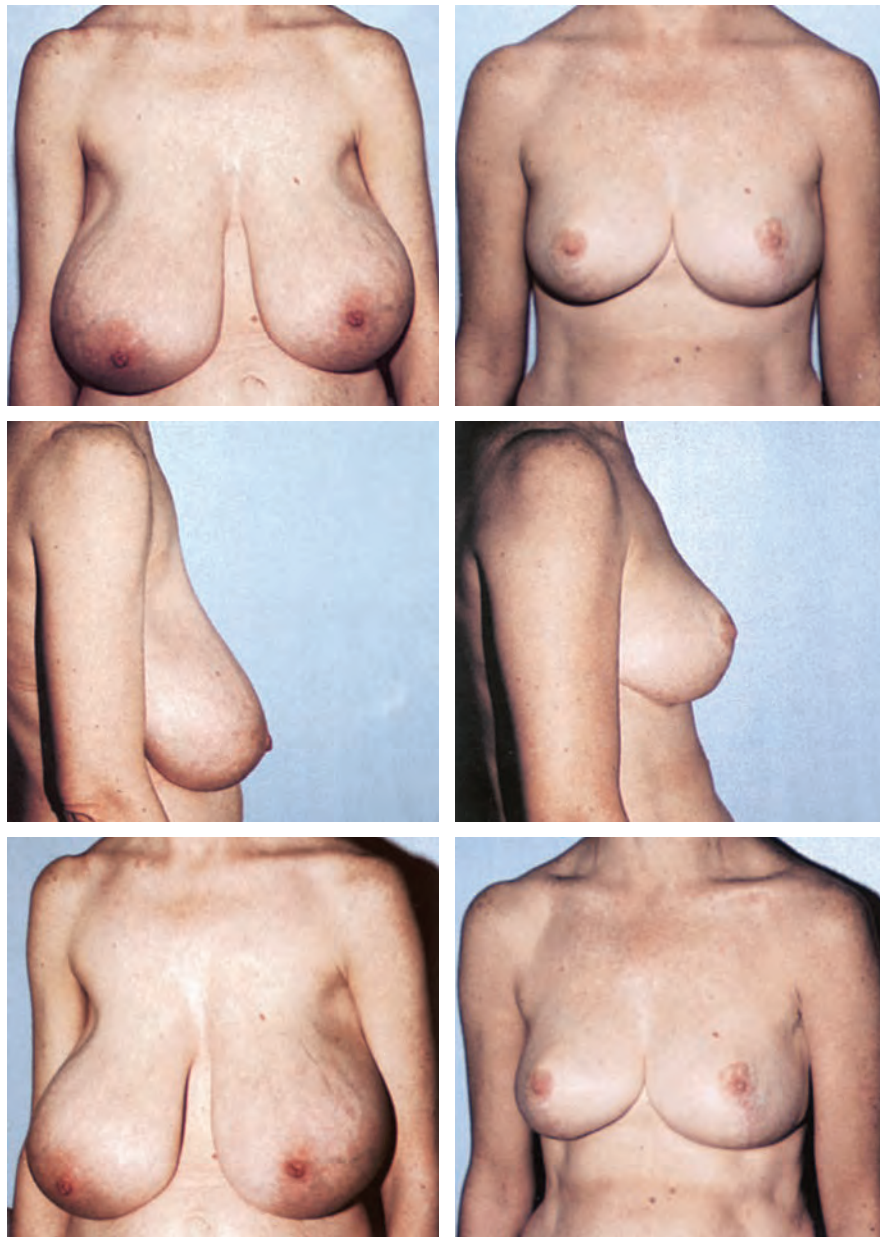
3 years postoperatively

20 years postoperatively

This 19-year-old patient underwent an inverted-T skin resection with an inferior pedicle for the nipple. She was 5 feet 1 inch tall, weighed 59 kg (130 pounds), and wore a 36 D brassiere. She had 255 g of tissue removed from the right breast and 285 g from the left breast.

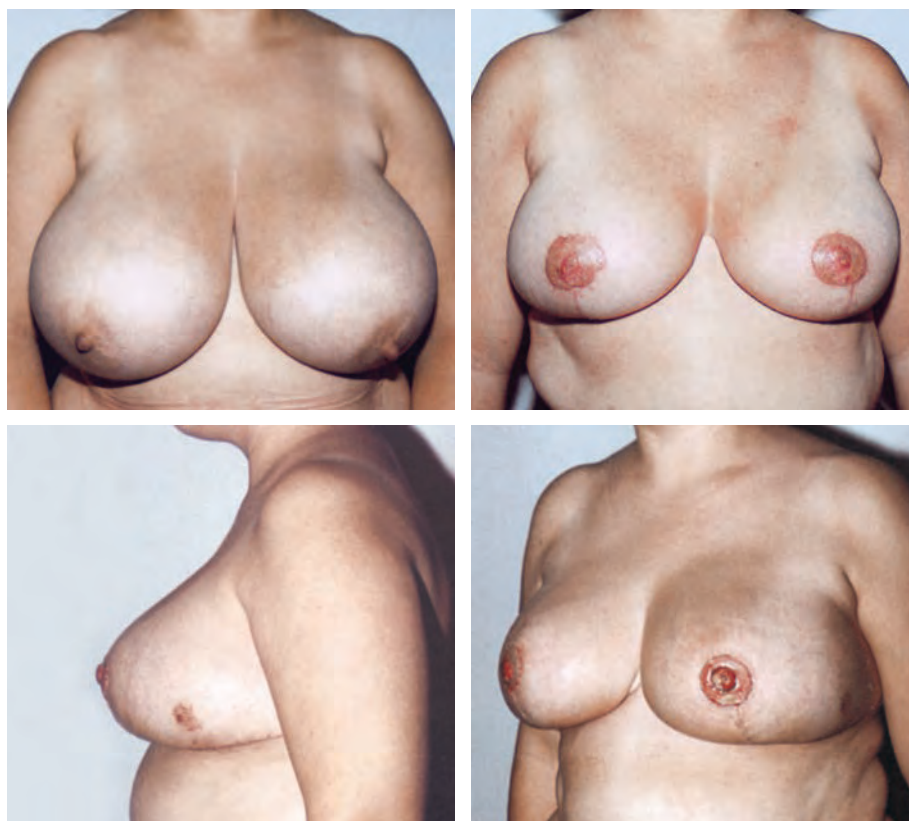
She had gained weight in the photographs shown at 3 years after surgery. The final postoperative photographs show her, with some weight loss, 20 years later. These images show evidence of recurrent ptosis, or bottoming out that can occur with time. Note that both the weight gain and weight loss tend to occur mainly in the upper pole.

Inverted-T Techniques With Free Nipple Grafts



Case from John Bostwick III, MD

These images show a 62-year-old woman 2 years after breast reduction. Because her history of smoking and desire for a significant reduction could cause problems, a breast reduction with an inverted-T skin resection and free nipple grafts was done. She was pleased with her reduced breast size and even regained some nipple sensation.



Case from John Bostwick III, MD

In this patient, 1700 g were removed from each breast. She is shown at 1 month post-operatively. The nipple-areola grafts healed well, but superficial desquamation of the areolar skin is still evident. The pigmentation is expected to diminish with time.

Vertical Techniques

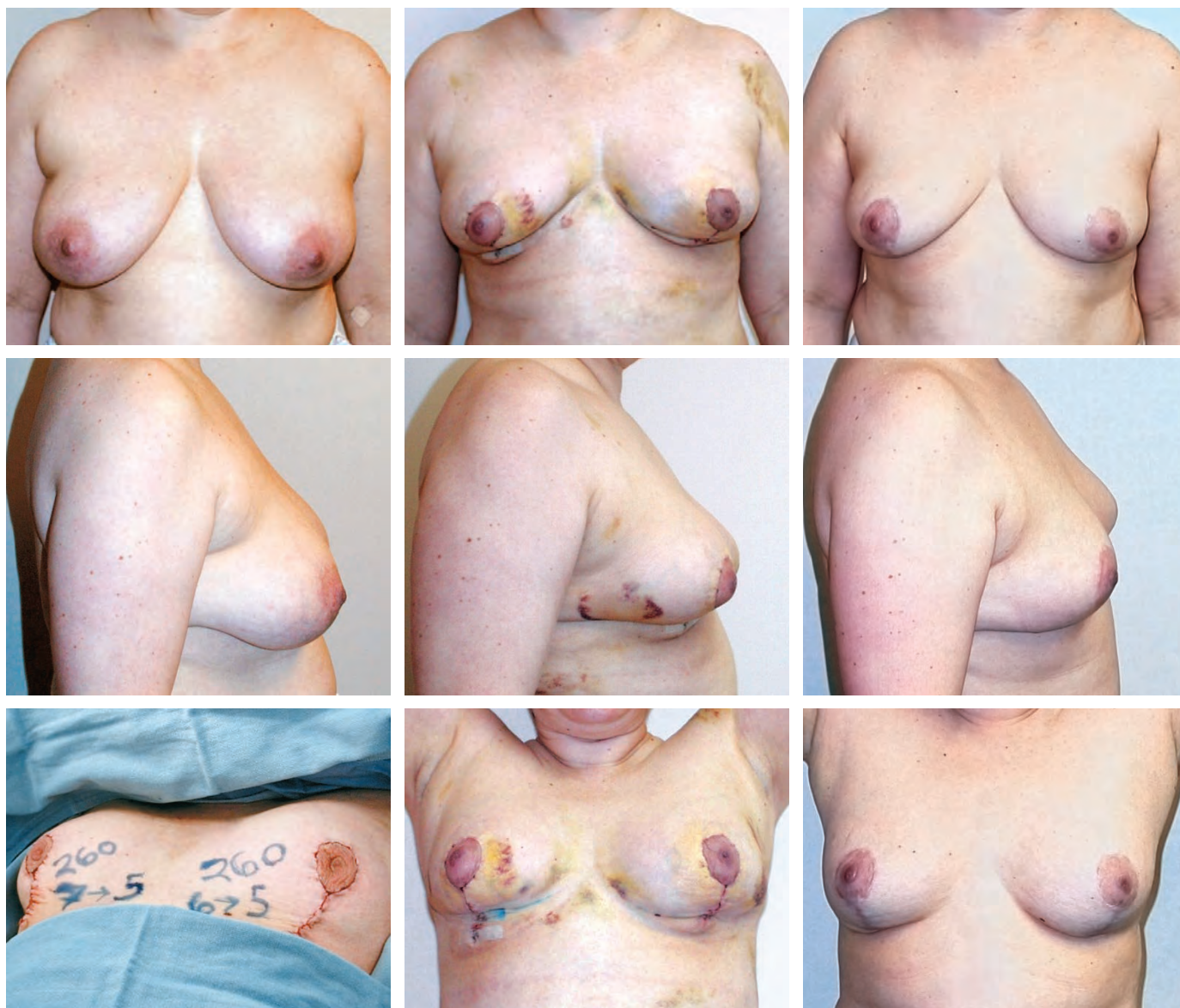


Preoperative

1 month postoperatively

1 year postoperatively

This 21-year-old patient was 5 feet 3 inches tall, weighed 91 kg (200 pounds), and wore a 38 DD brassiere. She had 525 g removed from the right breast and 480 g removed from the left breast. She is shown 1 month and 1 year after surgery. Note that the breast tissue is narrowed as the breast is coned.



Preoperative

10 days postoperatively

1 year postoperatively

This 49-year-old woman was 5 feet 1 inch tall, weighed 69 kg (153 pounds), and wore a 38 D brassiere. She had 260 g removed from each breast. She is shown 10 days and 1 year postoperatively.



Preoperative

2 weeks postoperatively

2 years postoperatively

This 56-year-old woman was 5 feet 7 inches tall, weighed 64 kg (140 pounds), and wore a 36 DD brassiere. She had some asymmetry, and the new nipple position should have been lowered on the larger side. She had 260 g removed from the right breast and 225 g from the left breast. The first postoperative views were taken 2 weeks after surgery; the final views were taken 2 years after surgery. Note that the nipple position is higher on the larger side. Closure of the vertical ellipse tends to push the nipple higher on the larger breast.



Preoperative

6 weeks postoperatively

3½ years postoperatively

This 64-year-old patient had 700 g removed from her right breast and 800 g from her left breast using the vertical approach and a medial pedicle. She was 5 feet 6 inches tall, weighed 82 kg (180 pounds), and wore a 40 DD brassiere. She is shown 6 weeks and 3½ years postoperatively.



Preoperative

2 weeks postoperatively

4 years postoperatively

This 51-year-old patient was 5 feet 2 inches tall, weighed 81 kg (178 pounds), and wore a 38 DD brassiere. She had a vertical breast reduction with a medial pedicle and had 570 g removed from the right breast and 690 g from the left breast. An additional 475 cc of fat was removed from the preaxillary area and lateral chest wall area. She is shown 2 weeks and 4 years after surgery.

Concluding Thoughts

The best breast reduction is the breast reduction that the surgeon does the best. There is no “right” way to approach breast reduction, but surgeons must have the ability to use several different approaches, depending on the circumstances (see the table below). It is important to understand that the pedicle, the skin resection pattern, and the parenchymal resection pattern can be used in various combinations. Many of us who perform vertical approaches like the fact that we remove the heavier inferior breast tissue, reshape the parenchyma, and then allow the skin to redrape. We believe that this not only results in fewer scars, but also provides a better shape with good projection. We have also found that this shape tends to last longer than procedures that rely on the skin as a brassiere or support.

Choosing the Best Option*						
Breast Characteristic	Skin Excision Pattern and Final Scar					
	Liposuction-Only	Periareolar	Vertical	Short Horizontal T, J, or L	Longer Horizontal L	Traditional Full-Length Horizontal T
Size of Reduction						
<500 g						
500-1000 g						
>1000 g						
Skin Elasticity						
Normal						
Inelastic						
Skin Excess						
Minimal						
Moderate						
Massive						
Parenchyma						
Firm and fibrous						
Soft and fatty						
Skin-Parenchyma Relationship						
Firmly adherent						
Loosely adherent						

*General recommendations for choosing skin excision patterns in breast reduction are based on the characteristics of the breast. Taking into account the size of the reduction, skin elasticity, skin excess, quality of the parenchyma, and the skin-parenchyma relationship, the appropriate skin excision patterns are indicated. A given skin excision pattern can usually accommodate a number of parenchymal resection techniques.

Clinical Caveats

The procedure must be adapted to the needs and desires of the patient, but within the experience and expertise of the surgeon. No one procedure fits all patients, but many surgeons now think that the vertical approach (with whichever pedicle is most comfortable for the surgeon) has wide applicability.

The shape of the breast is determined by the resection, specifically which parts of the breast are resected, and how the rest of the breast is reshaped. The skin plays little role in shaping or maintaining breast shape.

The longevity of the result depends not only on the technique but perhaps even more on the patient's tissues; specifically, the quality and elasticity of the skin.

Liposuction is best for those patients for whom breast shape and projection is not a priority. The appeal of this technique is that it is less likely to cause problems with scarring, circulation, sensation, or breast-feeding.

Liposuction alone has limited usefulness in those patients for whom it would be the most desirable: teenagers. In teens who are close to ideal body weight, it is unlikely that much of the breast is composed of fat. Perimenopausal women have the highest volume of breast fat, especially if they are overweight. These patients often have more ptosis, and shape can be an issue.

The inverted-T skin resection pattern may still be the best choice for patients with large breasts or in massive-weight-loss patients who have a considerable amount of excess skin.

Inverted-T techniques use the skin to shape the breast. It takes a different mindset to change from exact measurements and short vertical limbs in the inverted-T procedures to looser skin and long vertical limbs which are needed to accommodate projection in the vertical procedures.

It is critical in both inverted-T and vertical approaches to properly mark the new nipple position. A nipple that is too high is difficult or impossible to correct. Arbitrary measurements from the suprasternal notch should be avoided. The nipple should be designed at the level of the inframammary fold and in relation to the upper breast border. With the vertical approach, this position should be somewhat lower to accommodate the increased projection.

The inframammary fold can rise with some of the vertical techniques and tends to drop beneath the horizontal scar with the inverted-T technique.

Each method of breast reduction has advantages and disadvantages. The surgeon should evaluate each patient's desires in light of her physical presentation. No one technique satisfies all. Each surgeon should be comfortable with several techniques, even if he or she prefers one technique for most patients.

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This was the first in a series of articles documenting the use of liposuction alone for breast reduction.

Courtiss EH, Goldwyn RM. Reduction mammoplasty by the inferior pedicle technique. An alternative to free nipple and areola grafting for severe macromastia or extreme ptosis. *Plast Reconstr Surg* 59:500-507, 1977.

The Courtiss articles led to the acceptance in North America and beyond of the inferior pedicle inverted-T breast reduction as the procedure of choice for the majority of patients.

Daane SP, Rockwell B. Breast reduction techniques and outcomes: a meta-analysis. *Aesthet Surg J* 19:293-302, 1999.

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Gradinger reviews free nipple grafts using an inverted-T skin resection pattern. This technique has fallen out of favor, but probably should be considered more often.

Lassus C. A 30-year experience with vertical mammoplasty. *Plast Reconstr Surg* 97:373-380, 1996.

The author discusses the evolution of his vertical mammoplasty breast reduction technique. In a 30-year period there were few complications, indicating that it is a safe procedure producing long-lasting results.

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The many publications of Lassus and Lejour increased acceptance of the vertical skin resection pattern.

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Many articles in this list are important landmarks in the attempt to reduce scars and limit them to the periareolar location only.

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The authors present a good review of the main variations of the vertical skin resection pattern. This article highlights the differences between the techniques of Lassus, Lejour, Hammond, and Hall-Findlay and then details Spear's preferred approach.

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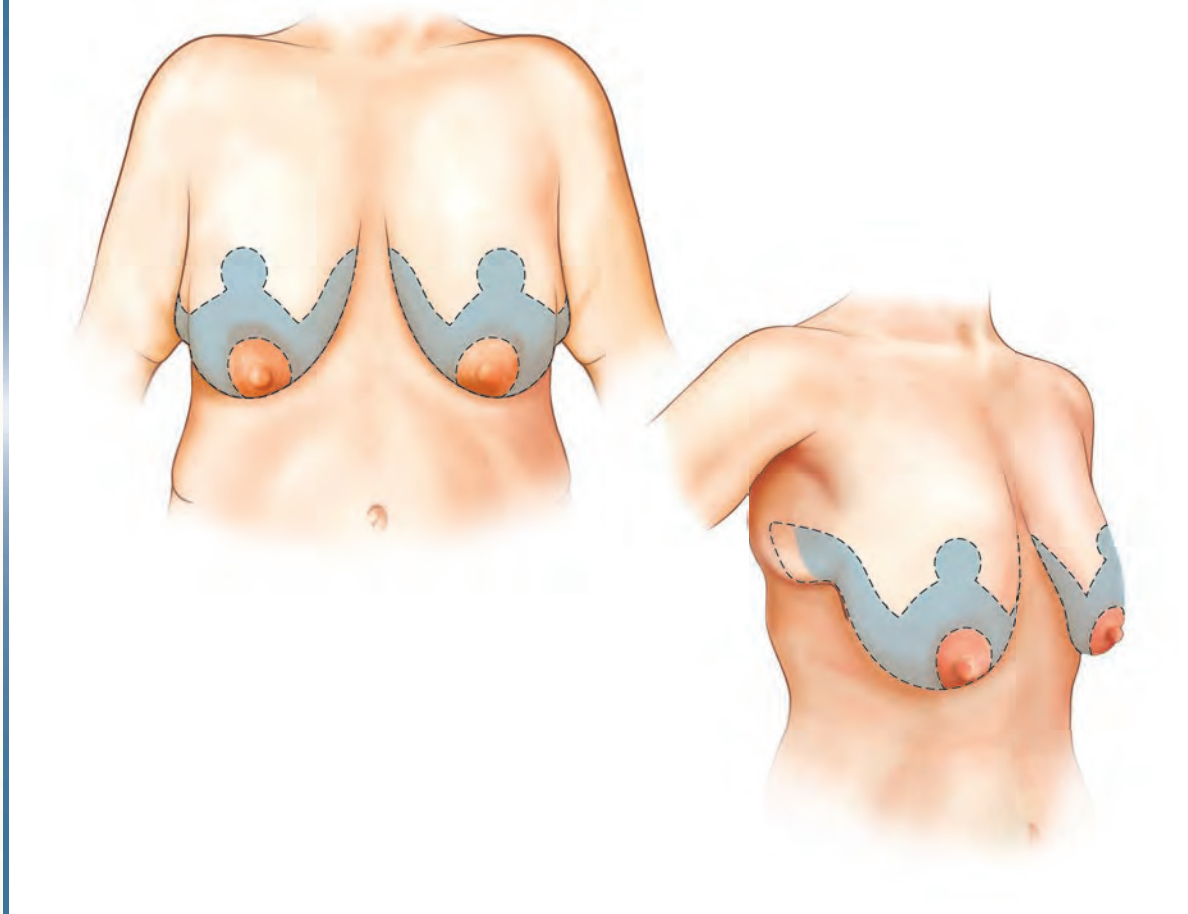
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CHAPTER 72



Mastopexy and Breast Reduction in Massive-Weight-Loss Patients

J. PETER RUBIN, JONATHAN TOY

The rate of obesity continues to rise in the United States at an alarming rate, with more than 35% of the population considered obese. To lower their risk of obesity-related medical conditions, many people have sought to lose weight either through bariatric surgical procedures or lifestyle modification—diet and exercise. After massive weight loss, defined as the loss of more than 23 kg (50 pounds), the individual is often left with redundant skin and excess subcutaneous tissue. For this reason, an increasing number of patients are seeking plastic surgery consultation for correction of these deformities.

After the abdomen, the next body area with which many women are most concerned is their breasts and their appearance after massive weight loss. Many of these women had full breasts before their weight loss and have severe deformities after reaching their goal weight. Extensive and asymmetrical volume deflation, descent and medialization of the nipple-areola complex, distortion of shape, including breast flattening, coupled with an excess of inelastic skin relative to the breast parenchyma makes the breast deformities difficult to treat. During the evolution of breast reduction and mastopexy procedures after massive weight loss, plastic surgeons have focused on key aesthetic goals: repositioning of the nipple-areola complex, minimization of scar and proper scar placement, achieving adequate projection and medial fullness of the breast, and long-term stability of the results.

The technique of dermal suspension, parenchymal reshaping, and selective autologous tissue volume augmentation (autoaugmentation) in massive-weight-loss patients was developed with the principles of prior breast reshaping procedures in mind. Earlier techniques in breast reduction and mastopexy relied on dermal support to maintain shape and were dependent on skin resection patterns. Bottoming out of parenchyma with recurrent breast ptosis were negative features of the techniques relying on these principles. The introduction of the vertical mammoplasty by Lassus and expanded on by Lejour heralded more long-lasting and reliable methods of parenchymal reshaping, with less reliance on the dermal envelope for shape. Others developed methods of dermal suspension to elevate breast tissues as well as techniques to increase upper pole fullness with sutures to affix the parenchyma to surrounding structures. Graf and Biggs devised a dermoglandular pedicle that is passed under a partial-thickness loop of pectoralis muscle and fixed to the pectoralis fascia under the breast. Closure of medial and lateral pillars behind the flap helps to secure elevation.

The approach to the breasts of massive-weight-loss patients differs from techniques used for non-weight loss patients. Short-scar techniques in general have a limited role because of the need for more extensive skin resection. In our technique of dermal suspension, parenchymal reshaping, and selective autoaugmentation, the vascularity of the nipple-areola complex is ensured with a central dermoglandular pedicle. A modification of the traditional Wise pattern allows control of the skin envelope and nipple position.

Advantages and Disadvantages of Mastopexy and Breast Reduction in Massive-Weight-Loss Patients

Advantages

- A lateral axillary roll deformity can be eliminated.
- Autoaugmentation of the breast may be achieved with the use of tissue in the lateral axillary roll.
- The skin envelope can be easily controlled.
- Parenchymal reshaping is facilitated.
- Long-lasting elevation of the parenchyma is achieved.

Disadvantages

- Scars are long.
- Operative time is increased because of the large areas to be deepithelialized.
- A high degree of intraoperative tailoring is required.

In this chapter we highlight the anatomic changes observed in the breast after weight loss and present details of a versatile technique to achieve an aesthetically pleasing result.

Goals of Breast-Reshaping Surgery

- To use all available breast tissue while maintaining the ability to recruit additional autologous tissue
- To address nipple position
- To restore superior pole projection
- To reshape the skin envelope without relying on it for support
- To eliminate the lateral skin roll
- To create a discrete “lateral sweep” or defined lateral curvature to the breast shape

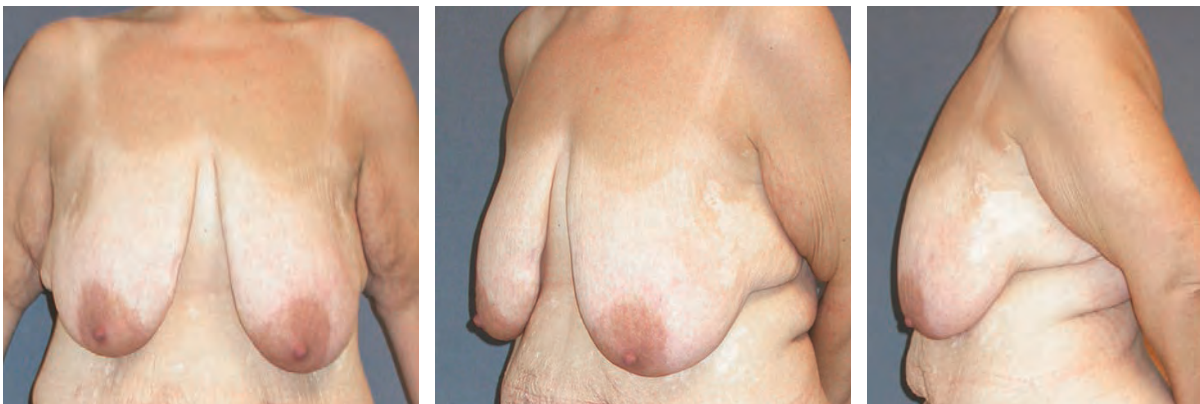
Indications and Contraindications

Indications for dermal suspension and parenchymal reshaping with selective autoaugmentation include severe ptosis with deflated breast shape and adequate parenchymal volume to build a breast mound. Although not required to perform this procedure, a lateral skin roll allows recruitment of chest wall tissue into the breast mound.

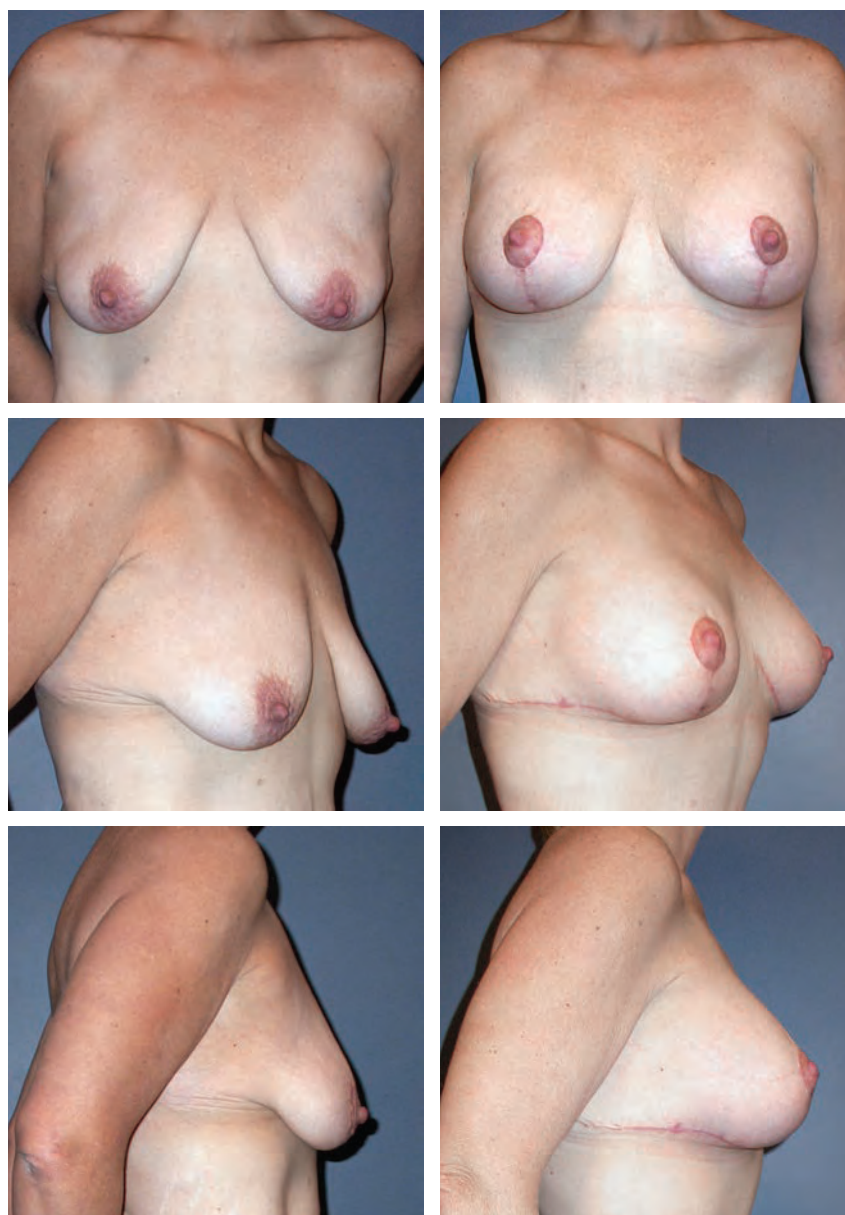
There are relatively few contraindications to the procedures mentioned. Patients who are current users of tobacco products are instructed to stop for 1 month before and after surgery. We routinely screen patients with a positive history of tobacco use with a cotinine urine test before surgery. Patients who have had previous breast surgery must be carefully evaluated to ensure that their old scars will not compromise any planned procedure. Patients with active intertrigo or diffuse fibrocystic disease may also not be ideal candidates. Also, inadequate parenchymal volume to build a breast mound is a relative contraindication, although lateral roll volume needs to be considered and may add sufficient volume. Finally, patients with a BMI higher than 35 may not be ideal candidates.

Patient Profiles

Good candidates for dermal suspension and parenchymal reshaping with selective autoaugmentation include those with parenchymal deficiency relative to skin with breast deflation and lateral skin roll. Poor candidates include those with no lateral skin roll, a short nipple-to-inframammary fold distance, and minimal breast ptosis.



This 40-year-old massive-weight-loss patient had lost 61 kg (135 pounds) before breast surgery and presented with a BMI of 33.8. She was a good candidate for the dermal suspension/parenchymal reshaping technique. These images demonstrate extensive breast ptosis and parenchymal deflation with a significant increase in the distance from the nipple to the inframammary fold; she had a sizable lateral skin roll. (Results are discussed on p. 2614.)



This 44-year-old massive-weight-loss patient was not an ideal candidate for the dermal suspension/parenchymal reshaping technique. Although she had lost more than 45 kg (100 pounds) after gastric bypass surgery (a BMI change from 41.8 to 25.4), her breasts were not extensively deflated and she had moderate ptosis. There was only modest parenchymal volume and minimal lateral skin roll for autoaugmentation. Postoperative images 3 months after a combined mastopexy-augmentation with saline implants and Wise pattern skin resection demonstrate excellent nipple repositioning and improvement in breast shape and projection. The use of the Wise pattern skin resection was necessary to adequately control the breast envelope and deal with the skin excess.

Pertinent Anatomy

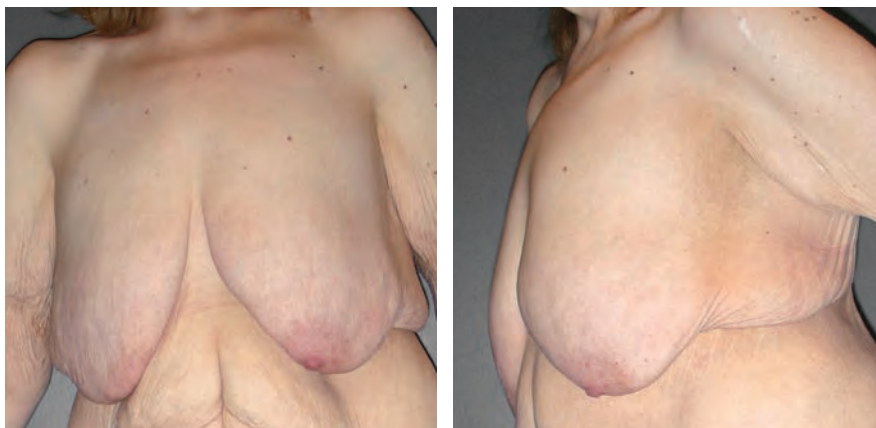
Women who have undergone massive weight loss have characteristic breast deformities that distinguish them from other women seeking correction of volume loss and breast ptosis. The Pittsburgh Rating Scale describes the spectrum of deformities seen after massive weight loss, with most patients exhibiting the more severe grades. This scale was designed to classify postbariatric deformities, in recognition that the standard ptosis grading scale was not descriptive enough to characterize the unique changes in breast shape that occur in this population. The least severe deformities involve grade I or II ptosis or macromastia. The midrange deformities (Pittsburgh Scale severity of 2 out of 3) demonstrate grade III ptosis and can still be treated with traditional breast-reshaping techniques. The most severe deformities (Pittsburgh Scale severity of 3 out of 3) have one or both of the findings unique to the massive-weight-loss patient: severe volume depletion with a flattened breast shape and/or a prominent lateral roll of skin and fat that merges the breast mound with the upper back tissues. Additionally, in any patient who has undergone massive weight loss, the nipples may be medialized. Failure to recognize this finding and move the nipples laterally along a true breast meridian is a pitfall of breast reshaping in massive-weight-loss patients.

Grading Scale for Severity of Breast Deformities After Weight Loss

Severity Grade	Deformities Noted	Recommended Treatment
0	Normal	Normal
1	Ptosis grade I or II or severe macromastia	Traditional mastopexy (with preference for vertical technique), standard breast reduction techniques, or implant augmentation ± elevation of nipple through limited mastopexy scars
2	Ptosis grade III, moderate volume loss, or constricted breast	Traditional mastopexy (often requiring Wise pattern) Consider implant augmentation to accompany mastopexy
3	Severe lateral roll and/or severe volume loss with loose skin	Parenchymal reshaping techniques with dermal suspension Consider autoaugmentation Avoid implant augmentation if existing volume will create a reasonable result



The changes in breast shape after weight loss, in the most severe form, are characterized by two findings that pose significant technical challenges. The first finding is volume loss with a stretched skin envelope and flattening of the breast against the chest wall.



The second finding is a roll of skin and fat on the lateral border of the breast extending onto the chest wall. This roll of skin and fat obscures the lateral curve of the breast, an important aesthetic unit. The technique of dermal suspension and selective autoaugmentation described in this chapter can correct these deformities and restore breast shape by using available parenchyma to build projection and recruiting the lateral chest wall tissue into the breast mound. In any massive-weight-loss patient, the surgeon must also be aware that the nipple position may be abnormally medial and should be repositioned along a true breast meridian.

Preoperative Assessment

In evaluating any massive-weight-loss patient, the surgeon should take a detailed history, including the type of weight-loss surgery, time since the surgery, and the patient's starting and current BMIs. The patient should be as close to goal weight as possible and at a stable weight, no more than a 2 kg (5-pound) change per month, for 3 months. This weight stabilization often occurs 12 to 18 months after gastric bypass. For a patient with a BMI over 35, the surgeon should consider referring the patient back to the weight-loss specialists to optimize her diet and exercise programs and optimize the BMI.

Physical examination of the breast should include a careful search for masses. Parenchymal volume should be assessed, along with the presence and size of a lateral roll of skin and fat. The surgeon should determine whether the native breast parenchyma and lateral roll together would provide adequate volume for a breast reshaping procedure. Prior scars should be noted and considered in terms of their impact on blood supply in the selected procedure. Mammography is performed in accordance with the American Cancer Society guidelines.

Preoperative Planning

Choice of Technique

Many procedures have been described for correction of the breast deformities seen in massive-weight-loss patients. The severity of each of the above-mentioned deformities, the preferred breast size of the patient, and the surgeon's experience will all influence the type of procedure offered. Each patient is unique and the chosen procedure must not only address each aspect of the breast deformity, but it must be able to deliver the size and shape that the patient desires.

Excessive Breast Volume (Pittsburgh Grade 1)

Some patients, despite massive weight loss, maintain significant breast volume despite varying degrees of ptosis. Patients who desire to be smaller than their current size will require a breast reduction. Although short-scar techniques have increased in popularity, the skin redundancy and poor skin elasticity will result in a large inferior dog-ear that will require horizontal excision. The pitfall of the short-scar technique in these patients would be to chase the dog-ear inferiorly. This would leave an unsightly scar below the inframammary fold. A predictable shape and size can be

achieved using a Wise pattern skin excision. This excision will often need to be carried out laterally onto the breast to excise redundancy in this area. A medial or inferior pedicle can be used depending on the nipple to fold distance and the experience of the surgeon. Due to the medial positioning of the nipple in many patients who have undergone massive weight loss, it may be difficult to get adequate nipple rotation if a medial pedicle is chosen. This must be given consideration in the preoperative planning. Liposuction of the lateral fold can also be a useful adjunctive procedure to assist in contouring the lateral fold of the breast.

Inadequate Breast Volume (Pittsburgh Grades 1 or 2)

Patients who have experienced significant breast involution as a result of massive weight loss will require breast implants if larger breasts are desired and a prominent lateral chest roll is not available to recruit into the breast mound (see next section). This autologous augmentation is almost always a better choice than implant augmentation. Young patients who have good skin tone can be considered for an isolated breast augmentation. In patients where there is excessive skin redundancy or an enlarged nipple-areola complex, a concomitant mastopexy may be necessary. In complicated cases where there is significant asymmetry or a loose inframammary fold, a staged mastopexy-augmentation may be necessary to achieve the best aesthetic outcome.

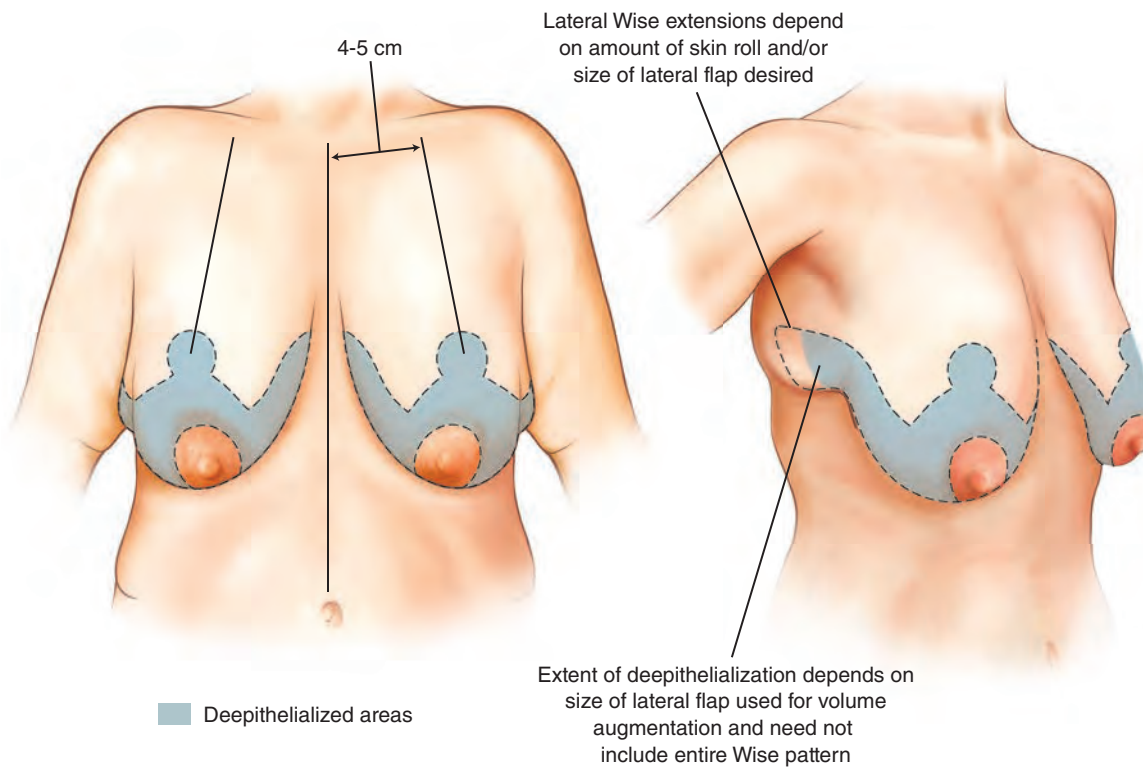
Adequate Breast Volume and Severe Changes (Pittsburgh Grade 3)

The majority of patients who have undergone massive weight loss present with significant breast ptosis and skin redundancy but maintain adequate breast volume. Even if the native parenchyma appears to have reduced volume, the lateral skin and fat roll adjacent to the breast mound, when added to the existing parenchyma, can create adequate size. During the consultation these patients often state that they want a breast reduction because of the significant skin redundancy and ptosis, when in reality they require a mastopexy. The parenchymal volume is often sufficient to achieve a good size and shape, but there is rarely much to spare. During the physical examination, the surgeon must determine whether there is adequate breast volume and whether there is a lateral skin roll with sufficient volume. For patients with sufficient parenchymal volume, severe ptosis, and a lateral skin fold, we recommend dermal suspension of the breast tissue to the chest wall with parenchymal reshaping and autoaugmentation from the lateral skin roll. In difficult cases, where there is significant asymmetry, the smaller breast can be augmented using autologous tissue to match the larger breast. If the autoaugmentation is not sufficient, the larger breast may need to be reduced to match the smaller breast.

The surgical plan is as follows:

- Mark with a Wise pattern, encompassing the lateral roll of tissue.
- Deepithelialize the entire Wise pattern area.
- Deglove the breast parenchyma.
- Elevate the medial and lateral parenchymal flaps.
- Suspend the dermal edge of flaps to rib periosteum.
- Plicate the dermis to shape the breast.
- Place sutures along the lateral edge of the breast to define its curvature.
- Redrape the skin.
- Release any dermis that is tethering the nipple.
- Close the skin.

Markings



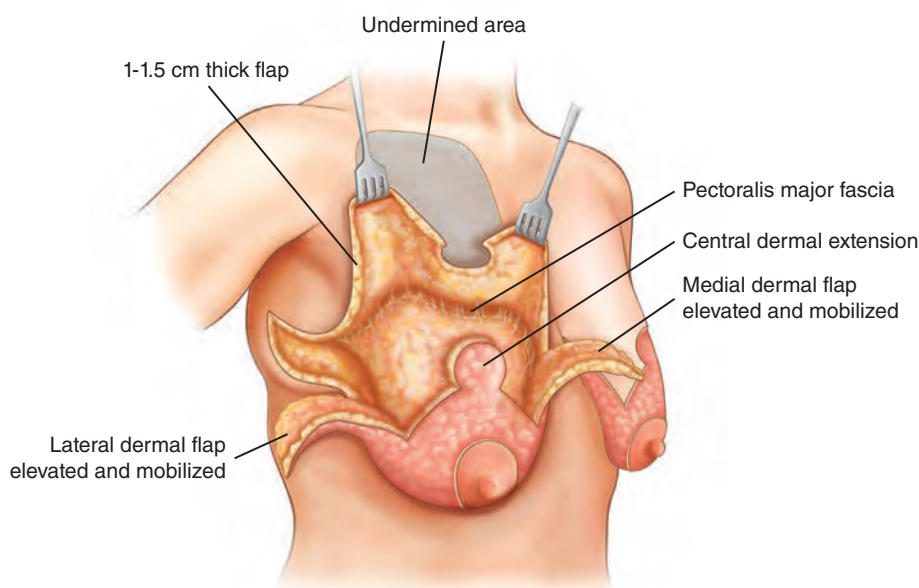
The incision design is based on an extended Wise pattern that preserves both the inferior and central pedicle. The midline, inframammary fold, and sternal notch are marked as in traditional mastopexy. A point 4 to 5 cm from the sternal notch is marked along the clavicle, and a new breast meridian is marked in the position at which the nipple will be placed. This line often lies lateral to the current nipple position as a result of the medialized position of the nipple in a massive-weight-loss patient. The new nipple position is gauged in relation to the inframammary fold and raised 2 cm along the new breast meridian. A keyhole pattern is then drawn, with vertical limbs of 5 cm. The lateral extent of the Wise pattern extends onto the lateral skin roll and is used for breast autoaugmentation. The robust lateral thoracic

perforators allow mobilization of a significant amount of tissue to the breast. Although other authors have advocated the use of tissue that extends onto the back, we often discard the tissue beyond the posterior axillary line because of concerns about vascularity and potential fat necrosis.

Operative Technique

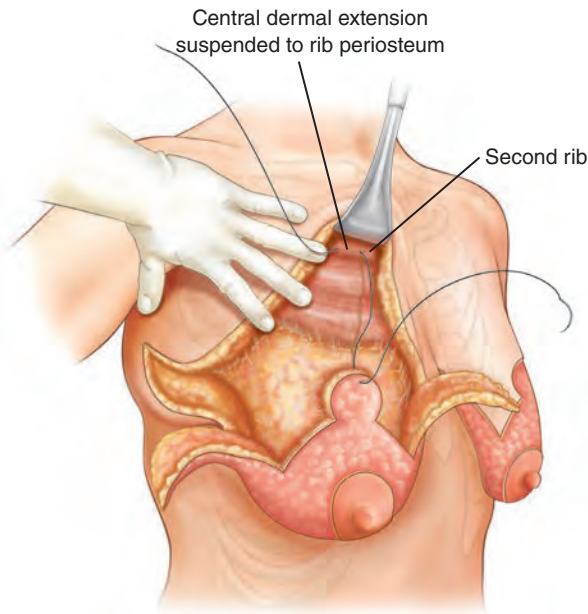


72-1 Dermal suspension mastopexy

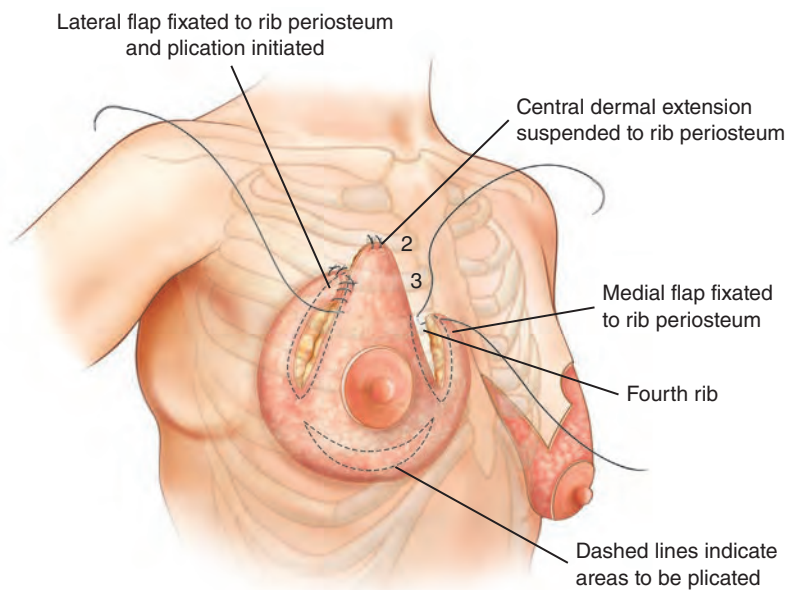


A 42 mm cookie-cutter is used to mark the circumference of the new nipple-areola complex. The entire dermis lying within the Wise pattern is deepithelialized. A pedicle base of approximately 10 cm is then marked. The medial and lateral extents of this pedicle are determined by the desired pivot points for the arc of rotation of the medial and lateral flaps. The dermis is scored in all areas except the pedicle base. Flaps 1 to 1.5 cm thick are then raised and the breast is completely degloved down to the pectoralis major fascia. During this dissection, the flaps are constantly monitored to ensure uniform thickness. Dissection continues along the fascia to the level of the clavicles.

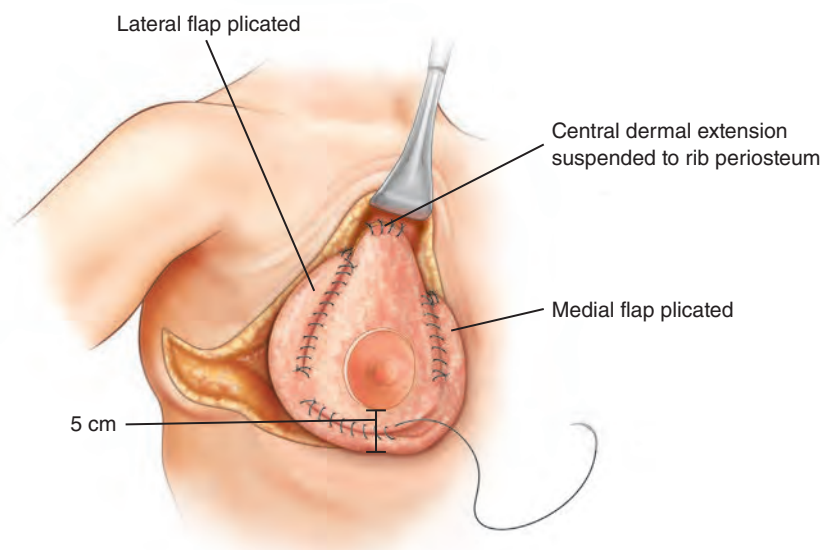
Care must be exercised not to release the attachments medially over the sternum, or synmastia may result. Medially, it is important to preserve perforators, including the perforator from the second intercostal artery. The lateral and medial flaps are then elevated down to the chest wall and mobilized. These flaps remain attached to the previously delineated 10 cm central pedicle, which is not undermined. Dissection of these flaps is limited to the minimal amount of tissue necessary to rotate the flaps to preserve the blood supply. These flaps are normally discarded in a traditional inferior pedicle breast reduction.



Once the breast parenchyma is degloved and the medial and lateral flaps are elevated, dermal suspension is performed in a specific sequence, with the patient in a sitting position. The central dermal extension is suspended to the periosteum of the second rib along the new breast meridian with two permanent 0 braided sutures to ensure stability. This is performed by placing the fingers of the non-dominant hand in the intercostal spaces, ensuring safe fixation to the rib periosteum. If the inframammary fold is low or the central dermal extension is short, the central pedicle may need to be suspended to the third rib. The suspension should bring the pedicle and the nipple-areola complex to the desired nipple position. The final decision as to which rib to fixate the parenchyma to is made while the patient is on the operating table.

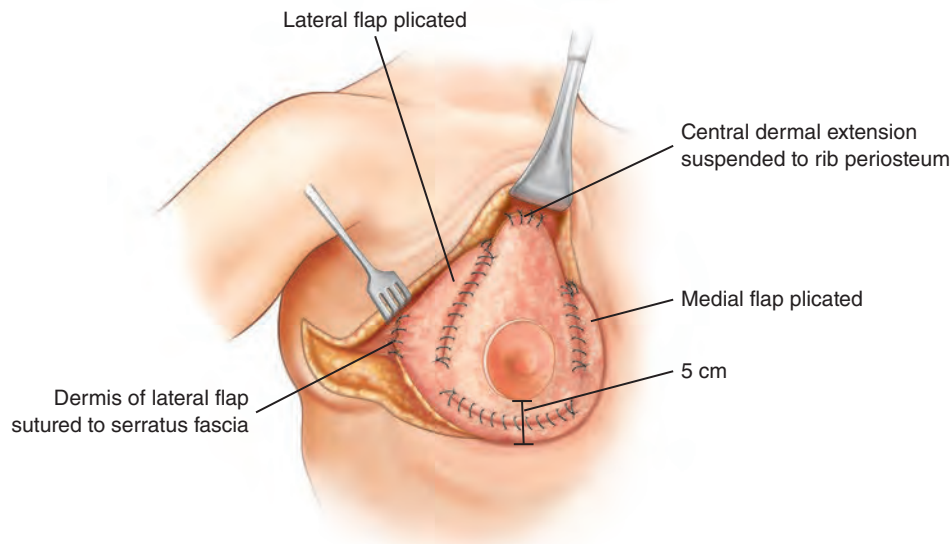


The lateral breast flap is mobilized and rotated superiorly and medially to shape the lateral border of the breast parenchyma. This flap is commonly fixated to the rib periosteum of the third rib just inferior to where the central pedicle was suspended with two permanent sutures. The size and length of the lateral flap can be reduced to selectively adjust the amount of autoaugmentation to achieve the desired size. The medial flap is then rotated superiorly and laterally to the level of the fourth rib periosteum and fixated in a similar manner. This flap is suspended medial to the new breast meridian to restore superomedial fullness to the breast. It is helpful to redrape the breast skin flaps after each fixation step to confirm that the correct level of dermal suspension has been achieved.



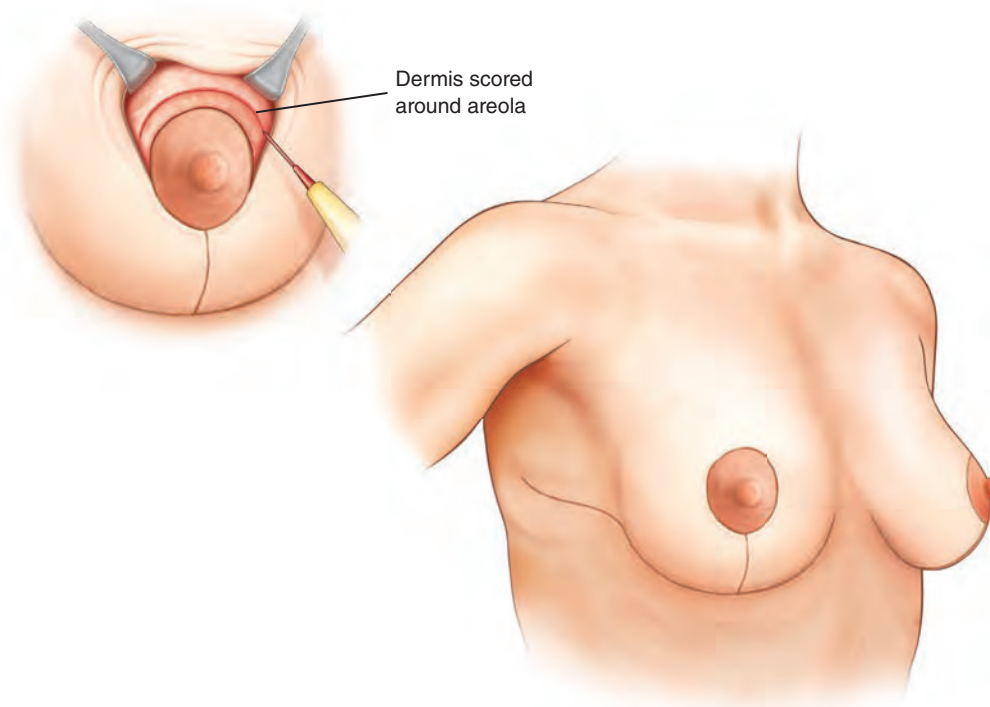
Once the dermal flaps have been suspended to the desired position, the breast parenchyma is shaped using 2-0 braided absorbable sutures. The lateral dermal flap is plicated to the central dermal pedicle first with interrupted sutures, followed by a running overlay suture. This is repeated for the medial flap. In some patients, suturing the dermis of the medial flap to the central pedicle dermis will distort the medial contour. In these cases, the breast parenchyma of the medial flap is sutured to the parenchyma of the central pedicle. Once the desired shape of the lateral and medial breast parenchyma has been achieved, the inferior plication is performed to increase nipple projection. The distance from the inframammary fold to the nipple-areola complex is measured and an inferior plication is performed to set this distance at 5 cm.

Dermal suspension and parenchymal reshaping are both performed with the patient in the sitting position. To minimize asymmetry, each of the previously outlined steps is performed sequentially on both breasts. The patterns of plication cannot be predicted preoperatively; adjustments must be made intraoperatively to achieve the desired shape. Additional rows of plication may be required. The surgeon should be satisfied with the shape of the parenchyma while the patient is on the operating table and should not leave the operating room if he or she is not happy with the dermal plication and the breast shape and projection after skin flaps are redraped. If the shape is not optimal, removal of previous plication sutures or further plication is necessary.



To further define the lateral sweep of the breast, the dermis of the lateral flap is secured to the serratus fascia. In addition to defining the lateral border of the breast, these sutures help increase nipple projection and minimize the risk of lateral herniation of the breast parenchyma. The lateral flap is not fixated to the rib periosteum to avoid potential injury to the long thoracic nerve and the thoracodorsal vessels and nerve.

The breast flaps are redraped, and the final breast shape and projection are assessed. Closure begins with a half-buried 2-0 polypropylene suture that secures both breast flaps in an inverted-T fashion to the inframammary fold. This is tied over an iodine-impregnated petrolatum gauze bolster to protect the skin and is left in place for 1 week. The remainder of the skin is temporarily reapproximated with staples. The vertical limb is closed in two layers with absorbable sutures, and the horizontal incision is closed with a running deep dermal suture. One drain is draped around the pedicle before closure and is brought out laterally through the incision.



The nipple-areola complex is occasionally tethered by the dermis and requires release to bring the nipple to the proper position. If this is not performed, the nipple may have a retracted appearance postoperatively. Because of the robust blood supply from the pedicle, the dermis around the areola may be safely scored halfway around its circumference. The nipple-areola complex is secured to the skin flaps with an absorbable suture in one layer. Cyanoacrylate glue is used along all suture lines to seal the incisions.

Postoperative Care

Gauze fluffs are placed over all incisions, and the chest is wrapped with an elastic (Ace) wrap until the first postoperative visit. The drains are removed when the output is less than 30 ml per day. The bolster stitch is also removed during this visit. Patients are instructed to wear a sports bra for 6 weeks to allow complete healing of all incision lines. We recommend the use of a sports bra that has a zipper in the front for patient comfort. The patient is instructed to minimize strenuous activity and not to lift anything greater than 4.5 kg (10 pounds) for the first 3 weeks, after which activity can slowly increase. Patients can begin wearing an underwire bra at 6 weeks postoperatively.

This procedure can be performed on an outpatient basis if no other procedure is performed at that time. If it is combined with other body-contouring procedures, we often keep the patient overnight in the hospital.

Combined Procedures

Patients who present for body contouring after massive weight loss often have multiple anatomic areas that they want corrected. The technique of mastopexy with dermal suspension and autoaugmentation can be combined with other body-contouring procedures in selected patients. Many patients request combined mastopexy with abdominal recontouring. For these women, the abdominal recontouring procedure should be performed first. Because the abdominal recontouring procedure will lower the inframammary fold, intraoperative adjustments may need to be made to the inferior line of deepithelialization before the mastopexy is performed. Similarly, if a fleur-de-lis abdominoplasty is to be performed, the inframammary fold may also be rotated medially, and the markings may require adjustment. In patients with loose inframammary folds, we consider deferring the mastopexy to a second stage to achieve the best aesthetic outcome.

This technique can easily be combined with either an upper body lift or with brachioplasty. When it is performed in combination with an upper body lift, the markings from the upper back lift will blend into the lateral skin roll excision for the mastopexy, leaving a single incision line. The lateral flap for the mastopexy is marked as usual and extends no farther than the posterior axillary line. The patient is positioned prone, and the upper back lift is performed first. The patient is then turned to the supine position for the mastopexy. The lateral incision of the mastopexy is then closed with no dog-ears by blending it into the upper back incision. When combining a mastopexy with brachioplasty, we attempt to merge the caudally directed axillary incision of the brachioplasty with the lateral incision of the mastopexy. We try to avoid an inverted-T point in the axilla if possible. The patient should be informed that there may be redundancy at the posterior axillary line that can be corrected with an upper body lift at a later time.

Fat grafting has recently become a popular technique for soft tissue augmentation. However, fat grafting has little role in the primary correction of breast ptosis resulting from massive weight loss. Once a patient has completely recovered from mastopexy with dermal suspension and parenchymal reshaping, fat grafting may be useful to correct any contour deformities or areas in which more fullness is desired. It could be a useful ancillary procedure in patients with significant skin redundancy and insufficient breast volume who desire a larger breast size without using implants. In these select cases, the patient may benefit from a two-stage procedure in which she undergoes a dermal suspension mastopexy in the first stage, followed by fat injections in a second stage to augment breast size.

Problems and Complications

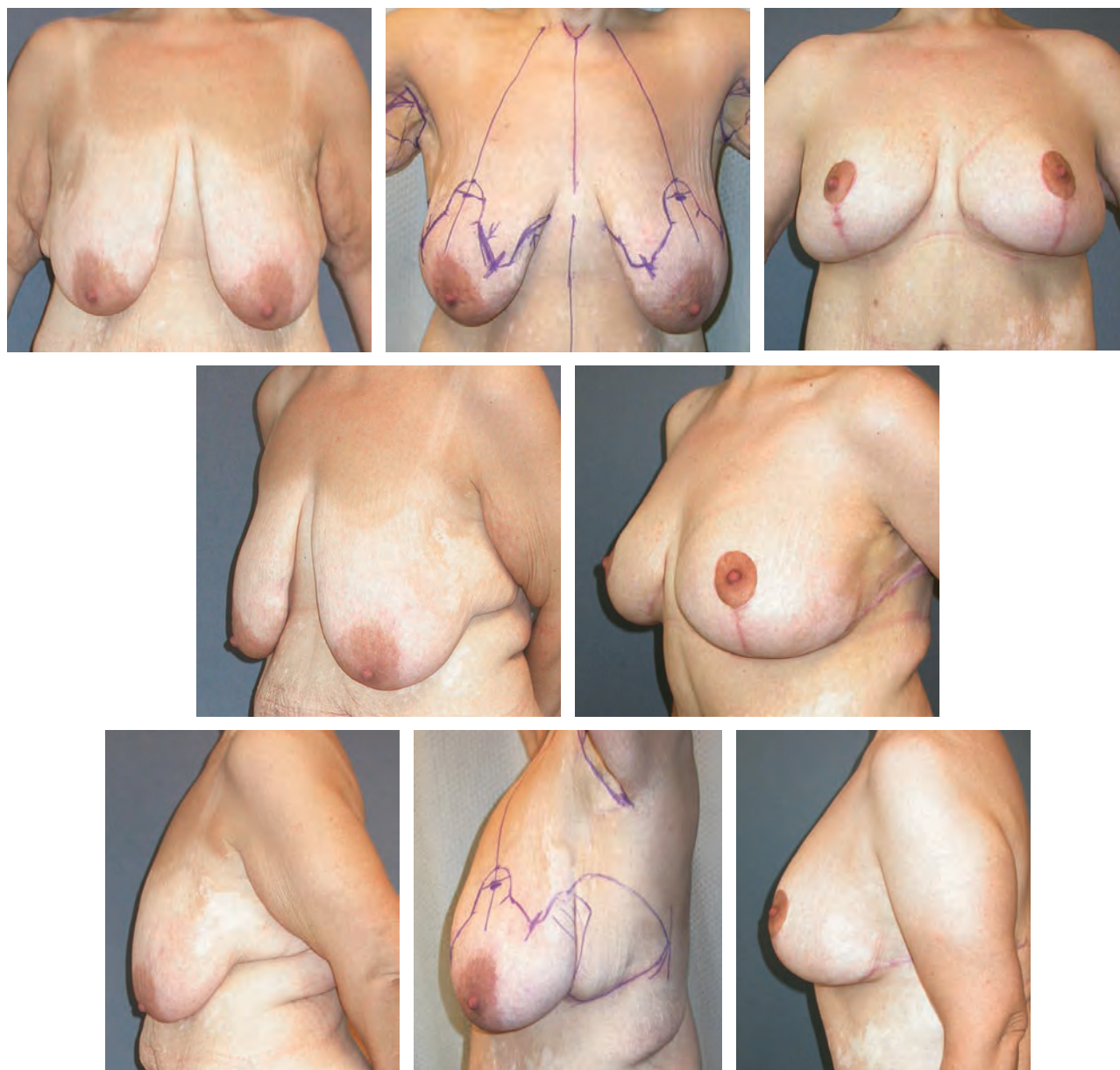
This technique has proved very safe and reliable. Complications include hematoma (less than 1%), seroma (less than 3%), and minor wound dehiscence at the T point (5%). The generous central pedicle blood supply, combined with the increased vascular network within the pedicle that is so commonly observed in weight-loss patients, helps prevent nipple loss. In fact, we have had no nipple necrosis in more than 120 dermal suspension mastopexy cases.

Wound dehiscence at the vertical incision and/or triple point is managed with debridement and gauze dressings in an office visit. These have all healed well with conservative measures. We routinely place a half-buried 2-0 polypropylene suture at the T point and remove this in the office 5 to 7 days postoperatively. This helps reinforce the closure at that juncture.

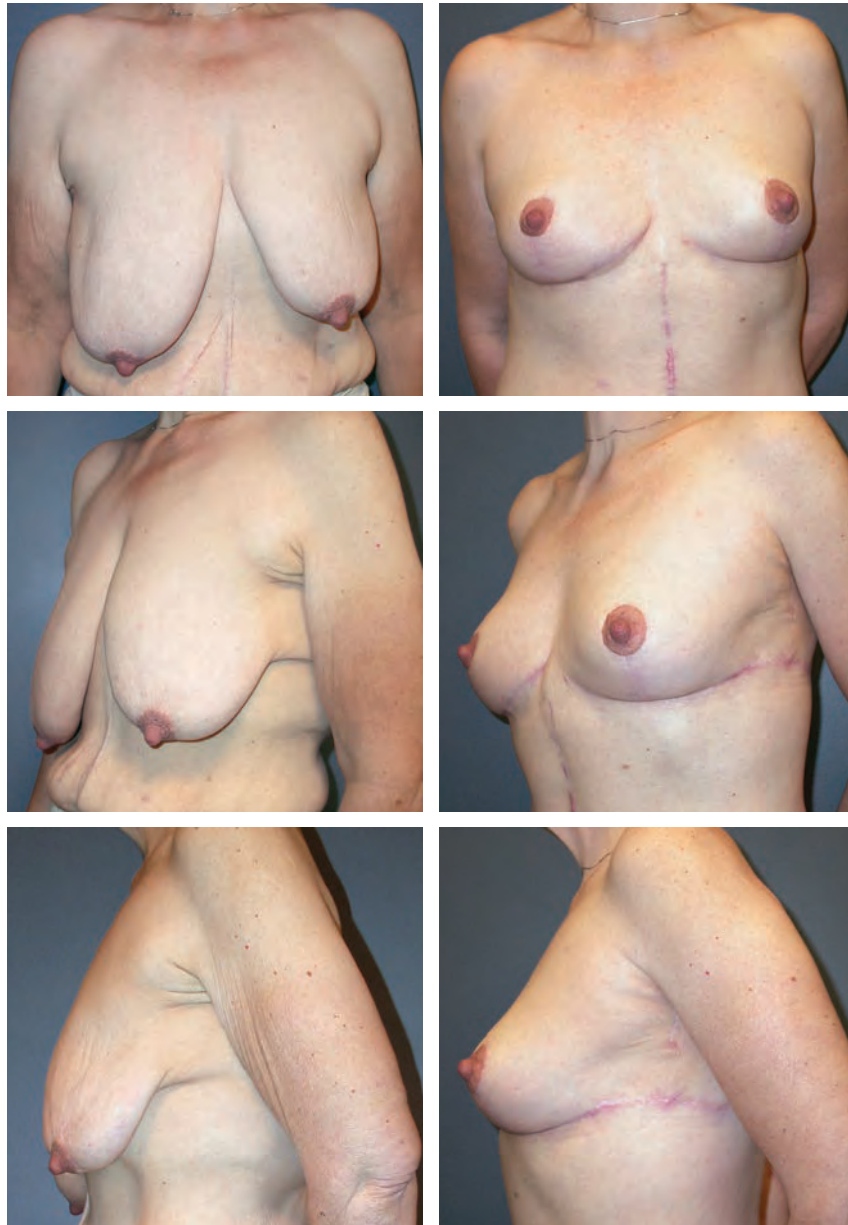
Seromas have been observed in the lateral region of the breast after drain removal and have all been treated with needle aspiration in the office. None has required reoperation.

One must always be wary of fat necrosis at the distal end of any transposed flap. We have not observed this in the lateral chest wall flap used for autologous augmentation, but we take several measures to avoid this complication. First, the lateral extent of the flap is limited to the region of the posterior axillary line. We do not extend this flap onto the midback. Second, the edge of the flap is checked for signs of arterial bleeding. Third, we exclude active smokers.

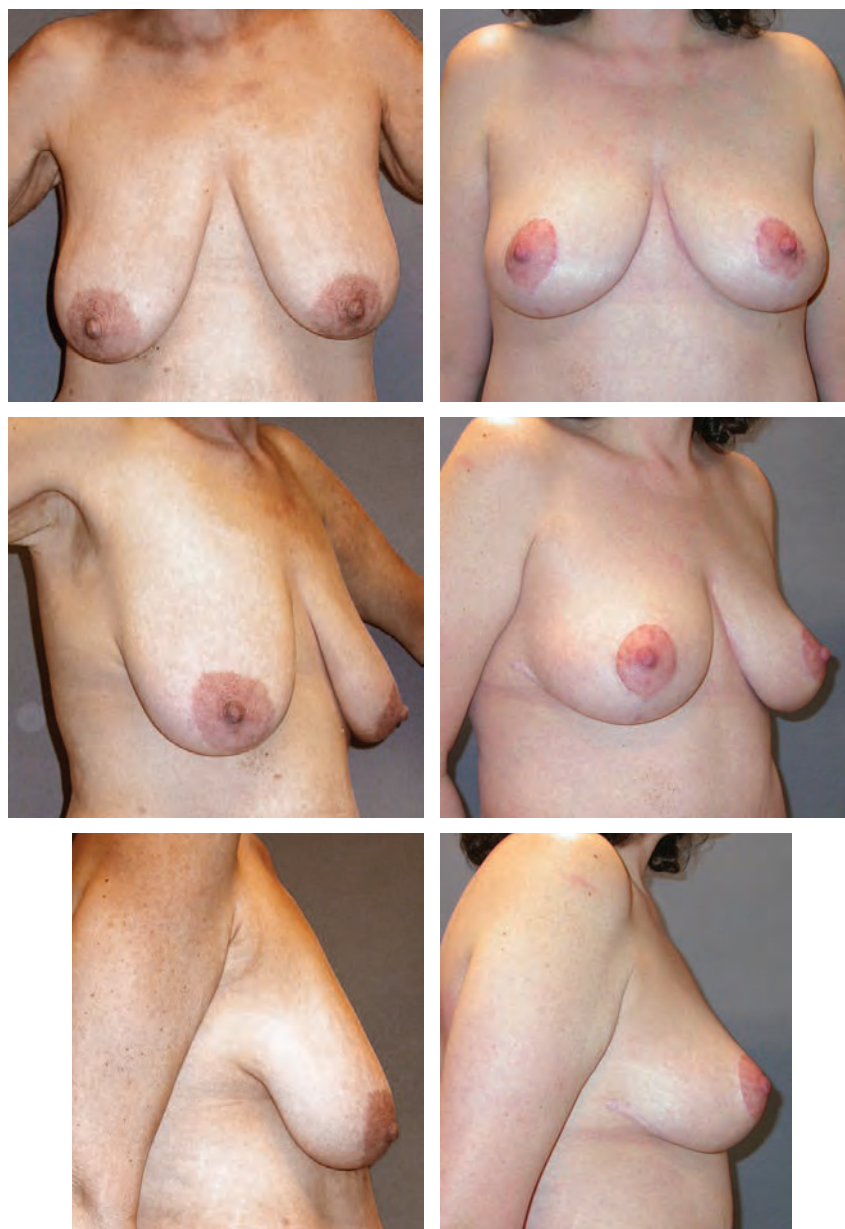
Results



This 40-year-old woman with a BMI of 33.8 lost 61 kg (135 pounds) before surgery. The lateral view of the surgical markings demonstrates an important point in the preoperative planning of this operation. The resection required to capture the lateral skin fold can extend beyond the tissue within the Wise pattern used for autologous augmentation. This flexibility allows the skin lateral skin envelope to be adequately contoured, with adjustment of the amount tissue mobilized to the breast. The results are seen 7 months postoperatively.



This 49-year-old woman lost 74 kg (163 pounds) after a laparoscopic gastric bypass procedure. Her BMI at the time of surgery was 27. She had significant preoperative asymmetry. By selectively resecting the breast parenchyma and by using lateral fold flaps of different volumes, postoperative symmetry can be dramatically improved. She is shown 1 year postoperatively.

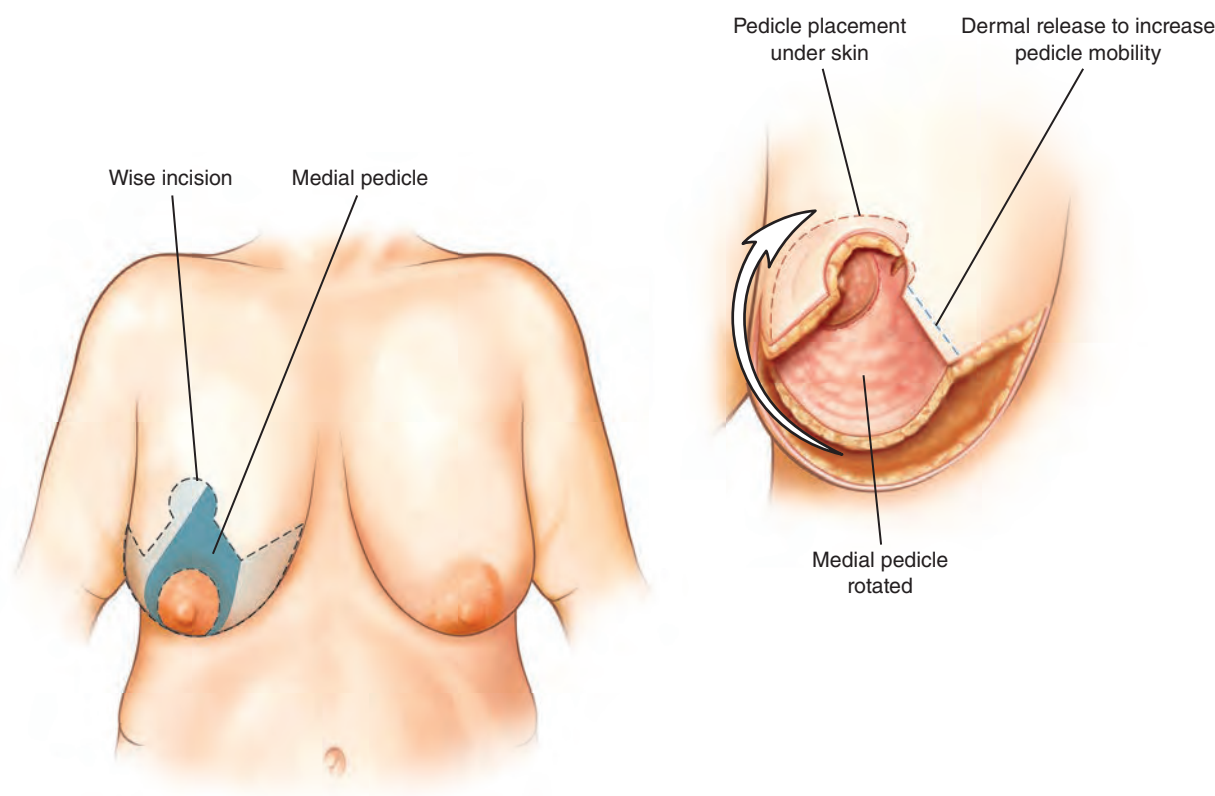


This 37-year-old patient with a BMI of 22.6 had lost a total of 62 kg (136 pounds). She had a small breast volume with no true lateral skin fold. Despite these findings, the procedure allowed very good control of the skin envelope and parenchymal re-shaping. She is shown 18 months postoperatively.



This 42-year-old woman with a BMI of 25 underwent a combined fleur-de-lis abdominoplasty and mastopexy. To prevent running the incision onto the chest, we stopped the incision at the xyphoid process. Four months after her initial procedure, the patient was left with a small dog-ear at the cephalad aspect of the fleur-de-lis incision. If a dog-ear remains 3 months postoperatively, we excise it in the office with the patient under local anesthesia. By waiting, we can minimize the cephalad extension of the scar. The patient is shown 4 months postoperatively (before the dog-ear excision) and at 7 months from her initial procedure.

Breast Reduction in Massive-Weight-Loss Patients



In a massive-weight-loss patient with ptosis and adequate or excessive parenchymal volume, a good option is breast reduction with a Wise pattern skin resection in conjunction with a traditional or extended medial pedicle. The Wise pattern allows resection of excess skin and precise control of the dermal envelope. The vascularly robust medial pedicle provides a pleasing medial curve to the breast shape and allows excellent repositioning of the nipple-areola complex. Upper pole fullness may be achieved by parenchymal elevation with suturing to the rib periosteum or pectoralis fascia. A decrease in the amount of pseudoptosis or bottoming out is an added benefit. Small to large parenchymal resections are possible, and the added benefit of familiarity of technique with most surgeons makes this an appealing alternative in massive-weight-loss patients.



This 56-year-old woman with a BMI of 29.5 after weight loss induced by lifestyle changes alone (no gastric bypass) manifested macromastia, severe ptosis, and moderate lateral chest skin excess. True macromastia is uncommon in weight-loss patients. These cases can be managed with a Wise pattern and medial pedicle to support the nipple. The medial pedicle, once rotated, helps maintain medial fullness and projection. Approximately 550 g of breast tissue was removed from each breast. The patient is shown 6 months postoperatively.

Concluding Thoughts

Following massive weight loss, patients often have sufficient breast volume to achieve an aesthetic shape. Dermal suspension with parenchymal reshaping and selective autoaugmentation is a versatile technique that enables the surgeon to effectively address the major breast deformities seen in the massive-weight-loss patient.

Clinical Caveats

When combining these cases with abdominal contouring cases, the abdominal procedure should be performed first. The inframammary fold will often be lowered, and the mastopexy markings may need to be adjusted superiorly.

A thickness of 1 to 1.5 cm should be maintained on the skin flaps to both improve contour, as well as to minimize tissue loss at the inverted-T point.

Preserving the second intercostal perforator medially will ensure a good blood supply to the overlying skin-parenchymal envelope.

The surgeon should not leave the operating room if he or she is not happy with the dermal plication, appearance of the breast shape, and projection after the skin flaps are redraped. If the shape is not optimal, removal of previous plication stitches or further plication will be necessary.

The dermis around the nipple-areola complex can be partially released around its circumference to allow it to be easily transposed to the keyhole pattern without tension. Failure to do so may result in a retracted nipple.

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CHAPTER 73



Management of Breast Asymmetry

GLYN JONES

Breast asymmetry is a distressing condition that carries significant implications for patients in terms of psychosexual impact. It also presents daily functional difficulties with the fit of clothing. The causes are usually developmental but may also be iatrogenic. Correction involves surgical intervention and may require a staged approach in more complex deformities.

Indications and Contraindications

To understand the indications for corrective surgery in breast asymmetry, one has to appreciate the plethora of causes of asymmetry in both the female and male breast.

Causes of Breast Asymmetry

Developmental Causes

1. Developmental hypoplastic breasts
2. Tuberous, constricted breast deformity
3. Poland's syndrome
4. Gynecomastia

Iatrogenic Causes

1. Asymmetrical breast reduction
2. Incorrect implant positioning during augmentation mammoplasty
3. Consequences of capsular contracture
4. Effects of breast reconstruction
5. Effects of radiation after breast conservation

This list provides a working classification of breast asymmetry. All of these categories constitute potential reasons to operate for asymmetry. However, contraindications to surgery are relative and include the following:

1. Body dysmorphic disorder
2. Severe psychiatric illness
3. Poor general health (breast procedures are elective and can be delayed)
4. Active smoking
5. Metastatic disease

Pertinent Anatomy

The anatomy of the breast has already been covered, but a few points bear reiteration. Correction of breast asymmetry centers on re-creation of symmetrical lower poles and good upper pole fullness and symmetry. An abnormally placed inframammary crease must be corrected to achieve symmetry. If the breast base is abnormal, the aesthetic outcome will be unsatisfactory. The tight inframammary fold associated with a constricted or tubular breast is tightly contracted. Correction involves release of the fibrous developmental band using radial scoring along the crease. This must be done up to the dermis to be completely effective, allowing expansion of the lower pole of the overlying breast tissue. Care should be taken to note and mark the correct natural crease position. The uppermost extent of the gland should be marked, and the surgical plan to correct deficiencies will involve implants, flaps, or fat injection. These two sets of maneuvers will go a long way toward correcting the appearance of the asymmetrical breast.

In addition, the contour of the underlying chest wall and sternal contour should be noted, because conditions such as Poland's syndrome or pectus excavatum can require larger than expected implant volumes to correct hypomastia. The level and degree of development of the nipple-areola complex are also essential to the creation of a symmetrical result. Even if the underlying breast mound has been perfectly matched, an asymmetrical nipple level will mar the aesthetic outcome dramatically.

Preoperative Assessment

Patients should be evaluated after taking a careful developmental history with specific reference to age of menarche and thelarche. Patients should be asked about upper extremity development and function. During the examination it is also helpful to attempt to form an impression of the patient's psychological maturity, particularly when surgery is proposed on younger women and teenagers; parental and peer pressure should be evaluated as a factor. Clinical examination involves assessment of breast, chest wall, and upper extremity development to exclude congenital problems, such as Poland's syndrome. The level of the inframammary creases and their de-

gree of tightness should be evaluated carefully. Nipple size, level, and the degree of development are noted. Measurements include nipple-to-notch and inframammary fold-to-nipple distances as well as pinch thickness tests to evaluate the thickness of available breast tissue in all quadrants of the breasts. Pectoralis major muscle bulk, thickness, and function are also worth assessing. The presence of pectus excavatum or carinatum can have an impact on the nature and success of a reconstructive attempt. Autologous fat donor sites on the abdomen and hips should be evaluated.

Preoperative Planning and Operative Technique

Management of Developmental Breast Asymmetries

Many women develop minor breast asymmetry during otherwise normal pubertal breast growth. It is not uncommon to see a young adult woman with one nipple slightly higher than the other or the lower pole of one breast slightly lower than the opposite side. These minor discrepancies are insignificant to most patients, and correction would require breast scarring, which is rarely justified, given the subtlety of the deformity. In other patients, however, the discrepancy in breast volume may approach one or even two bra cup sizes. These deformities are embarrassing for the patient and can lead to psychosexual problems in adult life as well as during puberty, when insensitive comments from peers during gym and sports activities can lead to social withdrawal. While catch-up growth may occur in the early to mid-teen years, it is rare in my experience to see a severely lagging hypoplastic breast achieve acceptable symmetry in the late teens to early adulthood. It is my preference to defer surgical intervention until after the patient is 18 years of age, but occasionally a severe deformity mandates earlier surgery.

Asymmetrical Hypoplasia

Developmental hypoplasia may range from mild to severe and can be unilateral or bilateral. In one sense, a bilateral deformity can be easier to correct, because it allows the surgeon the luxury of operating on both breasts to achieve a symmetrical outcome, particularly when implants are being used.



This 36-year-old woman developed severe breast asymmetry in her teens. She had a constricted hypoplastic right breast and a ptotic, almost tubular left breast. She requested breast augmentation. An asymmetrical breast augmentation with overlying mastopexy was performed. A 325 cc implant was placed on the right side with periareolar mastopexy, and a 250 cc implant was placed on the left side with a vertical mastopexy. The patient was delighted with the early postoperative outcome.

Unilateral Hypomastia With a Normal Contralateral Breast

Unilateral hypomastia requires augmentation of the hypoplastic breast to achieve volume symmetry. If ptosis is an additional component, mastopexy augmentation is indicated. Hypoplastic breasts often have an element of lower pole constriction that, if not corrected, will lead to a double-bubble deformity developing postoperatively. Every effort should be made to recognize and correct this problem at the initial operative procedure. Correction can be challenging and involves serial radial scoring along the tight inframammary crease to allow it to expand laterally over the implant curvature. These scoring incisions are passed through the fat up to the dermis, taking care not to burn the dermis with cautery. Cuts should be placed every centimeter along the old inframammary crease until the deformity is eliminated. The downside of performing these radial incisions is that they increase the likelihood of implant palpability in the lower pole. Inflatable, disposable implant sizers are extremely useful in assessing final implant volumes for these patients. I usually use a round implant in these cases. An inframammary approach to the subpectoral plane is acceptable if no mastopexy is planned. If a mastopexy is required, it is often relatively minor in extent, and a periareolar approach can provide access for both the augmentation and the required periareolar mastopexy scar. If there is any element of tuberous deformity with herniation of the breast into the areola, this approach provides the optimal exposure for correction. Assessment of patient symmetry in the erect position on the operating table is essential before skin closure.

Tuberous Breast Deformity

Patients with tuberous breasts often have a bilateral problem in that one or both breasts are relatively constricted, with one side larger and more ptotic than the other (see Chapter 63). Breast crease levels may be asymmetrical, with a very short inframammary fold-to-nipple distance present on the more hypoplastic side. The inframammary crease may be very tight and well defined, with clearly visible banding along the fold. Nipple-areolar diameters are often dilated, and the breast may exhibit a tendency to herniate into the areola, further worsening the appearance of deformity. If the larger breast falls within an acceptable size range for the patient, a mastopexy alone may be required on this side. However, if the larger side is also relatively small, it is preferable to perform a mastopexy augmentation on both sides, with a larger implant inserted on the more severely hypoplastic side. A periareolar mastopexy is usually sufficient on the smaller side, whereas a vertical mastopexy augmentation may be mandated on the larger side to help correct some of the glandular ptosis that accompanies the lower pole development on this side. The larger lower pole can be either imbricated or resected to allow a more symmetrical correction compared with the smaller side and its deficient lower pole fill.

It is essential to radially score the tight inframammary creases to achieve an adequate release of the breast tissue and skin over the implants to avoid the troublesome and unsightly double-bubble deformity. As with all mastopexy-augmentation procedures, it is essential to perform the augmentation first before committing to any skin excision. Failure to follow this simple dictum may result in excessive skin resection, creating a tight closure with risk of wound dehiscence or necrosis. I make the initial incision in the lower periareolar quadrant, at the juncture of the areolar-cutaneous junction. Once the implant is in place, tailor-tacking the skin gives a good idea of how much of the areolar skin disk may be safely resected as a periareolar mastopexy. Any vertical resection can be assessed in the same way on the larger, more ptotic side, if necessary.

For implant positioning, it has always been my preference to use the subpectoral plane in primary cases. This allows safe manipulation of the overlying breast tissue during mastopexy without concern for nipple and skin viability. Using this approach, the entire breast becomes the pedicle, because the relationship between the breast gland and the pectoralis major muscle is unaffected.

Poland's Syndrome

Poland's syndrome is a developmental abnormality involving the breast, nipple, and entire upper extremity and shoulder girdle. Typical patients have varying degrees of hypomastia and abnormal nipple-areola complex development, coupled with the absence of the sternal head of the pectoralis major muscle. This may be accompanied by

varying degrees of shoulder muscle hypoplasia as well as symbrachydactyly of the ipsilateral hand. All muscles of the upper extremity are potentially at risk, including the deltoid and less commonly, the latissimus dorsi. The presence and function of the latissimus dorsi should always be tested, because it can be used to reconstruct the ipsilateral anterior axillary fold and the lack of pectoral muscle bulk. Fat injection has recently been offered as an alternative to muscle transposition in less severe cases (see Chapter 63).

Surgery for Poland's syndrome aims to achieve three major aesthetic goals: creation of a breast mound, recreation of the anterior axillary fold, and restoration of the missing infraclavicular fill afforded by the absent sternal head of the pectoralis major muscle. Breast augmentation coupled with either latissimus flap transposition or later fat injection can achieve these goals. If the skin envelope is extremely tight, it can be preexpanded with the use of an integrated valve tissue expander, followed by an expander-implant exchange and latissimus transposition, if indicated.

If athelia exists, nipple reconstruction is also necessary. If the nipple is severely hypoplastic and located too high on the chest wall, it may be preferable to resect the nipple and perform a complete nipple reconstruction *de novo*. If the nipple is correctly placed but merely smaller than normal, soft tissue augmentation with a roll of acellular dermal matrix such as AlloDerm can be placed to increase projection. Tattooing if performed skillfully, can improve the diameter of the areola. If correction is performed in the early to mid teens, the patient and family should be warned that the breast implant will have to be exchanged for a larger one when the patient reaches maturity so that the normally developing contralateral breast can be matched. Patients should also be warned that a ptotic but otherwise normal contralateral breast may require a mastopexy at some point in the future to achieve symmetry. When dealing with Poland's syndrome, the surgeon should recall that the chest wall itself may be less developed and have an unnaturally steep lateral curvature that may make attaining symmetry even more difficult. An implant may tend to slide laterally off the chest wall in such patients, causing the appearance of less anterior projection from the implant than would normally have been achieved. In addition, the sloping chest wall may require a much larger implant volume to be used to compensate for the lack of lateral fill that would be provided by a normal chest wall contour.

Some authors have advocated the use of deepithelialized free flaps, such as a superficial inferior epigastric artery (SIEA) or parascapular flap, as an alternative to latissimus dorsi transposition in an effort to spare as much upper extremity function as possible. Autologous fat injection has also been used with increasing frequency and will probably attain greater significance in the management of this condition as techniques to maintain graft integrity improve (see Chapter 63).



The sternal head of the pectoralis major muscle was absent in this 9-year-old girl, and her nipple was underdeveloped and located abnormally high on her chest wall. Despite her young age, the upper chest deformity was so disturbing to her that correction was indicated, and her family was very supportive of surgical intervention. She is shown 9 years after her initial latissimus dorsi transfer, 7 years after an asymmetrical bilateral augmentation mammoplasty with saline-filled implants. She is now 18 years old, and breast symmetry has remained acceptable.



Courtesy Emmanuel Delay, MD

This 24-year-old woman presented with a moderate degree of Poland's syndrome deformity. Although missing almost all of the pectoralis major muscle, she had moderate breast development, which helped to soften the appearance of the breast deformity. Although a latissimus dorsi transposition and augmentation were certainly a reasonable option for this patient, fat injection was selected as a simpler alternative. A vertical mastopexy was planned to achieve better symmetry with the nonptotic hyperplastic breast. Staged fat grafting was performed, with three procedures involving injection of 260 cc, 350 cc, and 157 cc. Her result is shown at 1 year. Her breasts are now symmetrical, with complete correction of her deformity and a pleasing breast contour.

Gynecomastia

Gynecomastia involves abnormal enlargement of one or both breasts in men. It has two peaks of incidence: the first in puberty and the second in late middle age as male hormone balance changes. Most pubertal cases are idiopathic, but endocrine and chromosomal abnormalities should be identified when present. Obesity is an increasingly common cause of large breast development in males. Young men developing symmetrical, increasing breast enlargement after puberty in the absence of obesity should be questioned about marijuana use, which can stimulate breast growth quite strongly. In older men, the use of medications such as spironolactone should also be investigated. Most older men who develop gynecomastia do so as a result of changing hormone status with age, but breast cancer should be excluded, particularly in unilateral cases in the elderly. The use of systemic steroids can also result in gynecomastia.

Management of gynecomastia in obese patients should focus on weight loss before resorting to surgery. If medications such as spironolactone are the likely cause, their use should be discontinued and alternative medications tried. Once conservative measures have been exhausted, surgery becomes the only option. Many insurance companies do not cover these procedures, because they are regarded as essentially cosmetic in nature.

Surgery usually involves a two-pronged approach incorporating both liposuction and surgical resection. Liposuction is used to contour the chest wall fat peripheral to the enlarged gland; resection of the hypertrophied gland while leaving a small subareolar breast bud improves the central contour. Ultrasound-assisted liposuction has been touted as a successful means of removing both fat and glandular tissue, but I have not found it particularly helpful in dealing with the dense, fibrotic subareolar breast disk. I use power-assisted liposuction for the fatty component and then resect the excess glandular tissue.

Resection is performed through an infraareolar incision. When dissecting beneath the areola, great care should be taken to leave enough subareolar breast tissue in place to prevent the unsightly hollowing that can occur when too much tissue is taken beneath the nipple. This problem creates an extremely unattractive excavated look that is very difficult to correct, because the nipple adheres to the underlying pectoralis muscle and animates with arm motion. I leave a subareolar disk of breast tissue and then bisect the deep gland down to the pectoralis major fascia. Each half of the deeper gland can be resected in turn, which provides easier access than is feasible when performing a monobloc excision. Drains should always be inserted and a

circumferential pressure garment worn in an effort to prevent seroma formation. Ultrasonic liposuction seems to be associated with a higher incidence of seroma than is seen with power-assisted or conventional liposuction. Any resected tissue should always be evaluated histologically to exclude malignancy.

Management of Iatrogenic Breast Asymmetries

Asymmetrical Breast Reduction

The achievement of symmetry during breast reduction is an essential goal of the operation. Underresection or overresection on one side can produce asymmetry that will require subsequent revision. Breast symmetry should always be checked with the patient in the erect position on the operating table before a dressing is applied. Asymmetry caused by a focal problem, such as inadequate resection of the inferomedial or inferolateral quadrants of the breast, can be addressed with minor excisions of both skin and breast tissue with the patient under local anesthesia. Localized liposuction can also be used to address these issues if the breast is more fibrofatty than densely glandular. More gross asymmetries require a re-reduction procedure. Revisionary breast reduction can be a harrowing experience when performed by another surgeon, who may not have access to the original records and an understanding of the pedicle technique used. Generally speaking, if the patient had a Wise pattern reduction performed more than 10 to 15 years previously, it is likely that an inferior pedicled technique was used. Rarely, a superomedial technique may have been used. Vertical scar techniques are usually associated with superior or superomedial pedicles, unless a Hammond short-scar periareolar inferior pedicle reduction (SPAIR) mammoplasty technique was used. It is prudent to leave as much bulk around the pedicle as possible when performing re-reductions, and patients should be carefully counseled about the potential for nipple loss and fat necrosis. Suctioning of the periphery of the breast is usually safe in revisionary reduction, and skin laxity resulting from suction should be tightened by excision as needed. Stretched nipple-areolar diameters can be reduced, but this should only be done at the end of the procedure, because tension on the periareolar skin inset is often tighter than anticipated in re-reduction procedures. In thin-skinned patients, a Gore-Tex periareolar purse-string suture, as described by Hammond, is very useful in limiting skin stretch postoperatively.

Asymmetry Resulting From an Augmentation Procedure

Implant insertion for breast augmentation can lead to asymmetry, usually as a result of a failure to recognize and correct a preexisting asymmetry, or asymmetrical implant placement and overdissection of an implant pocket on one side.



73-1 SPAIR
mammoplasty
technique

Preexisting asymmetry requires the use of a larger implant on the smaller side and a smaller implant on the larger side. This may be more easily achieved with saline implants, which allow minor intraoperative adjustments to achieve as near perfect a result as possible. However, asymmetry may also arise when implants are placed in overdissected pockets, most commonly superior or inferolateral overdissection. Excessive upward dissection toward the clavicle creates abnormal fullness in the infraclavicular area, creating a top-heavy appearance to the breast. This is a particular risk of closed transaxillary augmentation, where inadequate release of the lower pole attachments of pectoralis major can displace the implant superiorly. The use of the endoscopic approach has alleviated this tendency considerably. Correction can be performed with an endoscopic transaxillary release of the lower pole, which allows the implant to settle in a more inferior position.

Overdissection of the inferomedial pocket allows the implant to bulge into the axilla, but what is more important, it creates an unattractive double-bubble appearance as the implant bulges beyond the lateral breast crease. Correction is extremely difficult, because the breast skin needs to be tacked down to the serratus fascia or muscle, all the while facing the outward force of a large implant being squeezed laterally by an active pectoralis major muscle. Fixation sutures of a nonabsorbable material such as 2-0 or 0 Mersilene or Ethibond can be useful, but the tendency to tear through with failure of the repair is high. Recently the use of a Strattice inlay anchored to the serratus muscle deeply and to the breast tissue and skin more superficially has met with better success. Another approach is advancement of an inferior skin flap, which can be tacked to the serratus muscle deeply; the overlying lateral breast crease skin is then sutured to the advanced skin, similar to the Ryan approach used in breast reconstruction. The attachment of skin to skin provides a more stable support mechanism than sutures between tenuous breast fat and serratus muscle. Avoiding this problem is definitely preferable to necessity of subsequent attempts at repair.

Overdissection of the medial breast pocket creates the potential for synmastia, an extremely unattractive deformity that is very difficult correct. Acellular dermal matrices have found an immensely useful role in this area: they provide a strong suturable material that, once incorporated and vascularized, can provide a firm barrier to subsequent implant migration medially. The procedure is combined with a suture plication capsulorrhaphy reinforced with Strattice or AlloDerm.



This patient presented with breast asymmetry and recurrent ptosis after a mastopexy-augmentation performed 5 years previously. Her right nipple was significantly lower than the left, and the right implant was higher than the left. A right open capsulotomy was performed to lower the implant on the right. An asymmetrical mastopexy was performed, raising the right nipple more than the left to achieve symmetry. The patient is shown 2 months after revision surgery.



This 34-year-old woman with hypomastia and ptosis had a subpectoral breast augmentation with saline-filled implants. The patient was concerned that her breasts were not large enough, and she had a clear double-bubble deformity on the left side. This was worsened by pectoral muscle action. The patient was advised to have an implant exchange to a larger size with subglandular conversion. The problem was corrected completely with this approach, and the patient is shown postoperatively with a symmetrical result.



This young woman had undergone transaxillary endoscopic breast augmentation with saline-filled implants. She was referred to me for correction, complaining of excessively high-riding implants. Clinically her implants had been placed too high, with at least 60% of the implant volume lying above the equator of the breast. Through the original transaxillary incision, I performed an inferior capsulotomy, allowing the devices to be placed into a more natural position. She is shown in the early postoperative period with a more acceptable aesthetic appearance of her breasts.

Asymmetry From Capsular Contracture

Capsular contracture is the single most common complication of breast augmentation. As the condition deteriorates, contraction causes increasing deformation of the augmented breast. Grade III and IV contractures may pull the implant into an abnormal position, displacing it in almost any direction and causing the shape of the implant to change from a teardrop to a more globular form on the chest wall. The net result of these compressive forces is breast asymmetry that deteriorates over time. Surgical intervention is the only means of correcting the deformity.

Closed capsulotomies are no longer performed; they have given way to open procedures. A capsulotomy with implant exchange, or better still, total capsulectomy with implant exchange, has become the mainstay of treatment. Once an established capsule has created a deformity, a recurrence is more like with a capsulotomy than with a capsulectomy. Capsulectomy provides the surgeon an opportunity to allow a fresh implant to generate a new capsule around the device, in the process adjusting the pocket position and size as required to achieve a more aesthetic result. If needed, acellular dermal matrices such as AlloDerm can be incorporated into the procedure; it is becoming apparent that this material may limit the formation of a purely fibrous capsule within the area in which it is placed. The high elastin content of human dermis in this biologic mesh is possibly partially responsible for the elastic nature of the capsule, as is the lack of cellular inflammatory response that is seen in the usual fibrous capsules forming around breast implants.

In addition, if a patient has a gel-filled implant associated with severe capsular contracture, this can be exchanged for a saline-filled device in an attempt to minimize recurrence. The addition of a textured surface may also help mitigate the capsular response, although at the expense of potentially increased palpability and wrinkling of the implant beneath the skin.

Fat injection is also showing promise as a means of softening the periprosthetic capsule, although data are still limited (see Chapter 65).

Effects of Breast Reconstruction

Breast reconstruction, particularly when performed unilaterally, may result in considerable asymmetry, particularly when implant reconstruction is performed. It is not within the scope of this chapter to cover all of the options available to achieve symmetry in breast reconstruction. Bilateral implant-based reconstructions tend to achieve a higher degree of symmetry because both breasts are shaped by an identical implant, often with the assistance of acellular dermal matrices placed at the time of the initial mastectomy and implant insertion. Unilateral implant reconstructions, however, often require adjustment of the opposite breast in the form of a mastopexy/augmentation or reduction, depending on the size and shape of the breast before mastectomy. In addition, fat injection has proved to be a powerful tool in helping shape the upper pole of the reconstruction, where implants often fail to achieve adequate volume fill. Autologous reconstructions have the potential to achieve greater symmetry without having to adjust the contralateral breast, because large quantities of skin and fat are available for shaping the reconstruction.



This elderly woman had undergone a right mastectomy for breast cancer 10 years earlier, with immediate expander-implant reconstruction. She developed capsular contracture around the high-riding implant, with severe acquired breast asymmetry. She was then diagnosed with a new left breast cancer requiring mastectomy. Treat-

ment involved immediate implant insertion, with AlloDerm coverage of the lower pole. On the right side, an open inferior capsulotomy with capsulorrhaphy to the upper pole of the implant pocket was performed. This allowed inferior placement of the implant into a more anatomic position. Shape and symmetry were vastly improved; the patient declined nipple reconstruction.

Effects of Radiation After Breast Conservation

Radiation is a powerfully negative force influencing breast shape after reconstruction of breast-conserving therapy. Breast-conserving therapy has been shown to be associated with deteriorating breast aesthetics over time; patients with larger breast volumes develop the most serious retraction, fibrosis, and fat necrosis when compared with women with smaller breasts. In addition, the deformity caused by the lumpectomy itself can also deteriorate with the addition of radiation therapy. To ameliorate these consequences, oncoplastic reduction plays an increasingly important role in treating patients undergoing breast-conserving therapy. Once the deformity is established, however, complex reshaping of the irradiated breast is the only means available to correct the asymmetry.

Correction of a breast-conserving therapy–induced breast deformity after radiation has been delivered involves the movement of breast flaps damaged by ionizing radiation. This results in compromised blood flow to the tissues and decreased tissue compliance from radiation-induced fibrosis and edema. Irradiated flaps do not move as well or as far as nonirradiated flaps, and seroma formation and infection rates are all increased in radiated beds. If edema is still resolving after radiation, I prefer to wait at least 3 to 6 months so that with massage and compression therapy, edema will be reduced. Referral to a lymphedema specialist can often expedite this process. Softer flaps are more pliable and move far easier than stiff, edematous tissues do.

Extreme caution should be exercised when dealing with such patients, and undermining of irradiated skin should be kept to a minimum. Skin necrosis is much more common after radiation therapy because of the reduction in cutaneous blood flow that accompanies the treatment. It is preferable to lift and/or reduce the contralateral breast to match the smaller irradiated side and keep tissue redistribution on the irradiated side to a minimum. In severely asymmetrical radiation-damaged breasts, it may be necessary to perform a completion mastectomy with immediate autologous reconstruction rather than attempt to reshape compromised, poor-quality local tissue. This may achieve a volume and shape match similar to the contralateral side. Alternatively, a contralateral balancing procedure may be necessary to match the reconstructed breast as a secondary procedure.



This 60-year-old woman presented 6 years after a right lumpectomy and radiation therapy for breast cancer. She had developed severe breast asymmetry and requested improvement without resorting to extensive flap procedures. The right breast was stiff and fibrotic, with lower pole edema. Treatment involved a left vertical breast reduction and a very conservative periareolar mastopexy to elevate the right nipple into a more acceptable position without extensive undermining. Although postoperatively her symmetry is not perfect, she is very happy with the outcome, achieved through a conservative outpatient procedure with minimal risk to the irradiated side.

Postoperative Care

The postoperative management of these patients varies enormously, depending on the nature of the deformity and the procedure required for correction. It is beyond the scope of this chapter to detail all of these procedures; see the appropriate operative descriptions in other chapters for this discussion.

Postoperative management involves the careful support of implants in their correctly placed location and may require the use of external taping or bras to assist with this process. Careful preoperative counseling and preparation for the possible need for revisions must be clearly explained to the patient to avoid postoperative disappointment, particularly with severe congenital deformities or radiation-induced asymmetry, both of which can be particularly challenging to correct.

Problems and Complications

Breast asymmetry surgery generates the same spectrum of risks and complications as the component operations used to correct the deformities. Congenital anomalies such as constricted, tubular breasts run the increased risk of double-bubble deformity if the original crease is not fully expanded and obliterated to make way for a new one. The position of the new crease must be placed accurately to match the contralateral normal position. Similarly, overdissection of the new crease position will result in an extremely unattractive bulge of the implant beyond the desired breast crease level, and such a deformity is extremely difficult to correct. A capsulorrhaphy is necessary between the breast capsule and the correct position on the chest wall, but the tissues are thin and hold sutures poorly, easily tearing through when a large implant exerts pressure against the repair. The use of a piece of acellular dermal matrix, such as AlloDerm or Strattice, is helpful in providing a more robust material to anchor such a repair.

Revision surgery for breast asymmetry requires operating in a previously scarred bed. The use of breast pedicles in such situations or raising scarred or radiated skin flaps may result in skin and fat necrosis or nipple loss. Every effort must be made to maintain blood flow to tissues by ensuring thick, broad-based pedicles and thicker flaps than might otherwise be used.

Outcomes

Breast asymmetry surgery is often difficult and may require revisions. Given the wide range of deformities and the spectrum of procedures required to correct them, it is almost impossible to provide outcomes data for this subset of clinical conditions.

Concluding Thoughts

Breast asymmetry is a distressing to the patient and carries a potentially profound psychological impact. The treatment of an established deformity requires the use of a broad range of procedures and techniques to attempt to restore a close facsimile of the normal breast from a less than ideal foundation. Achieving good results in these patients taxes the ability and skills of even the best surgeons and should not be embarked on lightly.

Clinical Caveats

Symmetry of the mound and nipple position must be created.

Abnormally placed breast creases should be eradicated and re-created at a natural level.

Radial scoring is performed perpendicular to the crease to eliminate a tight crease.

Broad-based pedicles are raised in revisionary surgery.

A herniated areola can be reduced by performing a periareolar mastopexy.

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The authors present a technique of augmentation mammoplasty with simultaneous treatment of glandular ptosis for patients with small, ptotic breasts. The technique has several advantages: it is simple and poses no circulatory problems to the flaps, the hospital stay and recovery are short, and only one procedure is required.

Gliosci A, Presutti F. Asymmetry of the breast: some uncommon cases. *Aesthetic Plast Surg* 18:399-403, 1994.

Six cases of significant asymmetry are presented. Treatment involved elaborate corrective methods.

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The author describes two types of tissue in patients with gynecomastia as well as treatment modalities.

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A subunit principle for breast reconstruction is presented based on a review of 10 years of autogenous reconstruction. Patterns of breast subunits are identified for defects of various sizes.

Vandenbussche F. Asymmetries of the breast: a classification system. *Aesthetic Plast Surg* 8:27-36, 1984.

The author proposes four main categories of breast asymmetry based on a review of 150 cases. These groups are true malformative asymmetry of breast, precocious primary asymmetry of breast, secondary or progressive acquired breast asymmetry, and tertiary or induced breast asymmetry.

Suggested Readings

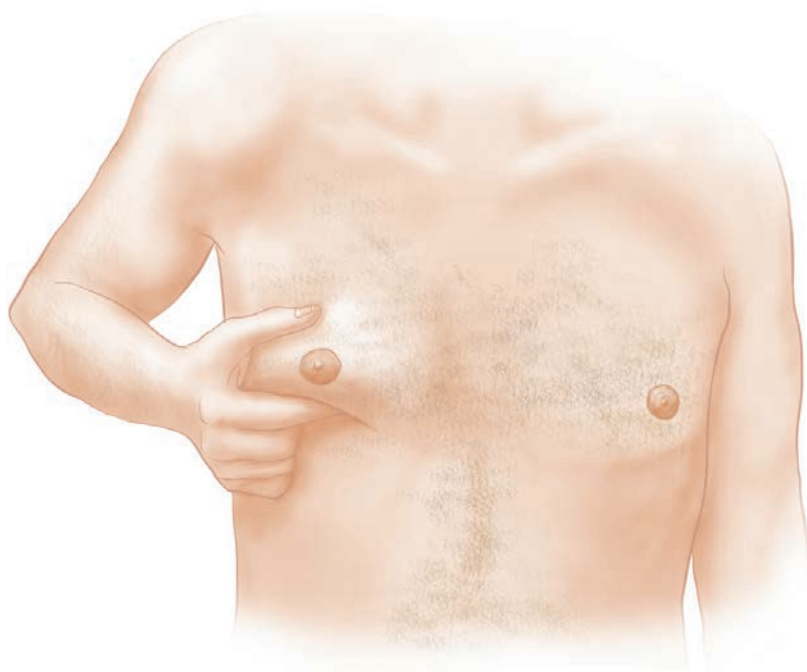
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CHAPTER 74



Treatment of Gynecomastia

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Gynecomastia is a condition in which unilateral or bilateral benign excessive breast development occurs in males. This is often an embarrassing and psychologically troubling problem that prompts the patient to seek correction. Initially thought to be a rare condition, a Navy study of recruits during World War II reported an incidence of 25% with excess breast tissue; more recent studies have reported an overall incidence of 32% to 36%, even as high as 40% of men in an autopsy series, and 64.6% in adolescent boys. The incidence of bilateral involvement also varies in the literature. The condition occurs bilaterally in 25% to 75% of patients. This wide variation probably stems from an increased appreciation of the psychological, physical, and social impact of the condition, as well as the lack of a clear and standardized definition within the plastic surgery and medical literature.

Etiologic Factors

The cause of gynecomastia is multifactorial, but in many cases an identifiable cause is elusive. Most authorities attribute the condition to stimulation of breast tissue by excess circulating estrogens or estrogen-like substances; this has been the basis for recent attempts at medical therapy for gynecomastia. However, surgical removal of the hypertrophic breast tissue remains the standard of treatment.

Gynecomastia has many identifiable causes, although idiopathic causes are the most common (25%). Recent investigations have demonstrated pathophysiologic mechanisms that involve a relative or absolute excess of estrogens, a decrease in circulating androgens, or a defect in androgen receptors. There is strong evidence for the estrogen-stimulating effects of breast tissue development as well as support for an inhibitory androgenic effect. Decreases in the androgen-to-estrogen ratio have also been associated with development of gynecomastia. No clear etiologic classification has been suggested based solely on hormonal influences. Instead, most accept an arbitrary classification based on physiologic, pathologic, pharmacologic, and idiopathic causes.

Physiologic gynecomastia can be further subdivided into neonatal, pubertal, and elderly periods. Circulating maternal estrogens transferred by the placental-fetal circulation are thought to contribute to excessive development of breast tissue in neonates. Because this is usually a self-limiting process lasting from weeks to months, treatment is rarely indicated. Up to 65% of adolescent boys exhibit varying degrees of gynecomastia, which usually resolves over several months to years. The degree of breast enlargement can be so minor as to escape recognition unless the area is clinically palpated. Relative excess of plasma estradiol compared with testosterone is implicated in the pathogenesis of pubertal gynecomastia. Older men (beginning at age 65) will often develop breast enlargement as plasma testosterone levels decline and peripheral conversion of testosterone to estrogen (peripheral aromatization) occurs, thus effectively increasing the plasma estrogen-to-androgen ratio.

Causes of Gynecomastia

Developmental/Physiologic

Neonatal
Pubertal
Aging

Drug-Induced (see box on p. 2650)

Hypogonadism

(decreased androgen synthesis or increased androgen resistance)

Primary
Acquired (trauma, infection, torsion, radiation exposure, mumps, chemotherapy)
Congenital
Secondary
Hypogonadotropic hypogonadism
Kallmann's syndrome
Pituitary failure (infarction, infection, neoplasm)

Tumors (increased estrogen production)

Steroid-producing (adrenal, testis)
HCG-producing (testis and others)
Aromatase-producing (testis)
Bronchogenic carcinoma

Systemic

Thyrotoxicosis (altered testosterone/estrogen binding)
Renal failure (acquired testicular failure)
Cirrhosis (increased substrate for peripheral aromatization)
Adrenal (ACTH deficiency or congenital adrenal hyperplasia)

Congenital Disorders

Klinefelter's syndrome
Enzyme defects of testosterone synthesis (may be late onset)
Vanishing testis syndrome (anorchia)
Androgen resistance syndromes
True hermaphroditism and related conditions
Increased peripheral tissue aromatase

Familial

HIV
Chest wall trauma
Psychological stress
Spinal cord injury
Malnutrition/refeeding (increased substrate for peripheral aromatization)
Herpes zoster infection
Cystic fibrosis
Alcoholism
Myotonic dystrophy

Idiopathic

ACTH, Adrenocorticotrophic hormone; HCG, human chorionic gonadotropin; HIV, human immunodeficiency virus.

Pathologic gynecomastia occurs as a result of various metabolic disorders (alcoholic cirrhosis, refeeding after a starvation state, feminizing adrenal tumors), endocrine disorders (hyperthyroidism, adrenal cortical hyperplasia, hypothyroidism), acquired hypogonadal states (orchitis, testicular trauma, granulomatous disease, renal failure, alcoholism, myotonic dystrophy), congenital hypogonadal states (Klinefelter's syndrome, congenital anorchia, androgen resistance), and increased estrogen states (bronchogenic carcinoma, true hermaphrodisism, testicular tumors).

Drug-Induced Gynecomastia

I. Drug Classes Associated With Gynecomastia

- Estrogens
- Gonadotropins
- Androgens (aromatizable)
- Antiandrogens (cyproterone, flutamide)
- Cancer chemotherapy agents (especially alkylating agents)
- Calcium channel blockers (verapamil, nifedipine, diltiazem)
- ACE inhibitors (captopril, enalapril)
- Antihypertensives (methyldopa, reserpine)
- Digitalis preparations
- Dopamine blockers (phenothiazines, metoclopramide, domperidone)
- Central nervous system agents (tricyclics, diazepam, phenytoin, diethylpropion)
- Drugs of abuse (marijuana, heroin, methadone, amphetamines)
- Antituberculous agents (isoniazid, ethionamide, thiacetazone)

II. Individual Drugs Commonly Associated With Gynecomastia

- Cimetidine
- Spirolactone
- Ketoconazole

III. Miscellaneous Drugs Related to Gynecomastia

- Amiodarone
- Auranofin
- Clomiphene
- Etretinate
- Metronidazole
- Omeprazole
- Penicillamine
- Sulindac
- Theophylline

ACE, Angiotensin-converting enzyme.

Pharmacologic gynecomastia can occur by several mechanisms, such as increased direct estrogenic activity, increased secretion of estrogen, decreased testosterone synthesis, and decreased androgen sensitivity. Also, many drugs with poorly understood mechanisms of action are associated with gynecomastia.

Bannayan and Hajdu identified three histologic patterns with varying degrees of stromal and ductal proliferation: florid, intermediate, and fibrous types. The florid pattern shows increased numbers of budding ducts in a highly cellular fibroblastic stroma. The fibrous type has extensive stromal fibrosis with minimal ductal proliferation. The intermediate type demonstrates overlapping of the fibrous and florid histologic patterns. Most experts agree that these patterns represent a transition related to the duration of gynecomastia and its symptoms, with the florid type usually seen in gynecomastia of less than 4 months' duration and the fibrous type seen when the gynecomastia has persisted for more than 1 year.

Associated Risks of Male Breast Cancer

One percent of all breast cancer occurs in males. However, patients with Klinefelter's syndrome have up to a 60 times greater risk of developing breast cancer; the incidence is approximately 1 in 400 to 1 in 1000. Many studies reviewing males with gynecomastia have demonstrated no increased risk of breast cancer compared with the normal male population. Thus in all non-Klinefelter's patients it is reasonable to treat gynecomastia surgically with both liposuction and excisional techniques without adding considerable morbidity or delaying the detection of male breast cancer.

In patients in whom hypogonadism is suspected, Klinefelter's syndrome must be ruled out, because this will ultimately have an impact on treatment. Because of the oncologic risk, excisional techniques are preferred for these patients.

Evolution of Treatment

Gynecomastia of long duration is unlikely to regress spontaneously and will often progress to irreversible dense fibrosis and hyalinization despite medical therapy. Withdrawal of an offending drug, correction of a systemic disorder, or the natural course of physiologic gynecomastia often results in spontaneous regression of gynecomastia; however, correction of an underlying disorder may not be effective in treating gynecomastia, especially if the duration of disease is lengthy and fibrosis of breast tissue has already occurred. Thus surgery remains the standard for management.

Evolution of Surgical Techniques for Gynecomastia

Year	Innovator(s)	Surgical Technique
1946	Webster	Semicircular intraareolar incision (resection of cone-shaped mass of breast tissue centrally with peripheral taper; reapproximate fat beneath areola)
1964	Barsky and Simon	Inverted omega intraareolar incision (improved exposure to under surface of areola)
1966	Pitanguy	Horizontal transareolar/intraareolar incision (improved exposure, easier dissection, and hemostasis)
1969	Letterman and Schurter	Superior periareolar incision with skin excision (for moderate to large gynecomastia; excess skin resected and nipple transposed superiorly)
1972	Letterman and Schurter	Nipple transposition on single dermal pedicle with oblique incision (nipple transposed medially and superiorly)
1972	Pers	Nipple transposition on vertical bipedicle with horizontal incision
1973	Simon	Excision redundant skin/breast tissue with free nipple graft (excision located as ellipse around nipple)
1974	Eade	Radial intraareolar incision
1974	Wray	Excision redundant skin/breast tissue, nipple grafting with inframammary fold scar (en bloc excision of breast tissue/skin with free nipple grafting; inframammary fold scar not in continuity with new nipple position)
1978	Balch	Transaxillary approach (2-inch incision in axilla)
1978	Artz and Lehman	Dermal pedicle
1979	Davidson	Concentric circle technique (half-circle serves as dermal pedicle; remaining half resected with breast tissue)
1981	Fara	Single superior dermal pedicle
1982	Huang	Concentric circle technique modification (no dermal pedicle; "apple core" around nipple/areola, vascular supply from chest wall)
1983	Teimourian and Perlman	SAL with excision (SAL used in periphery to smooth contour)
1986	Mladick	SAL
1987	Rosenberg	SAL (SAL used to evacuate both adipose tissue and dense parenchymal tissue in the breast, citing use of smaller 2.4 mm cannula as critical component for effective evacuation of the dense parenchyma)
1987	Courtiss	SAL (useful in selected patients with predominantly fatty breasts and well-located nipple/areola)
1994	Samdal	SAL
1994	Abramo	SAL (axillary approach for suction lipectomy)
1998	Smoot	Eccentric skin resection and purse-string closure
1998	Ohyama	Endoscopic transaxillary approach
1998	Botta	Circumareolar skin and SAL (technique described for patients with severe gynecomastia)
1998	Rohrich, Beran, and Kenkel	UAL (UAL technique reviewed, used successfully in all three grades of gynecomastia)
1999	Chiu	Pinwheel technique
1999	Gingrass	UAL (excellent results using UAL for most types of gynecomastia)

Surgical management, until recently, mostly consisted of excisional techniques. Standard suction-assisted lipoplasty (SAL) had an adjunctive role and was also advocated as a primary mode of treatment. However, limitations were encountered when SAL was used to treat severe cases or in breasts composed of primarily fibrous tissues.

Ultrasound-assisted liposuction (UAL), with known mechanical advantages in addressing dense, fibrous lipodystrophy, has extended the role of lipoplasty in the management of gynecomastia and has emerged as the preferred treatment modality. The technique was first described with the use of ultrasonic energy transmitted through excited piezoelectric crystals placed on terminal ends of suction cannulas to emulsify fat while preserving adjacent nervous, vascular, and connective tissue elements. Emulsification is effected through cavitation of fat cells in tumesced fields.

The UAL technique has been further refined, incorporating a three-stage process of subcutaneous infiltration of a wetting solution, followed by UAL, and completed by evacuation and final contouring by SAL. Endpoints for UAL (time and loss of resistance) differ from those for standard SAL (pinch and contour) but now provide parameters for safe and efficient lipectomy. Power-assisted liposuction (PAL) has provided a useful modality for treating patients with more fibrous gynecomastia. There have also been reports of laser lipolysis with pulsed 1064 nm Nd:YAG laser for the treatment of gynecomastia. Regardless of the technology used, an aggressive surgical approach is required to treat the more fibrous type of gynecomastia.

Advantages of Ultrasound-Assisted Liposuction

UAL has several advantages over SAL in the treatment of gynecomastia. Several studies have confirmed the selective emulsification of fat, which leaves higher-density structures such as fibroconnective tissue relatively undamaged. This allows more efficient removal of fat in areas that have higher densities of fibroconnective tissue, such as the male breast. At higher energy settings, UAL is effective in removing the denser fibrotic parenchymal tissue that SAL is inefficient in removing. In addition, UAL performed in the appropriate subdermal plane affects the dermis, aiding in skin retraction in the postoperative healing period. Further advantages of UAL include the reduced physical demand for large-volume liposuction of the breast, which allows the surgeon to contour the chest more precisely.

Indications and Contraindications

Some patients respond to nonsurgical management to correct underlying causes; these treatments include medications to regulate hormonal imbalances and irradiation. However, medical therapy with testosterone, antiestrogens (clomiphene and tamoxifen), and danazol has met with only limited success.

The surgeon and patient should consider proceeding with surgical management once a diagnosis of gynecomastia from nonphysiologic causes is established or if gynecomastia persists for longer than approximately 12 months. Hypertrophic breast tissue beyond this stage usually becomes irreversibly fibrotic. Patients with Klinefelter's syndrome should be treated by mastectomy because of the increased risk of malignancy. An algorithm for the diagnosis and directed treatment of gynecomastia is suggested (see p. 2660).

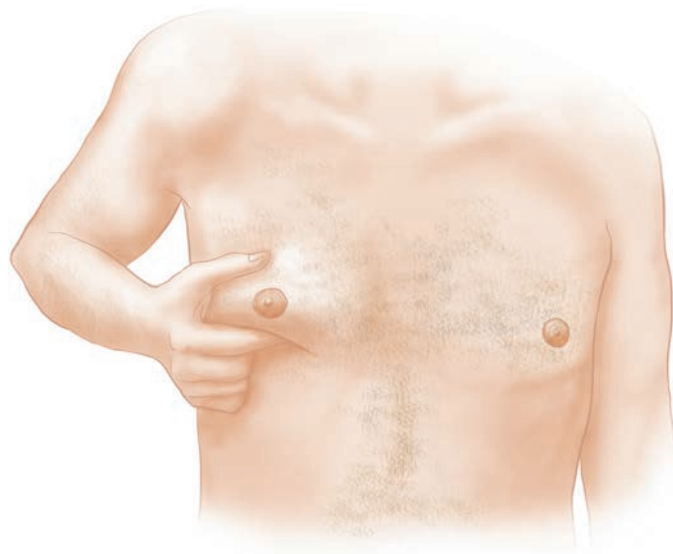
Pertinent Anatomy



In a normal male, the breast is typically flat, with some fullness around the nipple-areola complex. Glandular tissue is limited to the area directly beneath the nipple and areola and is usually not palpable as a discrete mass. A muscular male chest may exhibit superior fullness with a transition to a flat inferior chest near the inframammary fold. The nipple-areola complex is normally 2 to 4 cm in diameter and located over the fourth intercostal space. Nipple-to-sternal notch distance is 20 cm on average. Swelling associated with gynecomastia may occur as a circumscribed, firm, glandular mass of varying size just beneath the areola, or it may be a diffuse fatty fullness of the chest with ill-defined margins. Extensive glandular enlargement extending well beyond the areola has been described in body builders who use anabolic steroids.

Preoperative Assessment

A thorough medical history and clinical evaluation of the patient with gynecomastia are paramount. However, further workup is rarely indicated. The history elicited should include age, duration and onset of breast enlargement, symptoms of pain or tenderness, medications and recreational drug use, and psychological and social effects. A review of systems should involve signs and symptoms of hepatic disease, hyperthyroidism or hypothyroidism, recent weight gain or loss, adrenal disease, alcoholism, renal failure, and malignancies.



Physical examination of the breasts should involve assessment for glandular or fat predominance (by the pinch test), degree of glandular ptosis, skin excess, nodules or masses, and nipple abnormalities or discharge. Glandular or parenchymal tissue is characterized by rubbery breast tissue that is mobile and extends from a subareolar centric position. Suspicious nodules or masses may have abnormal firmness, overlying skin ulceration, eccentric location, or abnormal nipple discharge. In addition, the physical examination should look for testicular enlargement or atrophy and asymmetry, thyromegaly, hepatomegaly, pulmonary abnormalities, and abdominal masses.

Additional diagnostic testing should be individualized to address abnormalities identified in the history or physical examination. Cohen et al and McGrath suggested individualized workups, depending on the patient's age at the time the gynecomastia developed. These considerations are important, but arbitrary use of "screening" tests or laboratory data is not recommended. Rarely is an extensive workup indicated, and often this will have no impact on treatment.

Guidelines for Clinical Evaluation of Gynecomastia

	Consider	Tests
Prepubertal girls	Premature thelarche Exogenous hormones or drug usage Premature puberty Feminizing adrenal carcinoma	Serum estradiol level CT scan abdomen/adrenal LH/FSH (elevations may occur only at night) Bone age
Prepubertal boys	Idiopathic cause Drug use Premature puberty Feminizing carcinoma (Leydig cell tumor, adrenal carcinoma)	Serum estradiol LH/FSH HCG Bone age If HCG elevated, testicular ultrasound or thermography $\pm$ karyotype
Pubertal males with normal external genitals	Physiologic Klinefelter's syndrome Congenital anorchism Drug use Feminizing carcinoma (Leydig cell tumor, adrenal carcinoma)	LH/FSH Testosterone (total and free) Estradiol HCG If testosterone low and LH/FSH elevated, karyotype If estradiol is elevated, adrenal CT scan
Pubertal males with ambiguous genitals	Androgen biosynthetic defects Partial androgen resistance True hermaphrodism Mixed gonadal dysgenesis	LH/FSH Testosterone (total and free) Estradiol Karyotype Scans or exploration as indicated $\pm$ Androgen receptor analysis $\pm$ Androgen biosynthetic intermediate
Adult males	Testicular failure (viral orchitis, trauma) Ectopic gonadotropin production Feminizing adrenal carcinoma Drug use Chronic liver disease/cirrhosis Renal failure Thyrototoxicosis Idiopathic causes	LH/FSH Testosterone Estradiol HCG

FSH, Follicle-stimulating hormone; HCG, human chorionic gonadotropin; LH, luteinizing hormone.

Certain clinical findings should prompt further evaluation. In the scenario of a young (especially prepubertal) patient with a normal history and bilateral gynecomastia, testicular ultrasonography in conjunction with a careful testicular examination has been found to be cost-effective. The incidence of a functional endocrine tumor in this group is significant. Physical examination findings of feminization, including small testicular size (less than 3 cm in length or 8 cc in volume), lack of male hair distribution, or a eunuchoid body habitus, suggest a possible feminizing tumor. Endocrine testing in this situation (serum testosterone, luteinizing hormone, estradiol, and de-

hydroepiandrosterone) is appropriate. If feminizing characteristics are found in association with a marfanoid body habitus, karyotyping and an endocrine referral are indicated to rule out Klinefelter's syndrome.

Preoperative Planning

Classification and Treatment

Several treatment classification systems have been developed and excellent guidelines have been proposed for graduated management of gynecomastia based on degrees of lipodystrophy and skin excess.

We proposed a classification system in which candidates for surgical treatment are graded on the basis of the amount and character of breast hypertrophy, as well as the degree of ptosis. These grades can be further subdivided into grades IA and IIA for primarily fatty breast tissue and grades IB and IIB for primarily fibrous breast tissue. In this system, UAL and SAL are the primary treatment modalities.

Classification and Management of Gynecomastia	
Grade I	Minimal hypertrophy (<250 g of breast tissue) without ptosis
IA	Tissue type: Primarily glandular* Treatment: UAL or SAL
IB	Tissue type: Primarily fibrous* Treatment: UAL or SAL
Grade II	Moderate hypertrophy (250-500 g of breast tissue) without ptosis
IIA	Tissue type: Primarily glandular* Treatment: UAL or SAL
IIB	Tissue type: Primarily fibrous* Treatment: UAL or SAL
Grade III	Severe hypertrophy (>500 g of breast tissue) with grade I ptosis
	Tissue type: Glandular or fibrous* Treatment: UAL, 6-month staged excision†
Grade IV	Severe hypertrophy (>500 g of breast tissue) with grade II or III ptosis
	Tissue type: Glandular or fibrous* Treatment: UAL, 6-month staged excision†

*Fatty and glandular tissue is determined by a pinch test medially, laterally, and beneath the nipple-areolar complex.

†Delayed excision of remaining ptotic breast skin and/or breast parenchyma is performed 6 to 9 months after UAL to allow for maximal skin retraction.

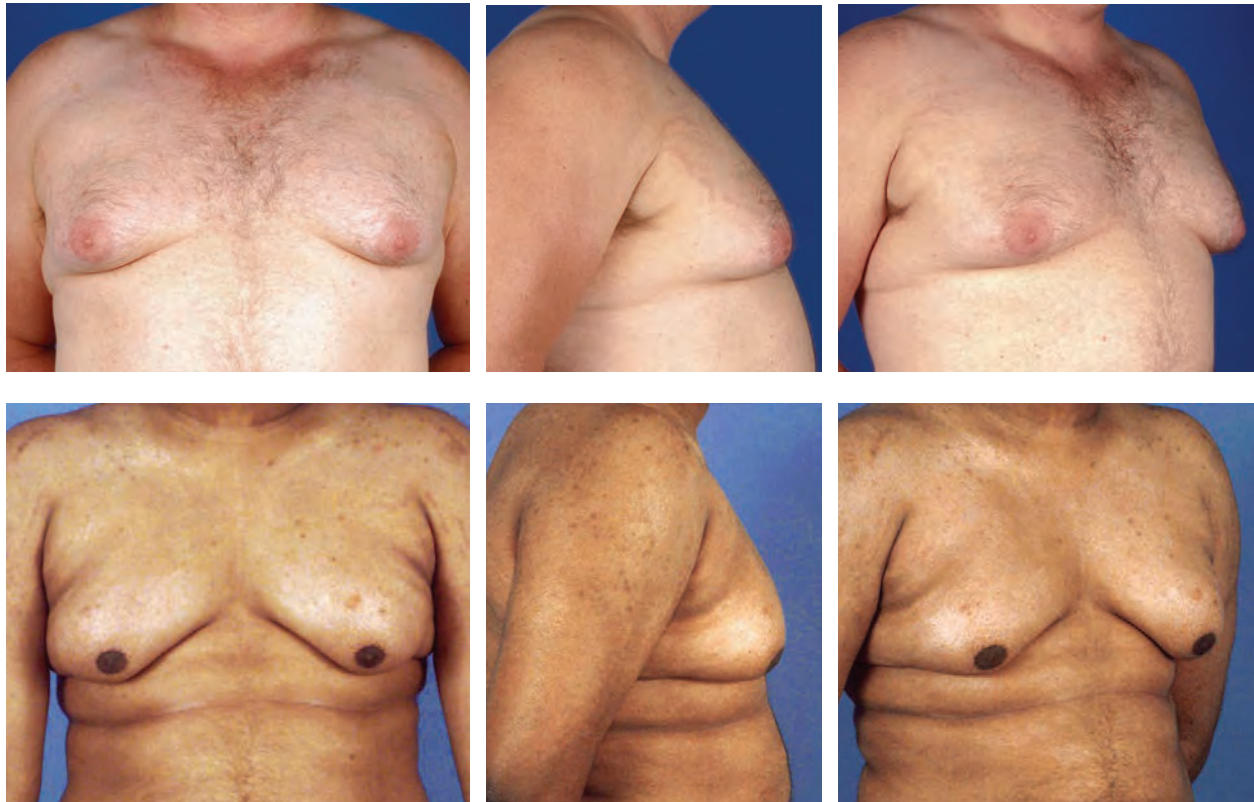
Grade I

Patients with grade I gynecomastia have minimal hypertrophy (less than 250 g of breast tissue).

Grade II

Patients with grade II gynecomastia have moderate hypertrophy (between 250 and 500 g of breast tissue).

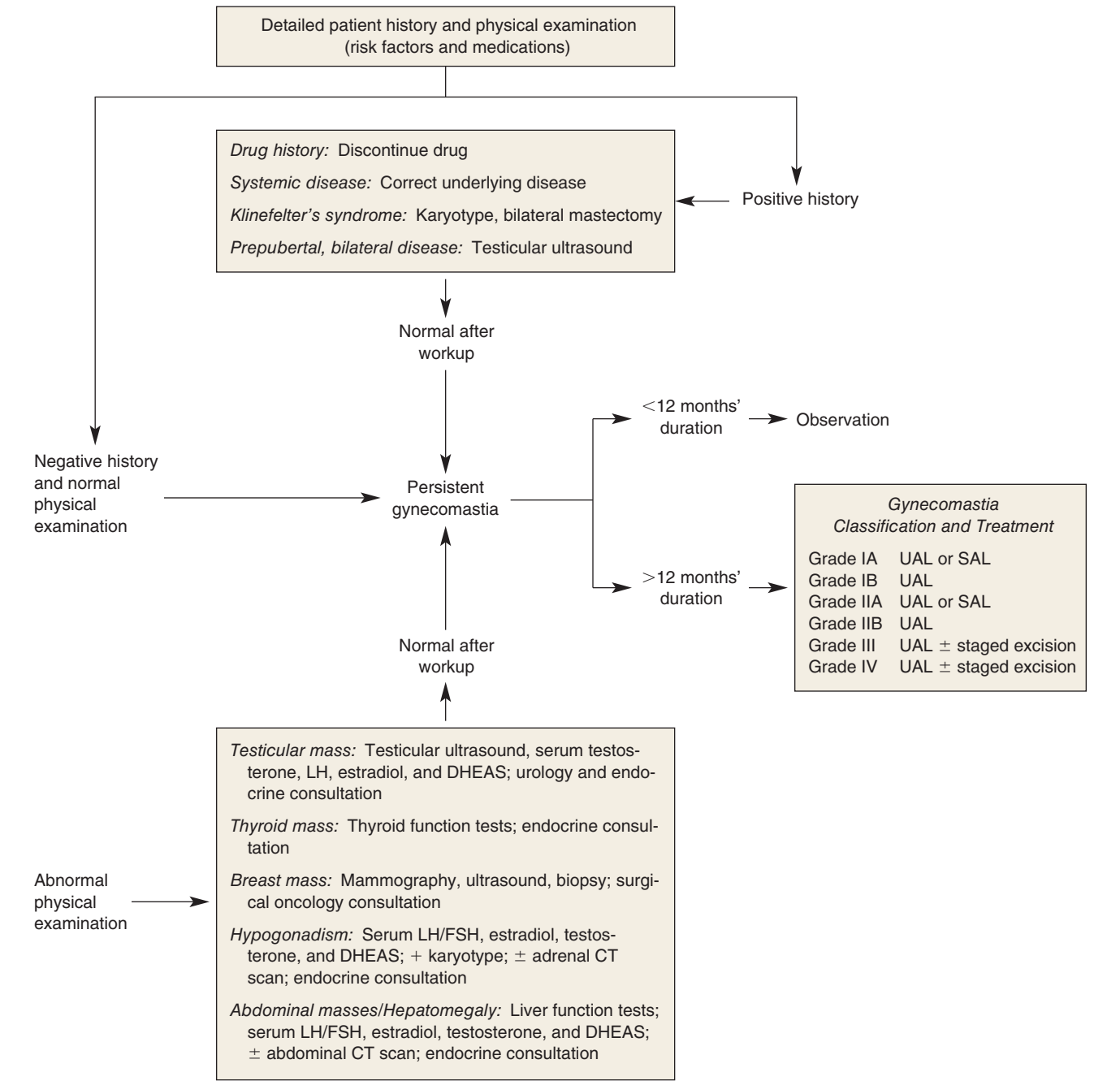
Grades III and IV



Patients with grades III and IV gynecomastia have severe hypertrophy (greater than 500 g of breast tissue) but are distinct because they have a greater degree of ptosis. Patients with grade III gynecomastia exhibit grade I ptosis, whereas patients with grade IV gynecomastia have grade II or III ptosis.

Power-assisted liposuction (PAL) and UAL are effective in all grades of gynecomastia. While they remain the primary treatment modality, increasingly it is becoming common to supplement PAL or UAL with partial resection of the retroareolar fibroglandular tissue. This may be accomplished via minimal periareolar incisions or the incisions used for the liposuction. Usually no further treatment is needed in grade I or II gynecomastia, and often a single UAL or PAL treatment is all that is necessary for grades III and IV, especially in patients with mild ptosis and good skin quality. Suction-assisted liposuction is a suboptimal modality for more severe gynecomastia (grades III and IV) and for patients whose glandular component is primarily fibrous tissue. Patients with grades III and IV gynecomastia may require staged excision.

EVALUATION AND TREATMENT OF GYNECOMASTIA



CT, Computed tomography; DHEAS, dehydroepiandrosterone; FSH, follicle-stimulating hormone; LH, luteinizing hormone.

Operative Technique

Markings

Markings are made preoperatively to outline boundaries of treatment. The outer perimeter of the breast base is marked initially, followed by the area of breast enlargement. The inframammary fold should be marked preoperatively with the patient sitting or standing. Adherent zones in the upper outer quadrants, where the breast retreats into axillary tissue, should be suctioned with caution.



Incision Placement

UAL access incisions are made inferolaterally in the inframammary fold. Occasionally, a second incision is made near the anterior axillary fold to facilitate evacuation and final contouring in patients with grade III ptosis and large fat deposits. UAL should not be performed through this incision because the overlying skin is quite thin and prone to thermal injury.

Anesthesia

A general anesthetic is administered, and the patient is positioned supine with the arms abducted. Incisions (3 to 4 mm) are made with a No. 11 scalpel in the lateral inframammary folds bilaterally for optimal access to the dense breast parenchyma. This route also provides superior access to obliterate the inframammary fold and to suction the medial chest.

Subcutaneous infiltration of wetting solution in the intermediate fat layer is performed using a standard infiltration pump and a 3 mm cannula. A superwet technique with a 1:1 ratio of infiltrate to estimated aspirate is used with a solution containing 1 L of lactated Ringer's solution mixed with 1 ampule of 1:1000 epinephrine and 30 cc of 1% lidocaine. Uniform infiltration can be challenging, and it is important to infiltrate all treatment areas in multiple layers systematically.

Technique

UAL is performed with an ultrasound generator (Mentor, Santa Barbara, CA, or LySonix, Carpinteria, CA), a 5 mm blunt-tipped titanium cannula or a 4 mm golf-tee cannula, and a standard surgical aspirator for evacuation. The Mentor Contour Genesis generator is set at an energy level ranging from 70% to 90%, with 90% being especially effective in the denser subareolar areas. The energy level on LySonix generators should be set between 5 and 7.

Volumes of aspirate and time of application are recorded. If the Vaser system is used (see Chapter 78), a single ring probe in the continuous mode at higher energy levels (greater than 90%) is effective. The stroke technique involves constant, deliberate passes of the cannula through the intermediate fat layer in a radial fashion from the lateral inframammary fold incisions. Additional passes are concentrated in the unique subareolar region where maximal fibroconnective density occurs.



A bimanual technique is used, with the nondominant hand guiding the UAL cannula through the subdermal layer. Liposuction of the subdermal layer is not a traditional level of treatment in UAL, but it is particularly important in addressing the dense fibrous tissue of gynecomastia and allowing maximal skin retraction. The periphery is treated for feathering and contouring. Disruption of the inframammary fold is essential in achieving a more gradual transition of the breast to the abdomen, which is characteristic in males (as opposed to the distinct demarcation of the inframammary fold in females). The adherent zones in the upper outer quadrants, as the breast retreats into axillary tissue, should be suctioned minimally, if at all (only for contouring), and extreme caution should be exercised.

PAL is also effective in treating gynecomastia. It is excellent for initial fat removal in fibrous areas, followed by treatment with SAL.

SAL is performed in standard fashion using 3.0 and 3.7 mm cannulas for final contouring and evacuation of emulsified fat. Evacuation should occur from the deep fat layer to the intermediate fat layer. Great care is taken to avoid overcontouring the area overlying the upper lateral pectoralis major muscle. After evacuation is complete, incisions are closed with 5-0 fast-absorbing plain gut sutures.

It is important to remember that the goal of UAL, PAL, or SAL in the treatment of gynecomastia is to restore normal male breast contour, not to eliminate all breast tissue. Achieving optimal results involves eliminating the excess breast tissue and performing peripheral contouring. The normal male breast has some subareolar fullness,

with varying degrees of superior chest wall volume. Using UAL, PAL, or SAL appropriately can avoid the “saucer deformities” that can be seen with overzealous resection from excisional techniques.

If additional contouring is necessary, an inferior semicircular periareolar incision is made to allow for direct access to any remaining fibroglandular tissue. Fibrous fragments are sequentially grabbed with a clamp and sharply excised under direct vision. Care is taken to not overly thin the subareolar area as this will create a contour depression. Leaving an approximately 0.5 cm thick portion of retroareolar glandular tissue avoids this complication.

Our preference is not to address skin excess at the initial operation. If removal of redundant skin and/or resistant lipodystrophy is still required after UAL or PAL, a staged excision is delayed for 6 to 9 months to allow for maximal skin retraction and healing. Thus the magnitude of the excisional technique and the resultant scarring can be minimized. A staged excision can be accomplished through a periareolar approach in most cases. Excision through extensive breast mound incisions has rarely been required.

Postoperative Care

The chest wall is dressed with a double layer of TopiFoam, and the patient wears a compressive vest for 4 weeks, 24 hours a day, followed by 4 weeks at nighttime only. Compressive therapy is critical in the postoperative period to prevent seroma or hematoma formation and to provide optimal contouring.

Patients should be followed periodically. Transient alterations in nipple sensation are rare, and affected patients can be reassured that sensation will return. If redundant skin or fibrous tissue persists, staged excision can be accomplished 6 to 9 months after surgery.

Outcomes

Courtiss reviewed 159 patients who underwent surgical management for gynecomastia; 101 patients (192 breasts) were treated with excisional techniques. Courtiss reported a high rate of complications with excisional techniques, including overresection (18.7%), unattractive scarring (18.7%), hematoma (16.1%), seroma (9.4%), and underresection (21.9%).

In a series of 60 patients treated with UAL reported by Gingrass, no major complications, hematomas, or episodes of skin necrosis were reported over a 4-year follow-up period; results were reported as “uniformly good to excellent.”

In a review of 61 patients by Rohrich and colleagues, no additional treatment was required in 86.9% of patients (53/61). Eight patients, four with grade III disease and four with grade IV gynecomastia, required staged excision of remaining breast tissue and skin (6 to 9 months after UAL) to optimize results.

Results

The following patients were treated with a combination of SAL and UAL for gynecomastia grades I through IV. All postoperative results demonstrate excellent restoration of normal male breast contour.



This 32-year-old man with grade IA gynecomastia was treated by UAL; 175 cc was removed from each side. He is seen 6 months postoperatively.



This 13-year-old boy with grade III gynecomastia was treated with UAL of the chest and disruption of the inframammary fold; approximately 350 cc was removed from each side. His initial result is seen 1 year later. He requested further improvement, so a second procedure was performed (*bottom row*) in which a persistent glandular remnant was removed and a periareolar skin excision was performed.



This 22-year-old man had grade IA gynecomastia. He underwent UAL removal of 200 cc from each side. He is seen 15 months postoperatively.



This 19-year-old man had grade IIB gynecomastia. He underwent UAL removal of 375 cc from each side. He is seen 6 months postoperatively.



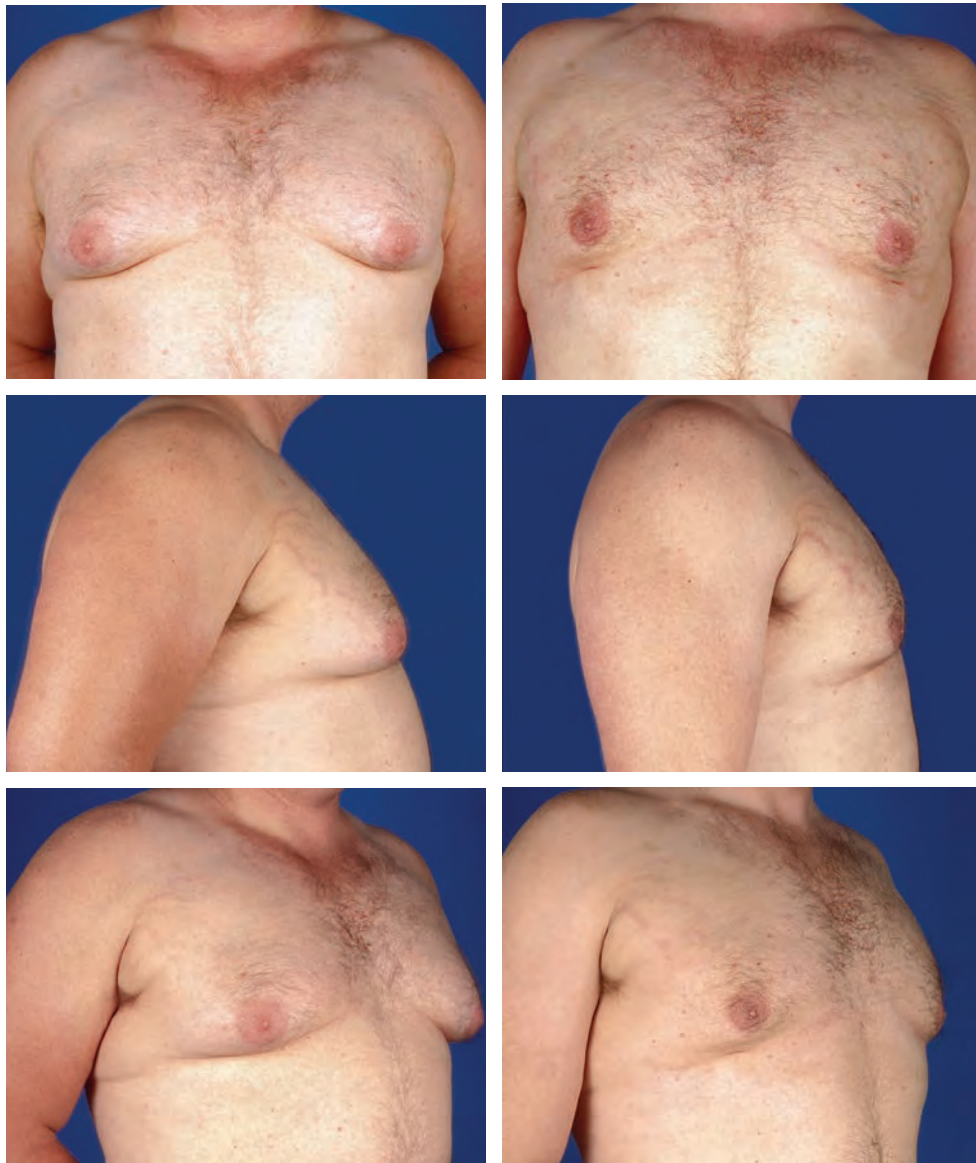
This 26-year-old man presented with grade IA gynecomastia. He is seen 6 months postoperatively after UAL removal of 200 cc from both sides of the chest and disruption of the inframammary fold.



This 16-year-old boy presented with grade IIA gynecomastia. He underwent evacuation of approximately 300 cc from both sides of the chest. He is seen 1 year post-operatively with a significantly improved contour.



This 36-year-old man had grade IIB gynecomastia. UAL and SAL procedures removed 725 cc from his left side and 700 cc from his right side. He is seen 8 months postoperatively with good symmetry and skin retraction.



This 38-year-old man presented with grade III gynecomastia. He is shown 7 months postoperatively after removal of 650 cc from the right side and 600 cc from the left.



This 18-year-old was diagnosed with grade IV gynecomastia; he subsequently underwent evacuation of 750 cc on the right side and 700 cc on the left side. Although there is some persistent ptosis postoperatively, he shows marked improvement for this more severe form of the disease.

Concluding Thoughts

The treatment of gynecomastia continues to be challenging because of the dense nature of the breast tissue as well as the skin redundancy that is often present. We have no doubt that some of the nonsurgical devices under investigation will be included in treatment algorithms of the future.

Clinical Caveats

Gynecomastia that is present clinically for more than 12 months does not typically resolve completely.

The goal of treatment is restoration of a normal male breast contour, not elimination of all breast tissue.

Excision alone should be avoided as the primary treatment for gynecomastia.

The lateral inframammary fold incision is optimal to concentrate UAL/SAL or PAL/SAL passes in the dense subareolar region.

Liposuction should be performed cautiously in the adherent zone.

UAL and PAL are effective for all grades of gynecomastia; SAL is primarily effective for grades IA and IIA.

Annotated Bibliography

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The author presents the following treatment recommendations for gynecomastia: if the gynecomastia is entirely due to fat, suction lipectomy alone is sufficient treatment. However, because suction will not remove breast parenchyma, patients whose gynecomastia is caused by parenchymal hypertrophy also require local excision of the parenchyma. Skin excision is rarely, if ever, necessary.

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A comprehensive work on the clinical applications of UAL and SAL.

Rohrich RJ, Ha RY, Kenkel JM, et al. Classification and management of gynecomastia: defining the role of ultrasound-assisted liposuction. *Plast Reconstr Surg* 111:909-923, 2003. *This article proposes a new system of classification and graduated treatment for gynecomastia based on glandular versus fibrous hypertrophy and degree of breast ptosis (skin excess). The authors have found UAL to be effective in treating most grades of gynecomastia. Excisional techniques are reserved for severe gynecomastia with significant skin excess after attempted UAL.*

Suggested Readings

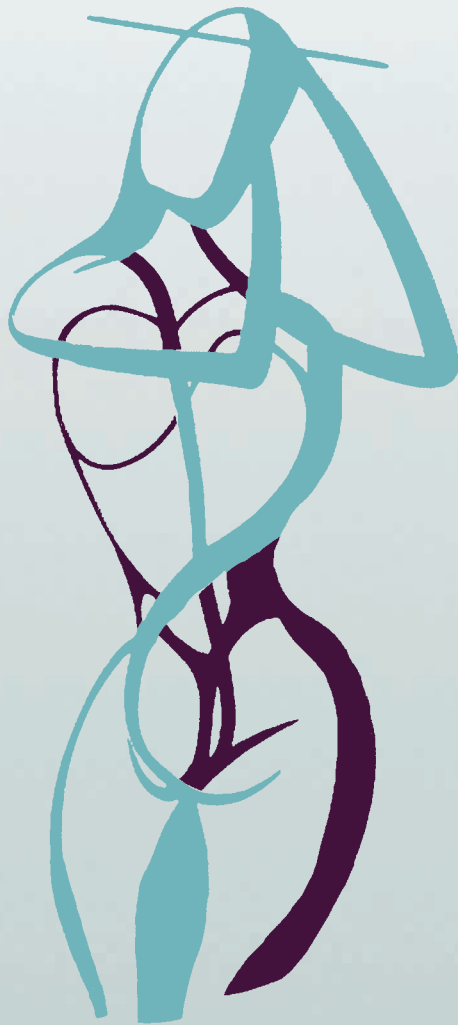
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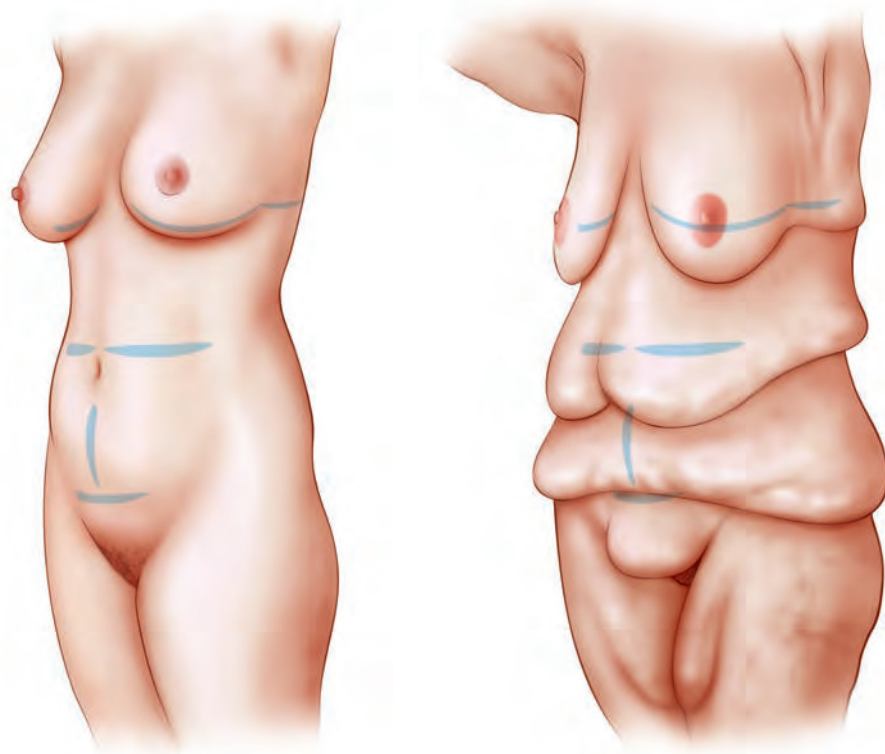
PART XII

BODY CONTOURING



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CHAPTER 75



Applied Anatomy in Body Contouring

ANGELA S. LANDFAIR, J. PETER RUBIN

Appplied anatomy is the practical application of anatomic knowledge to diagnosis and treatment of a patient. Applied anatomy in body contouring demands more than a passing familiarity with the underlying muscular, neurovascular, and bony structures. During body-contouring surgery, substantial three-dimensional zones of tissues may be simultaneously manipulated, transferred, and transformed. Therefore intimate knowledge of the subcutaneous tissue structure and composition and its relationship to the deeper tissues below is essential in optimizing surgical outcomes.

In this chapter we will review relevant universal anatomic principles that affect body contouring, with an emphasis on the superficial fascial system (SFS), zones of adherence, and the lymphatic system. Comprehension of these anatomic systems can help surgeons refine their technique and ultimately improve outcomes. Our discussion is not meant to describe operative techniques that are more extensively and appropriately discussed elsewhere; we will focus on the application of broad anatomic concepts for various surgical zones in body contouring.

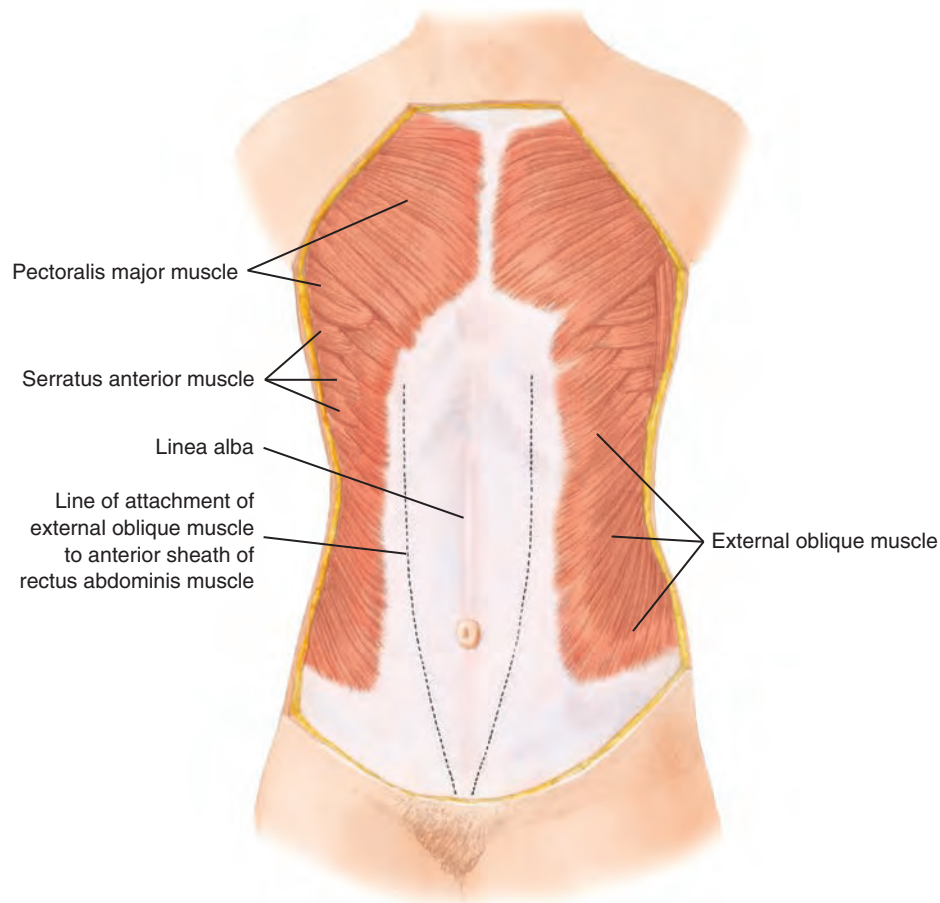
Evolution of Technique

In the past four decades, the science of body contouring has reached new levels of sophistication and ingenuity. In the 1970s there were tremendous advances in suction-assisted lipectomy, followed by innovations in tumescent, ultrasound-assisted, and large-volume liposuction. The surgeon's abdominoplasty repertoire has been augmented by the mini-abdominoplasty, marriage abdominoplasty (combination of mini-abdominoplasty and liposuction), limited dissection abdominoplasty, and lipoabdominoplasty, among others. Lockwood's descriptions of the superficial fascial system provided an anatomic basis for highly transformative excisional body-lifting procedures. Circumferential body contouring began with belt lipectomy and now encompasses various excisional lifting procedures, including simultaneous circumferential upper and lower body lifts.

The most recent advances in body contouring can be attributed to the increasing demand for bariatric surgery. Massive-weight-loss patients have presented many new challenges to plastic surgeons, introducing many unfamiliar contour deformities that had been inadequately addressed by previously existing procedures.

Ever the innovators, plastic surgeons have devised new procedures to address the deformities associated with massive weight loss. As our surgical arsenal grows in breadth and complexity, we can benefit by reevaluating the anatomic tenets that define the limits of tissue dissection and resuspension.

Superficial Fascial System



The superficial fascial system (SFS) is a vast connective tissue network extending from the dermis to the muscular fascia. The SFS comprises vertically and horizontally oriented fibers that interconnect to form a *connective tissue scaffold*. The vertical SFS fibrils arise directly from the deep dermis and attach to one of three locations: another SFS fibril; a secondary SFS layer, such as Scarpa's fascia; or directly to the muscular fascia. The SFS provides structure and a strut for subcutaneous fat and imparts additional biomechanical strength to surgical closures. Pathologically, the SFS is responsible for dimpling and cellulite. Manipulation of SFS has been discussed as a critical step in both excisional and less-invasive body contouring.

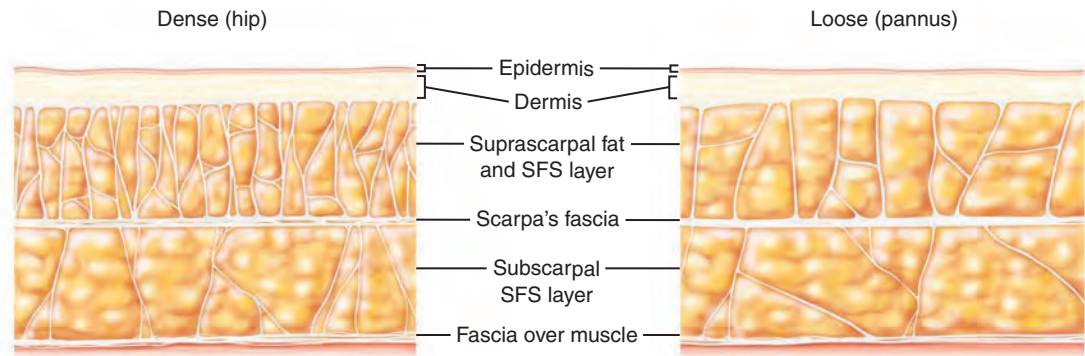


Histologically, the collagen and elastin content of the SFS is indistinct from that of the deep dermis. In the deep reticular dermis, the collagen and elastin fibers that are mostly horizontal in mid-dermis begin to orient themselves obliquely at angles that are more perpendicular to the epidermis. At the dermis-SFS junction, there are connective tissue fibers that emerge in a nearly vertical direction. The vertical SFS fibrils transmit interconnecting, more horizontal fibers to adjacent fibrils.

The SFS has a secondary component: the thin, gossamer sheets that emerge from the fibrils to encase the fat globules interspersed among the scaffold. These fine connective tissue sheets suspend the adipose tissue in their three-dimensional position.

The collagen and elastin makeup of the SFS fibrils indicates that the SFS shares viscoelastic properties similar to those of the dermis, including creep (lengthening of tissue under tension) and stress relaxation (decreased inherent tissue tension when pulled bidirectionally over time). In biomechanical testing of subcutaneous tissues, the SFS layer demonstrates viscoelastic properties independent of those of the dermis. When repaired along with dermis, the SFS confers supplementary initial tensile strength to wound repair.

In our animal study, suture approximation in the SFS layer, in addition to the dermis, significantly increased the initial biomechanical strength of the surgical repair and probably had a role in increasing permanent wound strength. Anchoring the SFS to deep fascia during closure has also been credited with decreased migration and widening of surgical scars.



In limited areas of the body, the SFS has a distinct, substantial horizontal layer that is suspended between the dermis and the muscular fascia below. This layer is called *Scarpa's fascia* in the trunk and *Colles' fascia* in the perineum. These defined connective tissue scaffolds most likely provide the majority of the tensile strength of the SFS layer when incorporated in body contouring. In other areas such as the lower legs, the SFS consists of layers of vertical fibrils and connecting horizontal fibers that do not coalesce into a substantial intervening horizontal structure.

Sex differences in SFS have yet to be satisfactorily elucidated. In general, however, the vertical components of the SFS are oriented more perpendicularly in women and more obliquely, or in a crisscross pattern, in men. As previously mentioned, the SFS scaffold consists of predominantly vertical/vertical-oblique fibers, with horizontal connecting fibers. It has been observed that in women with cellulite, there is a paucity of the horizontal fibers compared with women without cellulite, and that women without cellulite have SFS anatomy more similar to that of men.

The appearance of dimpling after overaggressive liposuction is probably caused by hollowed-out SFS pulling on the dermis. The appearance worsens with movement: the unidirectional pull of the SFS fibers emphasizes the dimples. The sex differences have not been investigated in morbidly obese or postbariatric patients. A reasonable assumption is that the overall effacement of SFS fibers and decreased elastin content seen with massive weight loss is likely to have a greater impact on SFS architecture than the sex of the patient does.

SFS is a dynamic viscoelastic structure that relaxes with age and weight gain. Stretching of these organized SFS fibrils is probably partially responsible for pathologic dimpling of the skin (cellulite) and for horizontal descent of tissues above more densely adherent areas, as seen in ptosis of the mons pubis. The impressive skin and soft tissue rolls often seen in massive-weight-loss patients arise from stretching and relaxation of skin and SFS, with deflation of the adipose tissue from weight loss. In areas of excess adiposity, SFS stretches from the burden of the intervening adipose tissue, and it is often difficult to distinguish distinct SFS fibers in areas of excess adiposity. In massive-weight-loss patients, the SFS fibers have been stretched to conform to a much larger tissue burden and often appear effaced in areas of greatest adipose loss.

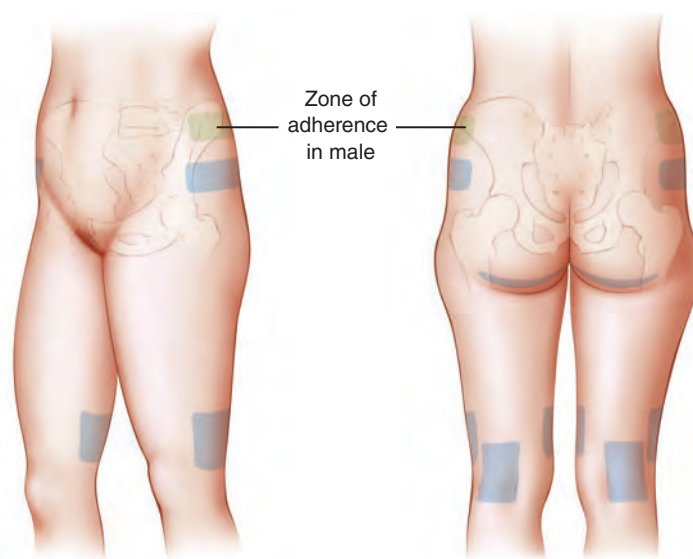
To equate body contouring with construction, the superficial fascial system is the scaffold. The SFS exists in every area of body contouring, and a successful outcome depends in large part on SFS reshaping and resuspension. Even when effaced by obesity and subsequent massive weight loss, the SFS remains an important layer in restructuring subcutaneous fat and minimizing scar and tissue migration.

Zones of Adherence

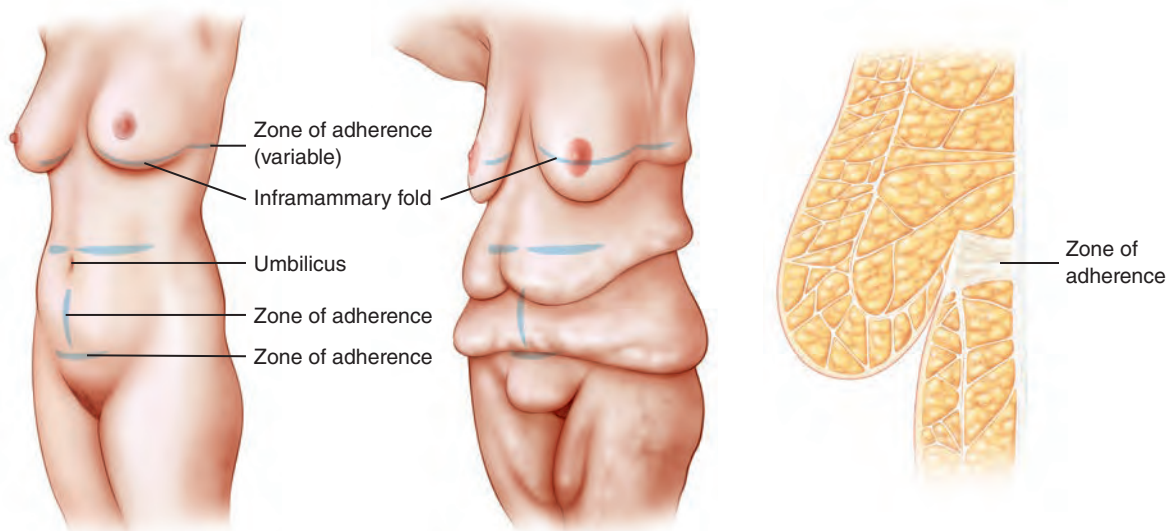
The topographic anatomy of the body is determined by the relationship of the SFS to the dermis above and the muscular fascia below. An area in which the SFS is specifically adherent and thickened creates a linear crease in the skin and a valley in the immediately surrounding soft tissue. These zones of adherence divide the adjacent subcutaneous tissue on either side into surgical compartments.

The zones of adherence have been emphasized in the past because they were considered zones to be avoided during suction lipectomy. Avoiding suctioning across these zones would result in conservation of subcutaneous connections between the skin and muscle fascia, thus preventing the overlying skin from vertical descent.

However, the classic zones of adherence are often not zones of avoidance in the massive-weight-loss population. In excisional lifting procedures, tissues within the zones of adherence may be excessive and should undergo direct resection. In the most severe massive-weight-loss deformities, the inferior tissue flaps may need to be draped over and superior to the existing zone of adherence and anchored at a more superior location. The new site to which the tissues are anchored may act as a *de novo* zone of adherence.



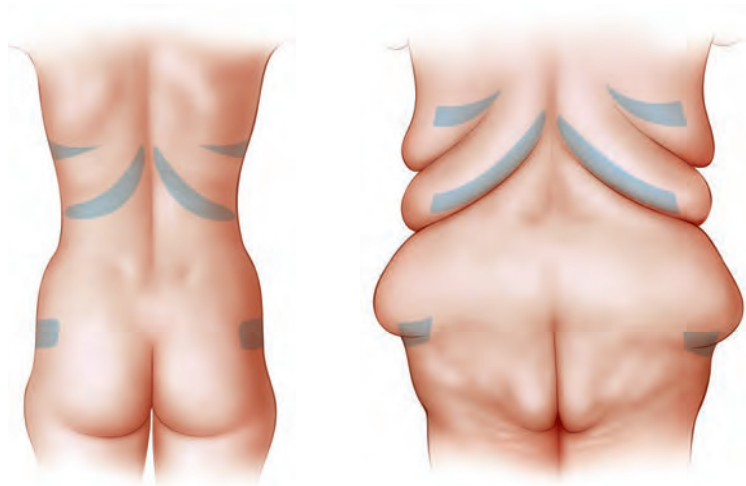
The zones of adherence do not occur equally between the sexes. The hip zone of adherence is demonstrated most convincingly at the level of the iliac crest in men, but several centimeters below the iliac crest in women. Adiposity below this zone of adherence in women accentuates the so-called saddlebag deformity, a finding largely absent even in obese men.



In massive-weight-loss patients, the combination of excess skin and attenuated SFS fibers creates large hanging areas that can originate and/or terminate at the various zones of adherence. An example of this is a moderate-sized pannus protruding and then descending over a known zone of adherence in the suprapubic zone, with the inferior margin of the pannus coalescing and attaching to the same zone of adherence. In female massive-weight-loss patients, significant deflation and ptosis of the breast occurs, with the majority of the ptotic tissue descending and hanging below the inframammary fold, which is an important zone of adherence. This phenomenon is seen in men as well, although to a lesser degree.

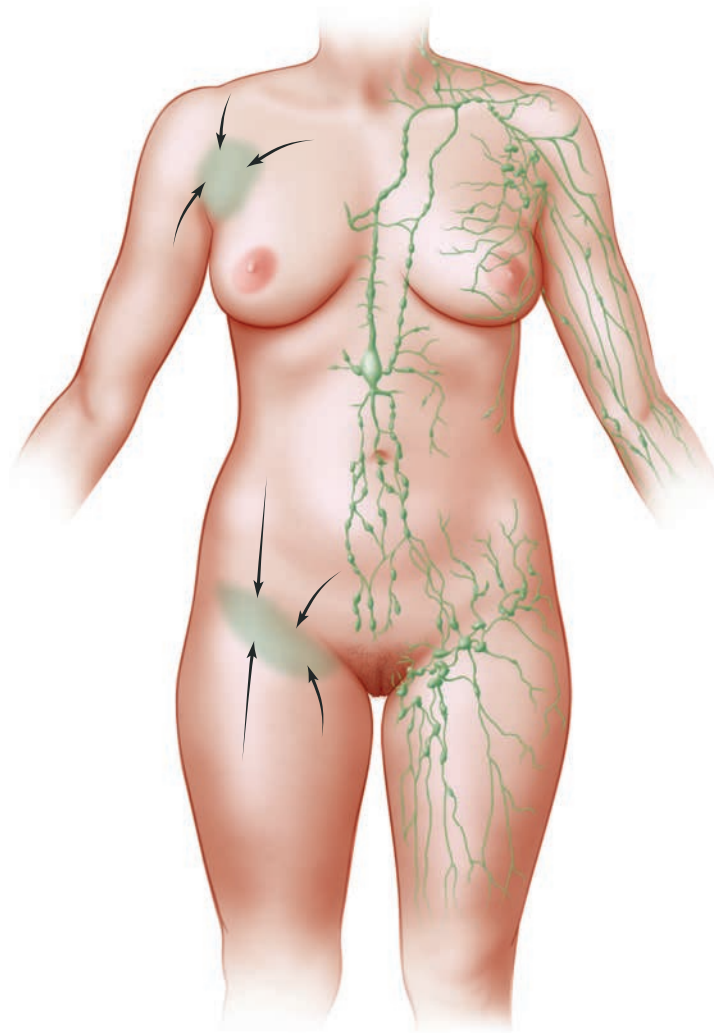
Pathologic zones of adherence are often observed in massive-weight-loss patients. For instance, the lateral chest roll that is often seen as a continuation of the breast suggests that the fascial coalescence that defines the inframammary fold continues laterally, causing overhang of lateral chest wall tissue in continuity with the breast tissue. The pathologic inframammary fold continuation into the lateral chest wall is likely present to some degree in all patients; however, this attachment is probably clinically insignificant in the nonobese and never-obese population, who do not have a significant quantity of lateral chest wall tissue excess.

Although the hips have been the most closely investigated area, zones of adherence are present throughout the body and are encountered during any body-contouring procedure. Inframammary folds and infragluteal folds are easily recognizable zones of adherence. The release of the crescent-shaped lower abdominal zone of adherence is of utmost importance during contouring of the abdomen and mons pubis.

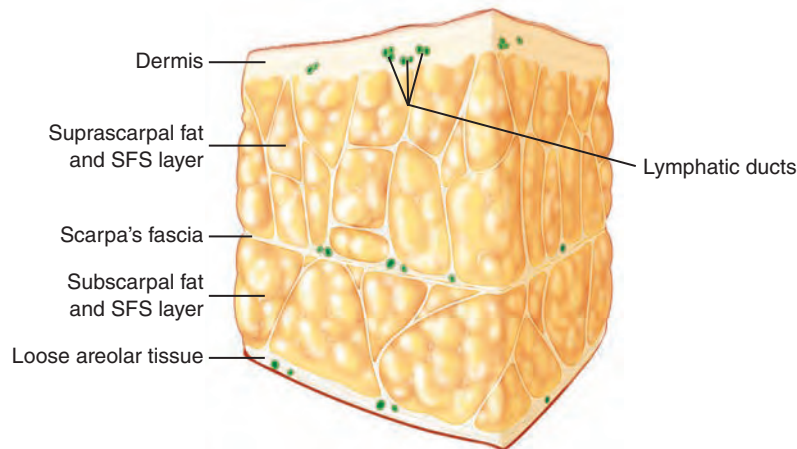


Based on photographic evidence of massive-weight-loss patients, it appears that the human body has numerous, although perhaps less well circumscribed, zones of adherence that anchor the skin and subcutaneous tissue at various locations. These zones become more obvious in a morbidly obese or massive-weight-loss patient. These midabdominal, midflank, and midback zones of adherence are clinically significant in massive-weight-loss patients, because these pathologic zones of adherence need to be incorporated into excisional lifting procedures to create a smooth contour where there are folds and indentations.

Lymphatic System



Often considered the third circulation, the lymphatic system exists in parallel to the venous circulatory system. Lymphatic capillaries arise from the deep dermis and along muscle fascia, coalesce to form larger lymphatic vessels, and travel unidirectionally through a valvular system toward nodal basins (*arrows*) and lymphatic ducts. The lymphatic ducts drain the lymph fluid into the central circulatory system by entry into the venous circulation. Venous capillaries reabsorb approximately 90% of interstitial fluid, while the remaining 10% is transported by lymphatic channels.



The lymphatic system can be loosely divided in two configurations: the epifascial, superficial system that collects lymph from skin and subcutaneous tissues, and a deep system that collects from all subfascial structures. The superficial lymphatic system is a factor during body contouring at all tissue levels. The initial lymphatic capillaries are found in the dermal papillae, which form a superficial subdermal plexus of lymphatic sinuses. Histologically, these lymphatic capillaries are composed of endothelium on a discontinuous basement membrane without tight junctions. These initial lymphatic vessels coalesce into superficial precollectors in the dermis, which then coalesce into lymphatic ducts. Lymphatic ducts are differentiated from other lymphatic vessels by the presence of smooth muscle in the walls. Lymph flow and lymphatic contractility in the ducts increase in response to tissue edema, exercise, mechanical stimulation, and temperature changes.

The surgeon must recognize the anatomic relationship between lymphatic vessels and their surrounding structures to prevent lymphatic injury during surgical intervention, which could lead to lymphedema. Specific areas should be carefully dissected, particularly regions near major lymphatic ducts and/or nodes that are regional basins of lymph transport. The lymphatic system exists in parallel to the venous circulatory system, and injury to a major vein often coincides with injury to regional lymphatic ducts. Some degree of lymphedema is common and expected after body-contouring surgery, but prolonged or permanent lymphedema is an unfortunate outcome that is at least somewhat preventable.

Lymphedema is a progressive pathologic accumulation of protein-rich fluid in the interstitial fluid, leading to inflammation that causes adipose tissue hypertrophy and fibrosis. When protein in the interstitium increases tissue colloid osmotic pressure, additional fluid is driven into the interstitium. When lymphedema occurs in a limb, it can impair the functional capacity of that limb. Plastic surgeons commonly encounter secondary lymphedema from excision of lymph nodes, such as in breast cancer patients who have undergone axillary dissection. More often, lymphedema is encountered in body-contouring patients as a sequela of lymphatic transport after massive tissue excision.

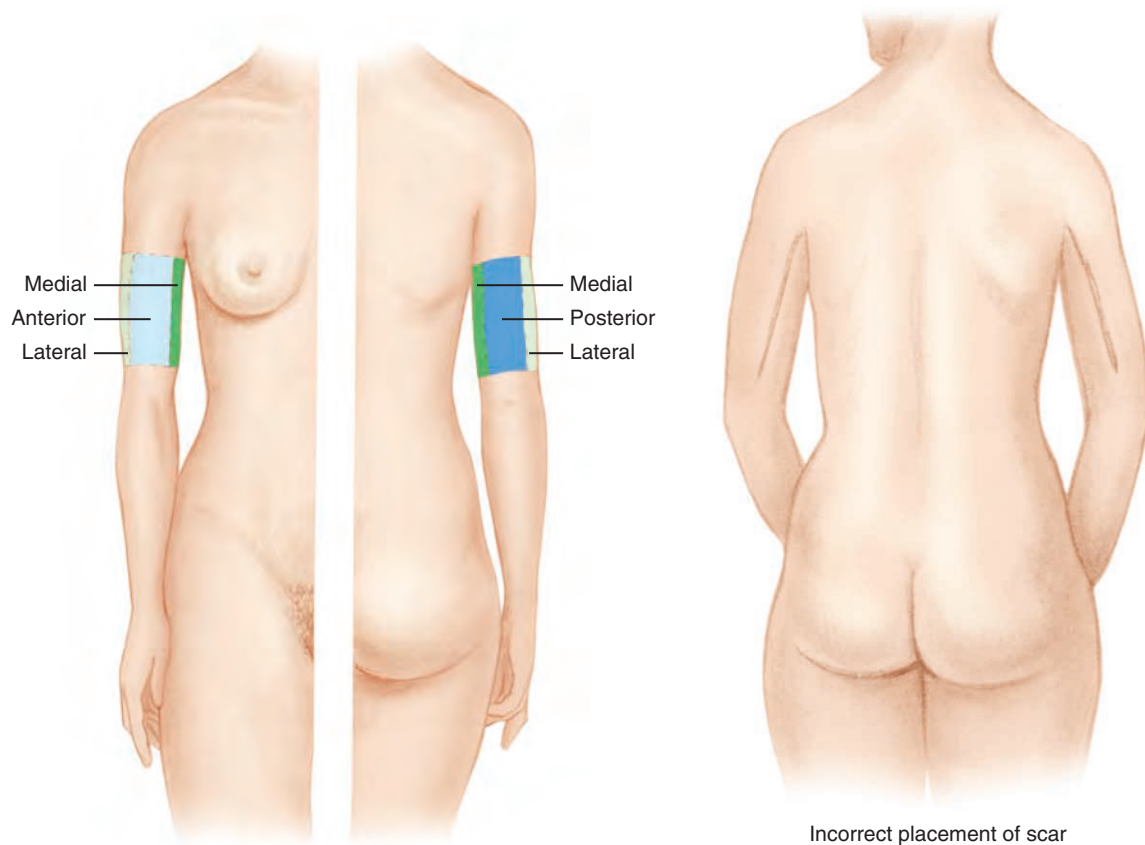
Chronic lymphedema of the lower extremity is a common clinical entity that plagues even a svelte individual but can be especially pronounced in a morbidly obese person. Improvement in the appearance of lymphedema when treated with mechanical squeezing of the lower extremities suggests that lymphedema indicates a functional deficit of lymphatic transport rather than an absence of or a decrease in the number of lymphatic vessels. It is probably akin to venous stasis in that the conduits are present, but the valves are not propelling its contents forward.

There are lymphatic channels in the dermis and subdermal plexus and along muscle fascia. Interruption of lymphatic vessels is often cited as a worrisome complication of suction lipectomy, but clinical experience indicates otherwise. Lower extremity suction lipectomy without excisional surgery (with a 3-month follow-up) was not shown to cause a significant change on lymphoscintigraphic examination. Liposuction without excision probably does not permanently damage the lymphatic system, and temporary reduction in lymphatic drainage could be explained by postoperative edema that compresses the lymphatic vessels. In contrast, a study by Moreno and colleagues of patients after medial thighplasty showed that at the 6-month postoperative visit, 30% of patients exhibited abnormal findings on lymphoscintigraphy compared with their preoperative scan. This study demonstrated that excisional surgery, in contrast to suction lipectomy, can cause enduring anatomic and functional changes to the lymphatic system.

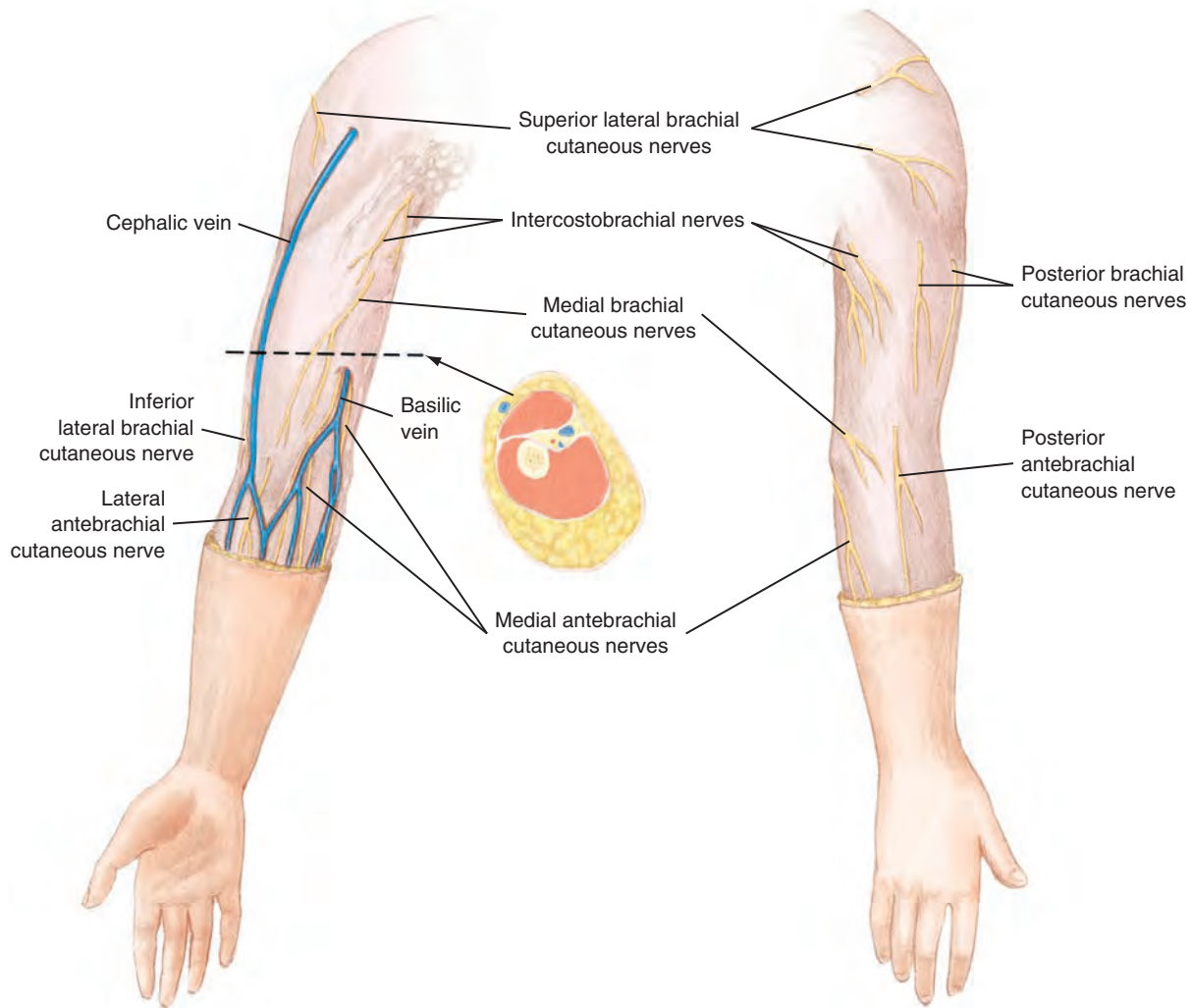
The nodal system is a pit stop for lymphatic fluid before it joins the venous circulatory system: the node basins allow passage of lymph fluid while trapping foreign particles. Chronic lymphedema of the upper extremity after axillary nodal dissection is caused by an absence of basins for lymph fluid from the affected extremity. The lymphatic vessels are present and probably still functional, but an absence of nodal basins causes a backflow of lymphatic fluid. However, clinically significant lymphedema occurs in a minority of axillary dissection patients, suggesting that even in the absence of nodal basins, lymphatic channels have direct connections to the ducts that drain into the venous circulation. Prolonged edema of the arm is reported rarely with brachioplasty, suggesting that disruption of lymphatic channels through excision of the posteromedial arm is rarely destructive enough to cause chronic lymphedema.

The superficial lymphatic system is a unidirectional network of lymphatic vessels and nodes that transport excess interstitial fluid into the circulatory system. Although it is a valved system, lymph vessels are vulnerable to temporary changes in local physiology created by local inflammation and postsurgical edema as well as chronic changes, such as the tissue burden of morbid obesity or massive weight loss. During excisional surgery, it is crucial to avoid the large lymphatic structures that often run alongside veins as well as efferent and afferent lymphatic vessels adjacent to nodal basins. Chronic lymphedema can be an unfortunate complication of excisional lift body-contouring surgery, and patients should be educated about the potential for this complication.

Arms



Guerrerosantos' classification divides the upper arm into four surfaces: anterior, medial, lateral, and posterior. These surfaces are defined with the arms hanging loosely at the sides, with the medial surface defined as the surface resting against the thorax. A common error in planning can make a scar too posterior, rendering it visible with the arms at rest. With aging or weight fluctuations, the laxity of the skin and soft tissues in the posterior proximal arm results in unsightly tissue redundancy. In patients of all weights, subcutaneous fat is most abundant in the posterior aspect of the proximal arm. After massive weight loss, excess skin and often excess adiposity persist.



During brachioplasty, the structures most at risk for damage are the intercostobrachial, medial brachial cutaneous, and medial antebrachial cutaneous sensory nerves. The medial antebrachial cutaneous nerve penetrates the deep fascia of the forearm at an average of 14 cm proximal to the medial epicondyle, becoming a superficial structure. The anatomic study by Knoetgen and Moran showed that the range for this distance was 8 to 21 cm and that the nerve did not run consistently with the basilic vein. The course of this nerve is variable, but it does reliably run in close proximity to the intermuscular septum. Careful dissection around this area can drastically reduce the likelihood of injury to this sensory nerve as well as to the basilic vein. The medial brachial cutaneous nerve runs posterior to the basilic vein and is at risk for injury if posteriorly placed incisions are used. The cephalic vein, which is superficial to the deep fascia throughout the arm, is generally safe from injury, as are superior lateral brachial cutaneous nerves, inferior lateral brachial cutaneous nerves, posterior brachial cutaneous nerves, and posterior antebrachial cutaneous nerves.

The preferred placement of incisions varies among practitioners; some surgeons favor a medial incision in the bicipital groove, whereas others choose posterior placement. Current designs in brachioplasty remove an ellipse of skin and soft tissue from the posterior arm as well as skin and soft tissue from the axilla. The dissection is superficial in the axilla and is unlikely to be in proximity to any vital structures.

According to Lockwood, the SFS of the arm has two distinct layers. First is the inherent SFS present throughout the rest of the body that encases and supports adipose tissue, undergoing stretching and relaxation with weight fluctuation and age. The second component is a longitudinal fascial system, or suspensory ligament, that extends from the inherent SFS to insert into the clavicopectoral and axillary fascia. Loss of tension in this suspensory portion of the SFS is most responsible for the ptosis of the posteromedial arm that is frequently seen in massive-weight-loss patients. Fascial anchoring of the suspensory ligament into the axillary and clavicopectoral fascia during brachioplasty to recreate this sling is crucial to performing a recontouring and rejuvenating procedure rather than a simply reductive procedure.

The suspensory ligament attachment to the axilla defines an important zone of adherence of the SFS to the underlying muscular fascia. Re-creating this zone of adherence produces a youthful axillary contour. After resuspension of the SFS in the axilla, the resulting zone of adherence should be concave compared with the posterior arm, with a sharp near-right angle when the arms are held in 90-degree abduction.

Small lymphatic vessels of the arm are distributed evenly and circumferentially throughout the arm. Anatomic studies have shown that large groups of superficial lymphatics are concentrated along the course of the basilic vein. A fair amount of skin and soft tissue reduction is performed in close proximity to the basilic vein during standard brachioplasties. Despite this, postoperative chronic lymphedema of the arm is rare in these patients, suggesting that the high concentration of lymphatic vessels in the rest of the arm can compensate for the vessels transected during brachioplasty.

Chest

Breast tissue is often severely affected by massive weight loss from relaxation of connective tissue layers, involution of breast parenchyma, and resulting skin excess. Lockwood described an anterior SFS layer of the breast as an indistinct connective tissue layer that lies between the dermis and the breast parenchyma, and the posterior SFS as the connective tissue fibers that travel through the breast parenchyma to attach to the pectoralis fascia. SFS fibers of the breast are not easily identified intraoperatively,

but should theoretically be a strength layer that encases the breast parenchyma. The suspensory ligaments of the breasts are called *Cooper's ligaments*; it appears that Cooper's ligaments are synonymous with Lockwood's SFS of the breast. The description differs in that Lockwood characterizes the anterior SFS layer as being somewhat separate from the posterior SFS throughout the parenchyma.

In massive-weight-loss patients the SFS is effaced, and the suspensory qualities of the SFS fibers are lost. Parenchymal reshaping techniques that rely on anchoring large areas of deepithelialized tissue to the periosteum of the rib or pectoral fascia are often more successful in massive-weight-loss patients with severe breast deformities. These techniques correct the vertical descent of the breast tissue and restore volume by resuspending, rather than excising, the descended breast tissue. There is often a large roll of soft tissue excess in the lateral chest wall in continuity with the breast. These soft tissue rolls can be deepithelialized and rotated medially on a random-pattern blood supply to augment the breast tissue.

Even in massive-weight-loss patients with the most severe deformities, the inframammary fold is usually intact. In most body-contouring surgeries, it is crucial to preserve the inframammary fold as the single most important zone of adherence in the upper trunk. Boutros et al performed a study to elucidate the anatomy of the inframammary fold. Through histologic evaluation, it was determined that the dermis of the inframammary fold houses regular arrays of horizontally oriented collagen fibrils. The arrangement is consistent through all layers of the dermis and is especially prominent in the papillary dermis. On gross examination, the SFS at the inframammary fold is condensed and thick, directly connecting the dermis to the pectoralis fascia below. The authors concluded that the inframammary fold is an intrinsic dermal structure consisting of regular horizontal arrays of collagen held in place by a zone of adherence formed by the SFS.

The symmetry of the inframammary fold is important in male body contouring as well, particularly because the inframammary fold is always visible in the normal male chest. In male chest contouring, the location of the horizontal scar for excision can lie at the inframammary fold. A well-placed horizontal scar can create the illusion of an inframammary fold, even without actual fascial attachments. The male inframammary fold should be located 4 to 5 cm inferior to the edge of the areola.

Lymphatic drainage of the chest wall is seldom problematic because of the proximity of tissues to the axillary nodes and the major lymphatic ducts, including the thoracic duct. Although some lymphatic flow through the nipple-areola complex is disrupted during breast-contouring procedures, the preservation of a dermal pedicle appears to provide adequate efferent lymphatics.

Trunk and Mons

The anterior trunk aesthetic unit comprises the abdomen, flank, and the mons. The abdominal wall is bound superiorly by the costal margin and inferiorly by the pelvic girdle. The umbilicus lies at the junction of the midline and the horizontal line drawn at the upper margins of the iliac crests. The natural waist is defined by a multilayer muscular suppression, which is approximately 1 inch above the umbilicus.

Sex differences in regional adiposity of the abdomen are well established. In general, women have a more protuberant anterior abdomen, and the adiposity is more pronounced in the inferior umbilical region. In men, the anterior abdomen is flatter and has a less pronounced flare at the iliac crest. With obesity, men tend to deposit more fat within the muscular envelope and in the flanks region compared with women. With massive weight loss, the sex differences are somewhat blunted, hidden beneath large areas of excess tissue. Ideally, body contouring should make the sex difference more pronounced, restoring masculinity and femininity to the patient's contours.

Both superficial and deep systems contribute to the blood supply of the anterior abdominal wall. Recent CT angiography and venography studies have revealed that perfusion of the soft tissue of the abdominal wall occurs through the subdermal and suprafascial plexus. The blood supply of the abdomen has been elucidated in multiple anatomic studies. The deep vascular supply to the abdominal wall comes from the following:

- The deep inferior epigastric artery and deep superior epigastric artery, which is an extension of the internal mammary artery. The vessels anastomose on the deep surface of the rectus abdominis muscle between the umbilicus and the xyphoid.

- The deep intercostal arteries T6-12, which travel in the plane between the transversus abdominis and internal oblique muscles, then join the central vasculature of the deep epigastric vessels at the semilunar line.

- The inferomedial to superolateral axis includes the deep circumflex iliac artery, which anastomoses with the lower intercostal and lumbar arteries.

The superficial blood supply consists of a network of connections between the inherent superficial vessels and the musculocutaneous perforators from the deep system:

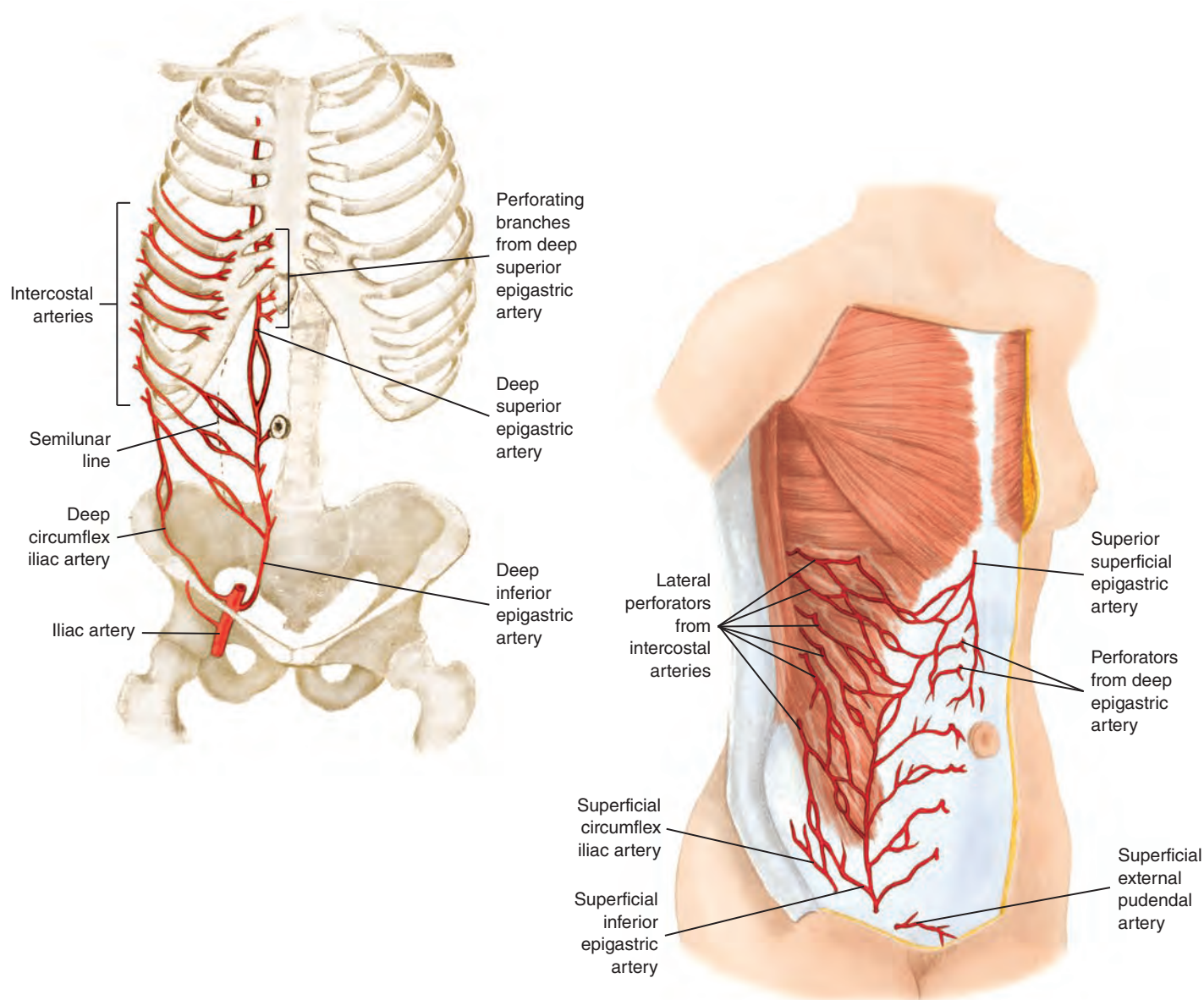
- The superficial circumflex iliac artery, which supplies the inferolateral abdominal skin and anastomoses with superficial branches from the intercostal vessels and perforators from the deep circumflex iliac system. This is divided during an abdominoplasty or other truncal excision procedures.

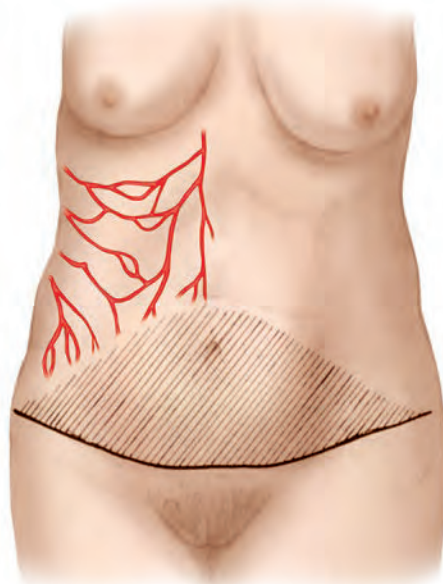
- The superficial inferior epigastric artery, which supplies the inferomedial abdominal wall and always runs superficial to Scarpa's fascia. This vessel is present in 80% of patients. The vessel forms an anastomotic network with the su-

perforating branches from the deep inferior epigastric artery, the lateral thoracic artery, and superficial branches of the intercostal arteries.

Intercostal musculocutaneous perforators at the level of origin of the external oblique muscle.

Musculocutaneous perforators from the superior and inferior deep epigastric arteries, the deep circumflex iliac artery, including the superficial superior epigastric artery, which enters the superomedial abdominal wall through the upper rectus abdominis muscle. The lateral branch of the superficial superior epigastric artery runs along the eighth costal cartilage and anastomoses with the eighth intercostal artery.

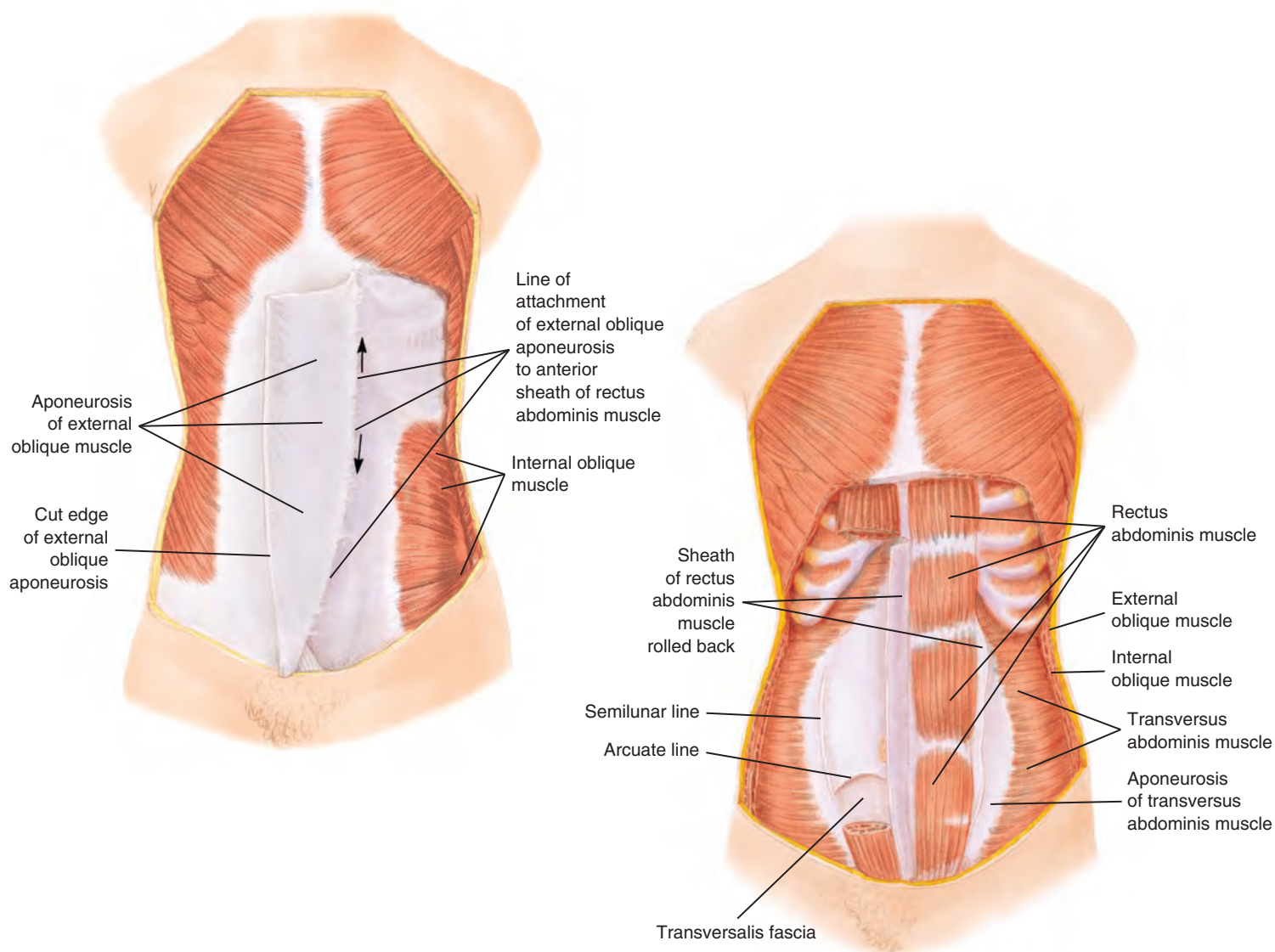




After abdominoplasty and other excisional truncal contouring surgeries, the superficial inferior epigastric perforators from the deep inferior epigastric artery and the superficial circumflex iliac arteries are divided. Flap survival depends on the superficial perforators of the intercostal musculocutaneous perforators and the superficial branches of the superior epigastric artery. The anastomoses between the deep circumflex iliac artery and the lower superficial intercostal vessels augment the flap supply; however, these anastomoses are divided during circumferential body contouring. Dye studies have revealed that the blood supply of the inferiormost portions of the abdominal flap is random, and any tension in the midline inferior margin can lead to skin and soft tissue necrosis.

The intercostal perforators and the subdermal and suprafascial plexus must be protected to ensure the viability of the abdominal flap after excisional contouring. With preservation of the superficial blood supply, abdominoplasty with deep plane resection of subscarpal fat can be safely performed in most patients. Lipoabdominoplasty—an abdominoplasty with selective undermining with liposuction of abdominal wall and flanks—has a low incidence of ischemic complications as a result of superior preservation of the blood supply.

Manipulation of the SFS is particularly significant in truncal contouring. Scarpa's fascia is the primary strength-retaining portion of the SFS network. Scarpa's fascia is congruent with Colles' fascia in the perineum. The deep fascia (innominate fascia, fascia of Gallaudet) that is adherent to the musculoaponeurosis is continuous with the fascia lata of the thigh. After excisional body contouring, the SFS must be resuspended to maintain the new contour. Frequently this means deep suspensory sutures tacking the SFS to the deep fascia in the desired location, creating a new zone of adherence with suture anchors.



The musculoaponeurosis of the abdomen, consisting of the external oblique, internal oblique, and transversus abdominis muscles, which envelope the anterolateral wall of the abdomen, and the aponeuroses of these muscles make up the anterior and posterior leaves of the rectus sheath. Relaxation of these aponeurotic connections within the rectus sheath creates the various diastases seen in the abdomen, especially in multiparous women. The aponeurotic layers coalesce at the midline, creating the linea alba. Frequently in multiparous women, there is significant relaxation of the midline aponeurosis, containing a rectus diastasis. During truncal-contouring procedures, various maneuvers may be performed to address relaxations in the aponeurotic layer. Vertical supraumbilical and infraumbilical figure-of-eight sutures are placed to close areas of diastasis. Horizontal or oblique imbricating sutures can narrow areas of true diastasis or aponeurotic excess.

Superficial lymphatic vessels of the abdominal wall drain into two systems. The lower-half lymphatics coalesce into trunks that drain into the superficial lymph nodes of the groin, whereas the upper abdomen vessels drain, along with the chest wall, into

the axillary nodes. Long-standing edema in the abdominal wall after an abdominoplasty or other excisional trunk procedure of the abdomen could be caused at least in part by the lack of lymphatic channels that drain the inferiormost part of the abdominoplasty flap. Residual postoperative edema in the tissues likely compresses existing lymphatic capillaries, preventing transport of interstitial fluid. Lipoabdominoplasty, which minimizes direct excision of soft tissue and instead uses suction-assisted lipectomy to debulk the abdominal wall, probably preserves a greater number of lymphatic vessels initially, resulting in improved contour and a decreased incidence of seromas.

Anatomic studies have delineated the presence of superficial lymphatic vessels at the fascial layer, but the nature of the connection of these two systems in the subcutaneous fat remains somewhat obscure. In general, it is likely that the initial swelling seen after any excisional body-contouring procedure is caused by the disconnection of lymphatic channels and lymphatic-venous anastomoses in the area of excision and dissection. The eventual improvement in edema suggests that there is some degree of lymphangiogenesis. Intervening infection or fat necrosis can cause scarring in the subcutaneous tissue, making it difficult for new channels to develop. Compression garments activate lymphatic ducts and temporarily improve their efficiency. One can extrapolate that panniculitis in the dependent abdominal tissue after massive weight loss may be not cellulitis but lymphangitis: inflammation of poorly mobilizing or stationary lymphatic fluid.

In the lower abdomen, leaving Scarpa's and subscarpal tissue intact above the mons to a height of approximately 3 fingerbreadths below the umbilicus will leave most of the lymphatics directly above the mons intact, allowing better control of postoperative lymphedema. Scarpa's fascia from below is then affixed to superficial rectus fascia at approximately the height of the umbilicus to create a lifting effect for the mons pubis and upper medial thighs.

No changes in sexual sensation will occur if mons fat is removed superior to the pubic symphysis and if labia majora fat is excised lateral to the pubic symphysis and clitoral hood. Anchoring the excised superior edge of pubic skin succeeds in creating a *de novo* zone of adherence and preventing further mons ptosis.

The pathophysiology of abdominal excess encompasses skin excess, striae/rash, thinned dermis, and attenuated SFS fibers, including Scarpa's layer. In massive-weight-loss patients, the excess abdominal tissue can be compromised by chronic lymphedema, rash, and panniculitis. In contouring the trunk, several anatomic principles must be adhered to:

The umbilicus should be anchored to the proper position and the inferior abdominal wall anchored to create a new zone of adherence.

The SFS fibers should be encompassed in lifting maneuvers to create a new contour.

Initial deterrence in lymphatic outflow should be expected to some degree, and postoperative compression can increase interstitial pressure, preventing lymphatic fluid from becoming static in the subcutaneous tissues.

The vascular supply to the newly contoured abdomen comes from the superolateral abdomen through the intercostal perforators; the midline inferiormost tissue is random in blood supply.

The lateral cutaneous branches of the iliohypogastric and intercostal nerves are at risk for entrapment, particularly during a circumferential body lift. Aggressive lateral plication of the external oblique muscle for waist definition can increase the risk for nerve entrapment.

Hips

Patients frequently express concern about their hips and flanks, although hips are more likely to have excess adiposity in women, whereas the flanks are more frequently a problem area in men. The hips and flanks have a continuation of the SFS, with superficial fat above Scarpa's layer encased in more closely related vertical SFS fibers, while fat below Scarpa's has fewer fascial fibers and the fat appears more mobile. The boundaries of the deep fat compartments are defined by zones of adherence.



The zone of adherence, as described by Lockwood and further defined by Rohrich et al, describes sex-specific areas of fascial attachments where the superficial, more dense SFS fibers send direct attachments to the muscle fascia below, creating a boundary between two fat compartments and creating an area of defined contour. In men's hips, the zone of adherence is along the iliac crest, whereas in women, the zone of

adherence of the hip is below the iliac crest. The fat compartments create a slight bulge both superior and inferior to this zone of adherence, even in normal-weight women. In overweight and even in many normal-weight women, excess fat deposited laterally below this zone of adherence imparts an unsightly saddlebag deformity. In men, the lateral deposits of fat are more frequently found above the zone of adherence, creating flank adiposity referred to as “love handles” or a “spare tire.” Contouring in this area frequently involves selective liposuction above and below the zone of adherence, since interruption of the zone of adherence will not correct a contour deformity caused by excess adiposity.

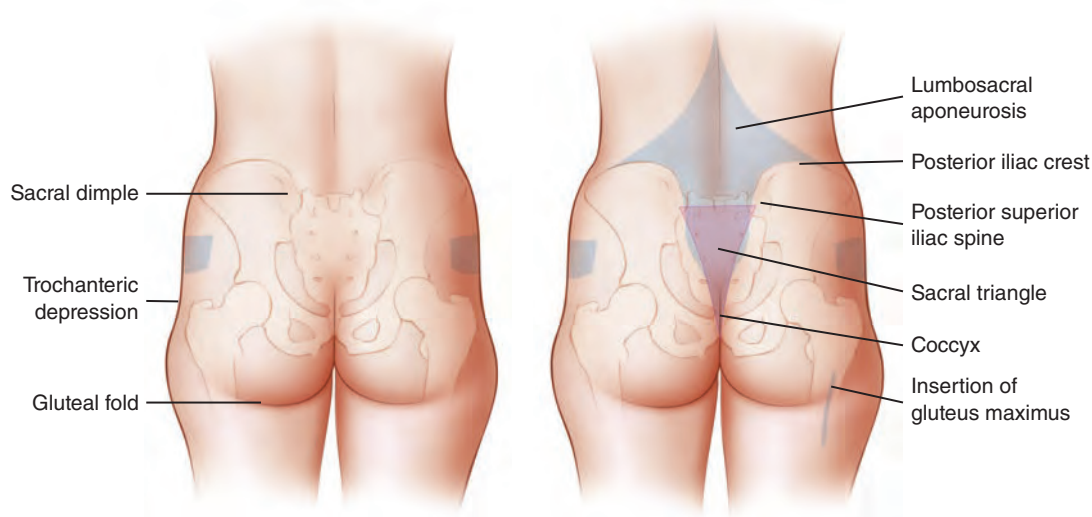
In massive-weight-loss patients the skin excess is often circumferential, and patients of both sexes will have contour deformities both above and below the hip zone of adherence. A lower body lift and other associated excisional lifting procedures actually remove the fascial attachments that previously defined a zone of adherence. A zone of adherence is, to begin with, less well defined and lax in this population. By lifting and reanchoring soft tissue above a prior zone of adherence, a *de novo* artificial zone of adherence is fashioned.

Buttocks

Senescent changes and changes from massive weight loss have very similar effects on buttock contours, including a loss of adipose volume, ptosis of soft tissue and skin, increased hip width, and lengthening and flattening of the gluteal fold. Central adiposity in the lower back increases with age and blunts the trunk-gluteal angle, further contributing to loss of projection. All these changes combine to create a buttock that appears flat, square, and in women, less feminine.

The buttocks in a massive-weight-loss patient appear hypoplastic. The deformities include loss of gluteal projection; effacement of the lower back/gluteal sulcus; loose, misshapen buttock skin; lateralization and inferior displacement of the remaining soft tissue; and a lax gluteal fold. In addition, the central crease and inferior gluteal crease droop. Midline skin and soft tissue should be excised as part of the lower body lift to recreate a more pleasing gluteal cleft without surrounding excess tissue.

Centeno and Young defined the eight gluteal aesthetic units: two flank units, the sacral triangle, two buttock units, the infragluteal diamond, and two symmetrical thigh units. Buttock reshaping is best achieved by enhancement of the buttock units in conjunction with reshaping and reduction of the other aesthetic units.



Anatomic landmarks in aesthetic surgery of the buttocks have been well summarized; these are the sacral triangle, sacral dimples, trochanteric depressions, posterior iliac crest, coccyx, and gluteal folds. The sacral dimples are created by the confluence of the posterior superior iliac spines, lumbosacral aponeurosis, and the insertion of the gluteus maximus and define the superior medial border of the buttock. The sacral triangle is defined by the bilateral sacral dimples and the coccyx, and liposuction of the triangle can further augment the protuberance of the buttock cheeks.

Traditional excisional lower body lifts significantly improved buttock contours but failed to correct the loss of gluteal projection, which often imparted an unfeminine, flattened buttock. Recently, gluteal contouring has focused on raising large deepithelialized flaps based on the superior gluteal artery perforator, anchoring the tissue beneath the superior and interior flaps of a lower body lift. This retains volume in combination with skin excision to create a tighter, more protuberant buttock. Various designs and techniques have been described, including island, mustache, and rotational flaps. In each case, the goal is to add projection and volume to the buttocks while diminishing the adjacent gluteal aesthetic areas. *One cannot overemphasize the importance of not interrupting the natural infragluteal fold, which will shorten in appearance with excision and lifting of superior redundant tissue.*

The deepithelialized gluteal flap is isolated on two major perforators from the superior gluteal artery and rotated in a superomedial direction to augment gluteal projection. To identify the superior gluteal artery perforators, a line is drawn from the posterior iliac spine to the greater trochanter, and the two major perforators are identified 6 to 9 cm from the midline along this line. These vessels send forth large musculocutaneous perforators that can be easily identified during suprafascial dissection.

Anchoring of the SFS of the inferior flap in a lower body lift to the muscular fascia plays a significant role in achieving the initial contour. The gluteal fold is a natural

zone of adherence but can appear effaced or discontinuous after massive weight loss. The zone of adherence must not be disrupted to avoid creating a new deformity.

During circumferential body lifts, the cutaneous branches of the iliohypogastric nerve, the superior cluneal nerves L1-3, and the dorsal rami of sacral nerve roots 3 and 4 are at risk. Permanent changes to protective sensations may occur, and this potential morbidity should be discussed with the patient preoperatively.

Thighs

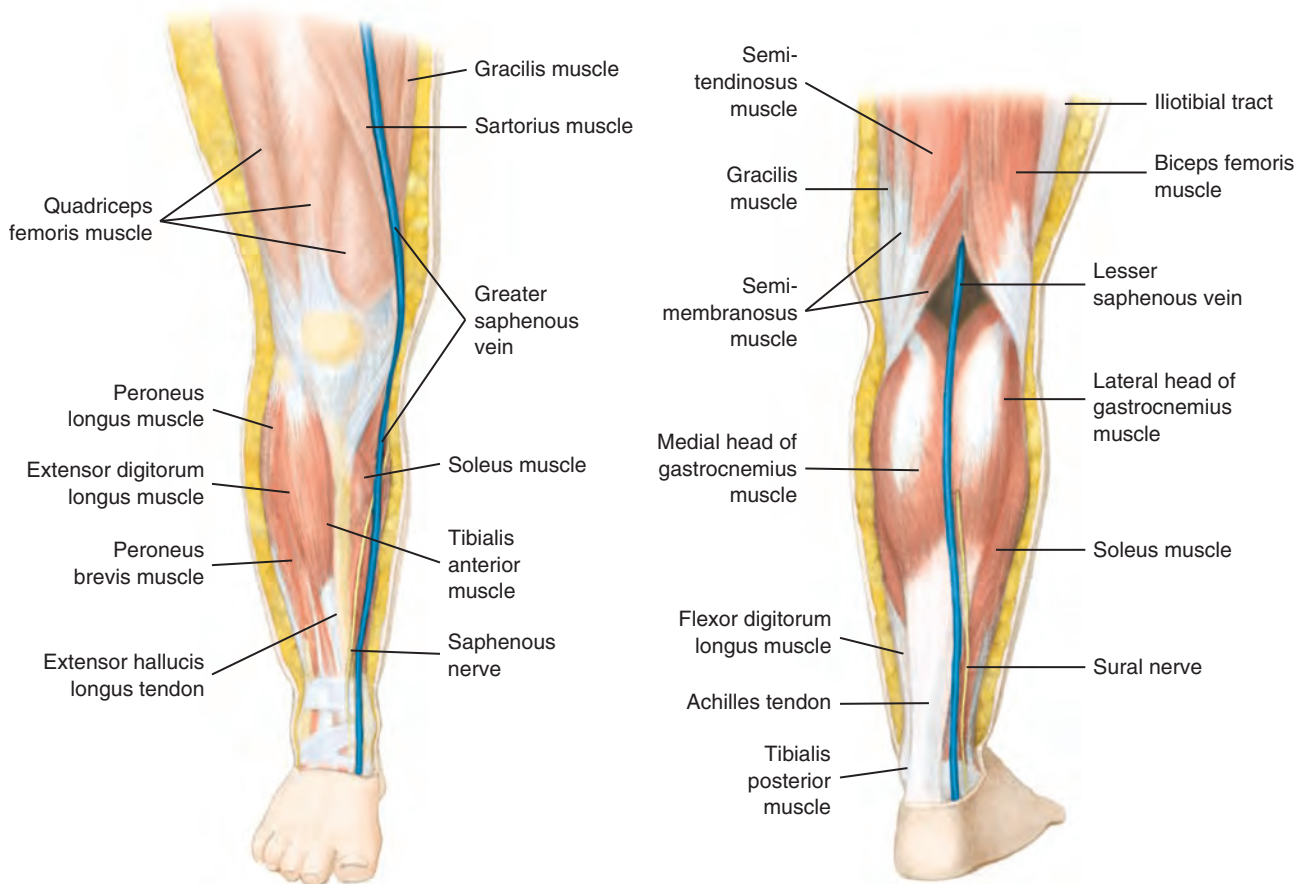
Relaxation of the SFS fibers in a negative vector combined with excess adiposity can lead to a ptotic appearance of the medial thigh as an individual ages or undergoes massive weight loss. In postbariatric patients, a tremendous amount of excess skin and subcutaneous tissue can lead to an extra soft tissue roll in the medial thigh. Recent articles have noted that much of the excess in the medial thigh after massive weight loss is vertical rather than horizontal. Because of this, the great majority of thighplasties in the postbariatric population require a vertical scar.

In medial thighplasty, the lifted portion of the medial thigh tissue must be anchored to the Colles' fascia of the perineum to prevent scar migration and early recurrence of ptosis. The anchoring sutures should also create a well-defined perineal-thigh crease. This is another way linear and sequential anchoring of the SFS can create new, well-defined topographic marks with little or no excess tissues blurring the anatomy. Colles' fascia attaches to the ischiopubic rami of the bony pelvis; anteriorly it is continuous with Scarpa's fascia; and posteriorly it fuses with the urogenital diaphragm. At the junction of the perineum and the medial thigh, this layer is clearly identifiable by dissecting to the origin of the adductor muscle on the ischiopubic ramus and retracting the skin and subcutaneous tissues of the vulva medially.

Anatomic studies reveal that 80% of lymph vessels run into the inner surface of the thigh, 20% on the lateral surface. Because of the risk of significant chronic edema after a medial thighplasty, some authors advocate leaving a layer of subcutaneous tissue along the muscle fascia of the area of resection, not completely resecting the lymphatic vessels in the area. Significant incisions and tissue excisions are also made away from veins, which are the natural accompanying structures of the lymphatic vessels. Anatomic studies show that around the thigh and groin area, the lymphatic ducts are concentrated around the greater saphenous vein, while in the lower leg the lymphatic ducts are more evenly distributed circumferentially around the leg. This suggests that interruption of tissues around the greater saphenous vein should be minimized to decrease the potential for trauma to the lymphatic ducts of the thigh and groin. The area anterior to the greater saphenous vein is particularly susceptible, with an afferent "bottleneck" visualized in anatomic studies.

In summary, the medial thigh is an unforgiving area for the plastic surgeon because of poor tissue quality, a high concentration of lymphatic vessels, the risk for scar migration and vulvar deformation with soft tissue anchoring, and the pain associated with anchoring sutures in the perineum. Although associated with discomfort and sometimes deformation of the vulva, a medial thighplasty is unlikely to be successful without strategic anchoring of thigh tissues to Colles' fascia. Careful preservation of the lymphatic vessels can help to reduce postoperative edema.

Knees and Legs



A natural zone of adherence occurs along the area at which the quadriceps muscle's aponeuroses coalesce along the upper edge of the patella. Fullness at the knee is often from the bulk of the quadriceps femoris as well as the medial muscle group containing the gracilis, sartorius, semitendinosus, and semimembranosus muscles. Commonly there is a localized pocket of adiposity overlying the medial muscle group. Excess fat around the knee is considered a particularly displeasing problem for women for which there is no good solution. In massive-weight-loss patients, a pannuslike envelope of skin and soft tissue can drape over the superior knee zone of

adherence. Although direct excision leaves an unsightly scar, the procedure has been performed. Often medial thighplasties incorporate a vertical scar that extends to the knee, creating some lifting and thinning in the medial aspect of the knee.

The anatomic basis for an undesirable silhouette is often muscular, making it more difficult to treat with traditional methods of liposuction and excisional lifting procedures. A bulky calf is often caused by a large gastrocnemius muscle proximally and the soleus muscles, particularly in the distal two thirds of the leg. The desired slender leg silhouette from calf to ankle is often obliterated by a wide, thick distal soleus, or a natural fullness of the lateral compartment muscles, particularly the peroneus brevis anterolaterally, and the flexor digitorum longus muscles posteromedially. A combination of undesirable muscle bulk and excessive length, along with excess tissue from massive weight loss, can cause an unattractive leg shape.

Fat distribution over the lower leg, except for a lack of fat over the anterior tibia, shows a pattern that is diffuse and circumferential. For these anatomic reasons, lower extremity contouring remains one of the greatest areas of challenge.

Ankles and the lower extremities are the anatomic areas most susceptible to lymphedema. Lower extremity lymph vessels eventually coalesce and merge into the superficial groin lymph nodes, making them the longest traveling lymphatic system in the body. With age and obesity, chronic lymphedema from an inactive or underactive lymphatic system is already likely to be present at baseline, and no doubt contributes to some degree to effacing the contours. Suction lipectomy must be used with utmost caution in the ankle and lower extremity, and with the expectation that long-term use of compressive garments will be essential to decrease lymphedema.

Recent cadaveric studies suggest that injection of tumescent fluid and longitudinal rather than transverse movement with the suction cannula decrease damage to lymphatic vessels. This is especially crucial in lower extremities with preexisting lymphedema and in zones of high concentration of lymphatic vessels within a narrow zone, such as the medial knee.

Concluding Thoughts

In the past, much of the discussion in applied anatomy of body contouring concerned neurovascular structures, musculoaponeuroses, and regions of adiposity. Although knowledge of blood supply and adjacent nerve structures is crucial, we think that understanding the roles of SFS, zones of adherence, and lymphatic drainage in the superficial subcutaneous tissue can help to elucidate problem areas in body contouring and aid in the innovation of new therapies.

Clinical Caveats

The SFS is a subdermal soft tissue scaffold that exists throughout the body; it encompasses adipose tissue and imparts biomechanical strength to surgical repairs.

Pathologic conditions of the SFS are partially responsible for cellulite, ptosis, and the large overhanging soft tissue rolls seen in massive-weight-loss patients.

Incorporation of the SFS in surgical repair is particularly important in parenchymal reshaping and excisional lifting techniques of body contouring.

The zones of adherence are pathologic and sometimes displaced in postbariatric patients.

Zones of adherence are often interrupted during excisional body contouring, and anchoring and suspension of tissues are important to prevent tissue descent.

Violation of certain zones of adherence (inframammary fold, gluteal fold) can lead to secondary deformities that are challenging to correct.

Lymphatic vessels are found in the deep dermis, subdermal plexus, and along muscle fascia.

Interruption of lymphatic channels through excision can cause chronic edema in surgical zones, particularly if a nodal basin is interrupted.

Liposuction causes temporary slowing of lymphatic drainage but does not cause permanent damage to lymphatic vessels.

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gender, region, and degree of adiposity. Manipulation of the SFS provides the anatomic basis for surgical lifting techniques in body contouring.

Markman B, Barton FE Jr. Anatomy of the subcutaneous tissue of the trunk and lower extremity. *Plast Reconstr Surg* 80:248-254, 1987.

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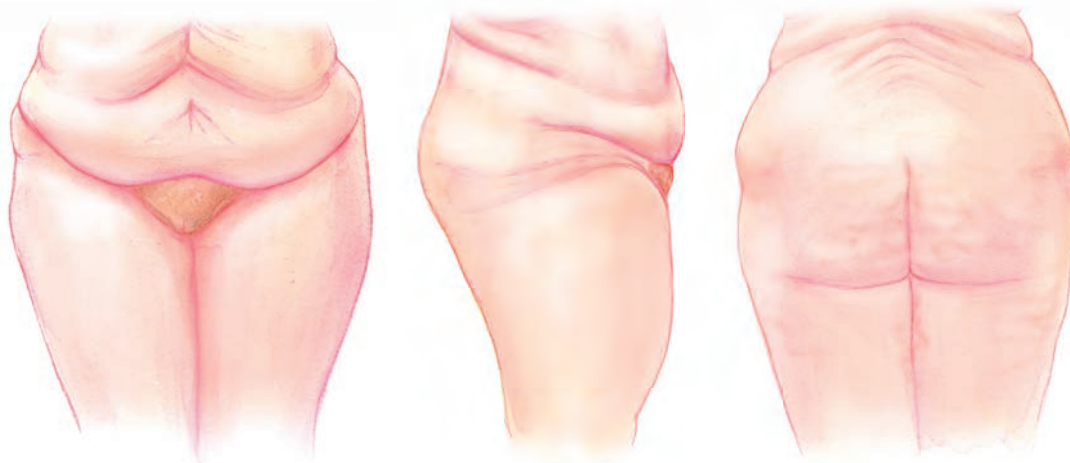
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CHAPTER 76



Clinical Decision-Making in Body Contouring

FOAD NAHAI

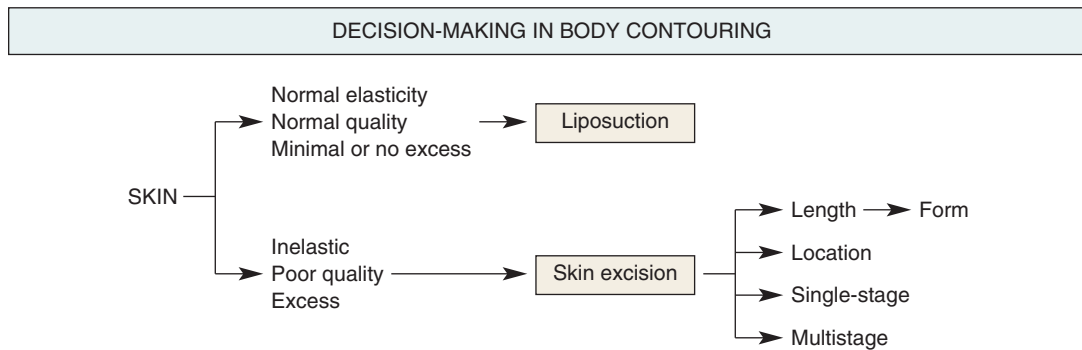
*It's all about the skin.
It's all about safety.*

The advent and increasing popularity of liposuction over the past 30 years not only revolutionized but also forever changed body contouring. Even today, the tremendous impact of liposuction is influencing the further evolution of body-contouring procedures. The incorporation of liposuction has not only made body contouring safer, faster, and possible with minimal scarring, but also liposuction has been the most common of all aesthetic surgical procedures for several years running, according to the American Society for Aesthetic Plastic Surgery (ASAPS) statistics, only to be displaced to number two by breast augmentation in recent years. Most notable, however, is the fact that through liposuction, body contouring has become an option to many who would not otherwise have considered it because of the obligatory long scars.

Not all those who seek body contouring are candidates for liposuction as their ideal procedure. It is very disappointing to have to explain to a patient why he or she is not a candidate for liposuction. Although contraindications and relative contraindications to liposuction, such as morbid obesity, intercurrent cardiac disease, or endocrinologic disease apply to all forms of body contouring, in reality the major reason that most patients are not “ideal” or the “best” candidates for liposuction relates to the quality and quantity of their skin.

Whether we are discussing short-scar face lift, short-scar breast surgery, or body contouring through liposuction, the limiting factor is skin quality and skin quantity. Inelastic, stretched, poor-quality skin will not redrape or contract and must be excised.

Evaluation of the skin is the key to decision-making in body contouring. Once the surgeon has decided that skin quality or skin quantity is such that it will redrape, in most patients and in most anatomic areas liposuction alone will be the procedure of choice. If the surgeon decides to resect skin, the location and length of the incision are determined. The decision as to the exact method of skin resection—a single-stage versus a multistage procedure—must also be made at this time.



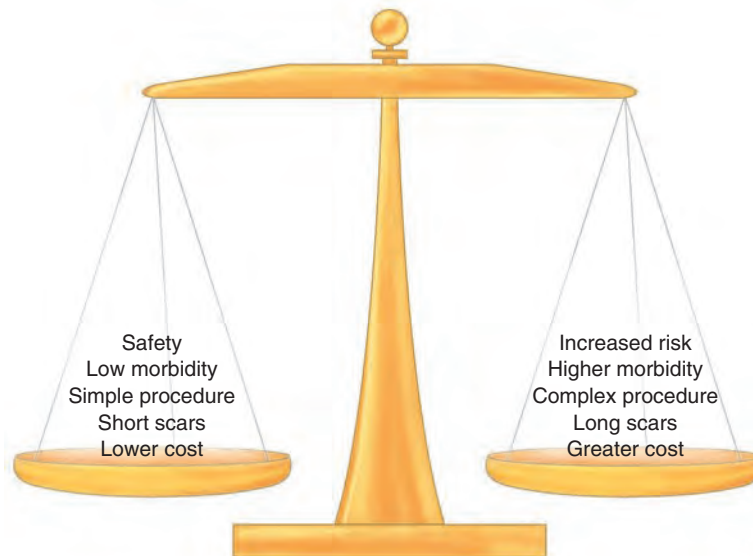
Patient Evaluation and Counseling

When I greet a new patient who is interested in body contouring, one of the first questions I ask is, “Would you like to look better in your clothes, or in and out of your clothes?” Most younger women answer that they wish to look good in and out of their clothes, especially in bikini bathing suits. Older women and most men reply that they would like their bulges improved so that they appear more shapely and better contoured in their clothes. The patients’ goals and expectations of the result are a useful guide to me. I then examine them and make recommendations. We must balance the goals and their vision of the results against the realities of their tissues, especially their skin. I try to establish whether the patient is seeking reshaping or reshaping and skin tightening.

After I examine the patient, which includes evaluating the skin and fat, we discuss the patient’s options. The options and decisions are straightforward in patients who are ideal candidates for liposuction. Similarly, for those who obviously require skin excision, the options and decisions are straightforward. However, for a group of patients between these two extremes, a complex discussion concerning skin excision is entertained. The tradeoff is a longer scar with skin and soft tissue excision and a better result, versus a minimal scar from liposuction, recontouring without skin improvement, or even a worsening of skin laxity and the appearance of skin folds. Another issue to consider is the risk-benefit ratio of the more complex procedures. For some patients in this middle group, the risk of more extensive surgical procedures

may not be justified by improved skin tightening. Patient safety, morbidity, and length of recovery should all be taken into account in the decision-making process. Obviously, the expense of the procedures is another issue that may be more important to some patients than to others. Clearly, liposuction is less time consuming and less expensive than resectional body-contouring procedures.

These factors must be borne in mind and openly discussed with patients before embarking on expensive body-contouring procedures, especially in patients who have experienced massive weight loss. These patients present a special challenge to the aesthetic surgeon in that extensive skin resection and recontouring procedures may be needed in all anatomic areas. The question of single-stage versus multistage procedures is an important consideration. Although a single-stage procedure obviously will be less expensive and perhaps more appealing to more patients, this should be balanced against the increased risk posed by prolonged surgical procedures in this group of patients.



Balancing the quality of the result with safety, scars, and cost

Decision-making in body contouring, especially for massive-weight-loss patients, must take into account the balance between the quality of the results and safety issues. Ultimately, cost should not factor into a final decision about the procedure.

Abdominal Contouring

Abdominal-contouring procedures range from liposuction to circumferential abdominoplasty combined with a body lift.



The first patient (*left*) is a suitable candidate for liposuction; the second patient (*center*) requires an abdominoplasty; and the third patient (*right*) is best suited to full-body contouring, including a circumferential abdominoplasty and body lift.

Abdominal Contouring Evaluation Checklist

- Skin
- Fat
- Muscle and fascia
- Adjacent areas

Evaluation and classification of abdominal changes precedes decision-making and the selection of the appropriate operation. The skin, fat, and musculofascial contour have traditionally been the three major components to be assessed; however, we do not evaluate and treat the abdomen in isolation, especially in massive-weight-loss patients. To these three major components we now add a fourth: assessment of the adjacent areas, including the thighs, flanks, and back. These four primary components of abdominal changes assist in classifying the severity of the problem and selection of appropriate treatment. Most patients fall into one of the four categories.

Classification of Abdominoplasty Candidates				
	Class 1	Class 2	Class 3	Class 4
Skin excess	None—minimal	None—minimal	Moderate-severe	Severe
Skin elasticity	Normal	Normal	Poor	Poor
Fat excess	Mild-moderate	Mild-moderate	Moderate-severe	Moderate-severe
Musculofascial contour	Normal	Abnormal	Normal or abnormal	Normal or abnormal
Adjacent areas	Normal	Normal	Normal	Abnormal

Skin

We assess the quality and quantity of the abdominal skin. We assess the quality and elasticity through observation for stretch marks and the pinch test, in which the skin is pinched and pulled away from the underlying subcutaneous tissues; during the pinch test, we look for elasticity and recoil as indicators of retraction and redraping after surgical intervention. We also look for scars that may affect liposuction or be improved through excision with open abdominoplasty procedures. We also look for excess skin above and below the umbilicus, for umbilical hooding, which is an indication of periumbilical skin excess, and for loss of skin elasticity.

Skin Evaluation Checklist	
Skin quality	Skin excess
– Stretch marks	– Below umbilicus
– Pinch test	– Above umbilicus
– Scars	– Umbilical hooding

Fat

The amount of excess fat and its location are noted. In general, larger volumes of excess fat are usually seen with excessive amounts of poor-quality stretched skin and striae requiring excision. Smaller and more moderate volumes of fat are amenable to liposuction as long as the skin is suitable. The location of the fat above and below the umbilicus and flanks is noted.

Musculofascial Contour

The patient is examined while standing and recumbent. The muscles and fascia above and below the umbilicus are evaluated. With the patient standing, the general appearance and protuberance of the abdomen are noted. The patient is asked to relax and to tighten the abdominal muscles so abdominal wall strength and integrity can be evaluated. Any abdominal weakness, diastasis, or hernia is noted. Then, with the patient lying down, the abdomen is again examined at rest and on straight-leg-raising, which contracts the abdominal muscles, making weakness, diastasis, and any hernia much more obvious. Extensive diastasis and hernias will have to be repaired to achieve flattening of the abdominal contour. If there is no abdominal protuberance, liposuction only may achieve the goal of flattening the abdominal contour. On the other hand, any diastasis or umbilical or midline ventral hernia will require open or endoscopic repair to effectively recontour the abdomen.

Adjacent Areas

In most patients after an isolated abdominoplasty, the recontoured abdomen blends in well with the adjacent areas, the upper thighs, hips, buttocks, flanks, and back, especially if the abdominoplasty is combined with some liposuction of the flanks. However, in an increasing number of patients seeking abdominal recontouring, especially after massive weight loss, the abdomen cannot and should not be dealt with in isolation. We therefore have to evaluate the adjoining areas—the thighs, flanks, hips, and back. If any of these areas require recontouring to restore balance to the patient's trunk, a combination of other procedures must be included with the abdominal operation. These will range from belt lipectomy to abdominoplasty combined with a body lift.

Patient Profiles

Class 1



Typically, class 1 patients have excess abdominal wall fat, often localized below the umbilicus, with normal fascia without laxity, diastasis, or herniation. The skin is of normal quality, with no excess. Ideally there should be no preexisting abdominal scars. These patients will have a good result after liposuction. No fascial tightening is needed, and any minimal skin excess will respond well to redistribution and contraction.

Class 2



Class 2 patients have normal-quality skin with minimal to moderate excess fat. They do not require skin excision, and the excess fat is amenable to liposuction. However, these patients have significant musculofascial laxity, which may include diastasis, midline ventral hernia, or umbilical hernia. These patients must have anterior abdominal wall plication to achieve maximum contour improvement.

I believe they are ideal candidates for endoscopic abdominoplasty as a first-choice procedure. A mini-abdominoplasty would be an acceptable alternative. Although some skin excision is possible through the lower abdominal excision with a mini-abdominoplasty, the primary role of the incision is access to the abdominal wall for repair. Through this incision, the infraumbilical abdominal wall is readily exposed and the repair of the fascia from the umbilicus down is easily accomplished. The umbilical stalk can be divided (umbilical float) to allow access to the upper abdomen for fascial repair above the umbilicus. Although this repair is possible through the mini-abdominoplasty approach, it is not easy.

In these patients, the advantages of the endoscopic approach include a much shorter scar, 4 to 5 cm in length, decreased postoperative pain and morbidity, and accurate repair of the fascia from the xyphoid process down.

Class 3



Patients in class 3 have moderate to severe amounts of excess skin of poor elasticity riddled with stretch marks; they also have moderate to severe amounts of excess fat. There may or may not be muscular or fascial weakness. Liposuction or an endoscopic or mini-abdominoplasty approach is not appropriate for these patients. They require a full abdominoplasty with resection of the excess skin and fat, with umbilical transposition. Liposuction may assist lateral contouring. A variety of incisions are available for the dermolipectomy in this group, and the final choice is a matter of patient and surgeon preference. However, the scar should be placed low enough and in such a position to avoid any unnatural elevation of the pubic hairline.

Class 4



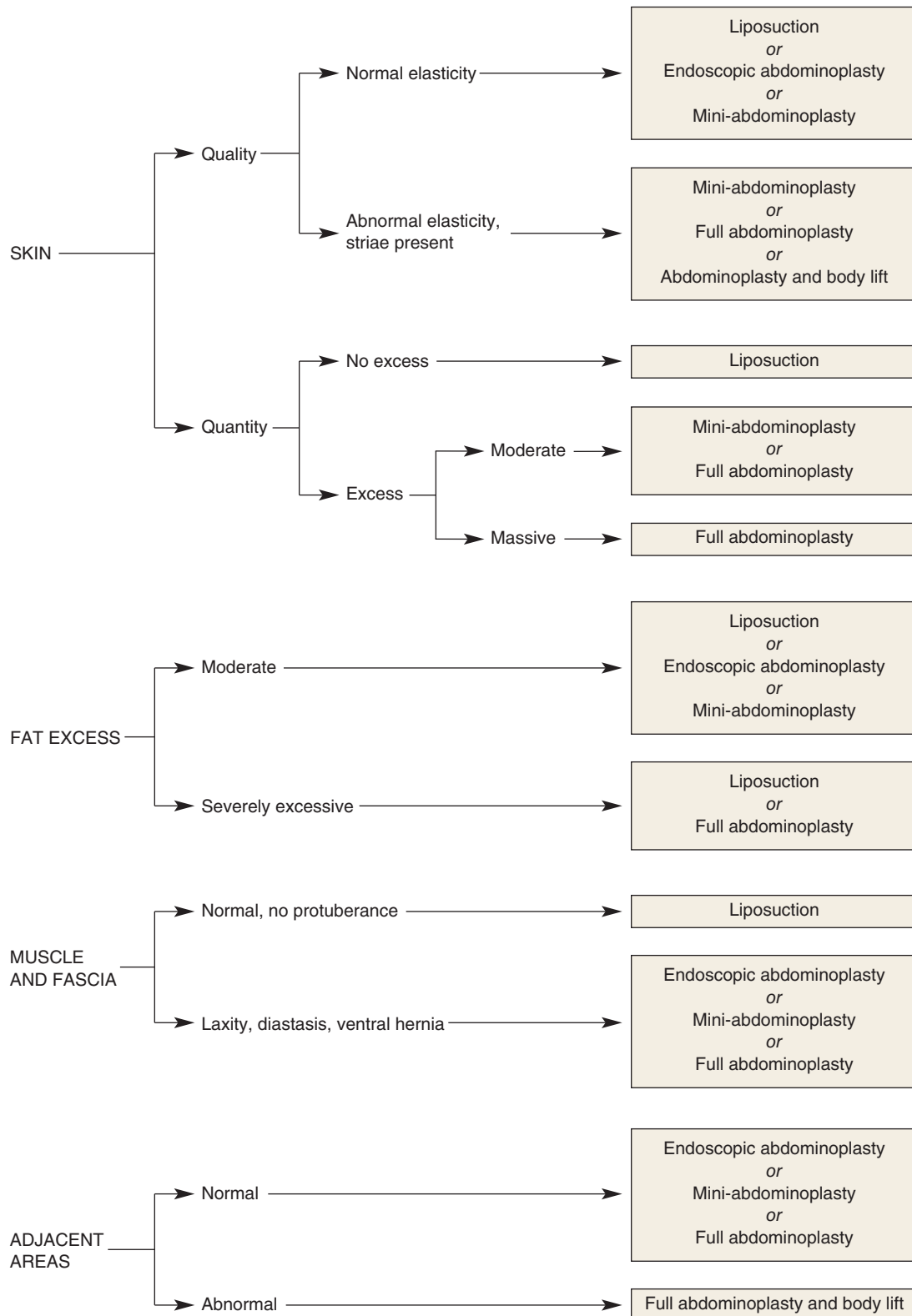
Typically, class 4 patients have all the features of class 3 patients and much more: more skin and fat excess in the adjoining areas—the flanks, back, and thighs. Most if not all massive-weight-loss patients are in this category. An isolated abdominoplasty is not an appropriate procedure for class 4 patients; they are best treated through a combination of procedures that will include an abdominoplasty and thigh or body lift. Most patients in this category have undergone massive weight loss. In addition to routine preoperative tests, an assessment of nutritional status is essential in this group of patients.

Safety Issues

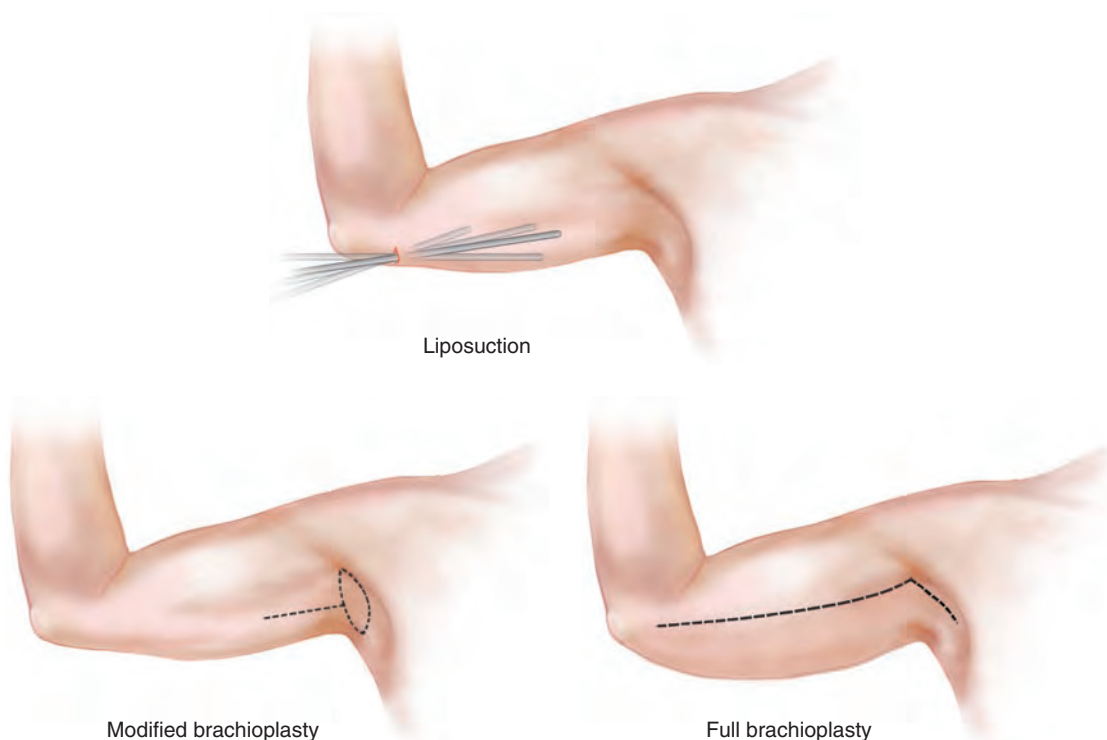
Abdominoplasty, in particular an abdominoplasty combined with a body lift, is one of the highest risk procedures that aesthetic surgeons perform. Patient safety is of paramount importance. The risks are minimized and patient safety is ensured through appropriate patient selection, patient preparation, assessment of nutritional state, and staging of the procedures, if necessary. Intraoperative precautions include deep venous thrombosis prophylaxis, expert administration of anesthesia, and limiting not only the length of the procedure but also the combination of procedures.

The risk of venous thromboembolism (VTE) is highest with abdominoplasty and increases further when abdominoplasty is combined with other procedures. Chemoprophylaxis should be considered for such patients.

ASSESSMENT OF ABDOMINAL FEATURES



Upper Arms



The options for recontouring the upper arms range from liposuction to the standard arm lift, with the long incision extending from the axilla to the elbow. An extended brachioplasty, which combines simultaneous excision of redundant posterior axillary fold tissue, is best suited for individuals who have lost massive amounts of weight. Selection of technique, as with almost all body contouring, is based on the patient's skin excess and skin quality. Individuals with excess fat but minimal or no skin excess and with normal skin elasticity are ideal candidates for liposuction. Their skin has enough elasticity to redrape and contract after liposuction. In these patients, my preference is ultrasound-assisted lipoplasty (UAL) over suction-assisted lipoplasty (SAL). The patient illustrated in the top image is a candidate for liposuction; the patient in the lower right image will require a full brachioplasty.

Patients with significant skin excess with loss of skin elasticity are clear candidates for brachioplasty with the classic incision. There is a small group of patients with excess fat who also have moderate skin excess with normal or minimal loss of skin elasticity. These patients may be candidates for a modified limited-scar brachioplasty combined with liposuction. In this group, the skin excision is limited to a horizontal excision within the axilla, with or without a short vertical extension along the medial border of the arm. I evaluate candidates for this modified approach by pinching and pulling the skin within the axilla and observing the effect on the arm. If the skin tightening appears sufficient and the patient, who observes this maneuver in the

mirror, indicates that he or she will be happy with such a result, then I would recommend this modified approach.

Thigh Lift

Options for recontouring the thighs range from liposuction to body lift combined with abdominoplasty.



The patient on the left, who has already had liposuction, has skin excess and skin irregularities, especially in the medial and distal thigh. She is a candidate for a medial thigh lift through a groin crease incision. The patient in the center is a candidate for abdominoplasty combined with a medial thigh lift, with the scar limited to the groin crease. The patient on the right represents the extreme; she is a candidate for a combined abdominoplasty, medial thigh lift, and body lift. In addition to the groin crease incision, the medial thigh lift will require a vertical skin excision and resultant scar along the medial surface of the thigh. The distinguishing factors among the three women are the volume of fat excess and the quality and amount of skin excess. The patient on the left has the least amount of excess fat, the least amount of excess skin, and the skin with most elasticity.

Liposuction

Ideal candidates for liposuction have minimal to moderate amounts of excess fat with minimal or no skin laxity or skin excess, and their skin will have normal or near-normal elasticity.

Medial Thigh Lift

The classic medial thigh lift scar in the groin crease extends from the anterior superior iliac spine along the inguinal ligament running adjacent to the labia majora or scrotum and ends in the gluteal crease. Through this incision, a variable-sized crescent of skin and excess fat is excised from the upper inner thigh with the maximal skin excision centrally located over the upper inner thigh. The best candidates are those with moderate amounts of fat and mild skin excess and laxity, especially involving the upper medial thigh. It is safe to combine this procedure with liposuction of the anterior thigh and knee, as needed.

Medial Thigh Lift Combined With Abdominoplasty

This combined approach is best for patients who have the thigh changes described previously, plus abdominal changes that require a full abdominoplasty. The lateral part of the thigh lift and abdominoplasty incision meets at the medial end of the inguinal ligament. The combined procedure results in improvement of the abdomen and thighs, especially the medial and anterior thigh. This procedure may safely be combined with liposuction of the anterior thigh and knee.

Medial Thigh Lift With Groin Crease and Medial Thigh Scar

Patients with extreme skin laxity and skin excess, especially along the medial thigh, will respond minimally to skin excision through the crescent at the upper end of the thigh. In addition to that crescent, they will require a variable amount of skin excision vertically along the medial axis of the thigh, a triangular skin excision with the base of the triangle placed superiorly.

This procedure can safely be combined with an abdominoplasty or with a full lower body lift. However, combining it with too many other body-contouring procedures may increase the risk and should only be undertaken on a highly selective basis. This procedure may be safely combined with liposuction of the anterior thighs.

Choosing the Best Option

Morphologic Changes	Thigh-Contouring Options			
	Liposuction Only	Medial Thigh Lift + Groin Crease Incision	Medial Thigh Lift + Abdominoplasty	Medial Thigh Lift + Groin Crease Incision + Medial Vertical Scar
Fat Excess				
Moderate				
Extreme				
Skin Quality				
Normal elasticity				
Poor elasticity				
Skin Quantity				
No excess				
Moderate				
Extreme				
Adjacent Areas				
Normal contour				
Requires recontouring				

Clinical Caveats

The patient's goals and expectations must be matched with the realities of his or her tissues.

Decision-making in body contouring, especially for massive-weight-loss patients, requires taking into account the balance between the quality of the results and safety issues.

Recontouring must be distinguished from skin tightening.

Skin, fat, muscle, fascia, and adjacent areas are evaluated before selecting procedures for abdominal contouring.

Body contouring in a massive-weight-loss patient is a high-risk procedure.

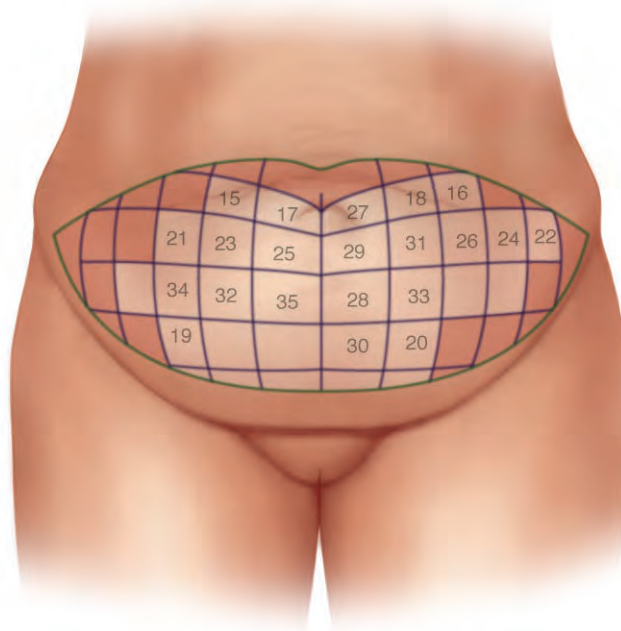
Multiple procedures may need to be staged to minimize risk.

The patient's nutritional state should be assessed, especially in massive-weight-loss patients.

Chemoprophylaxis is important for massive-weight-loss patients and when combining abdominoplasty with other procedures.

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CHAPTER 77



Noninvasive and Minimally Invasive Body Contouring

JASON N. POZNER, BARRY E. DiBERNARDO

Weight loss in the United States is a \$30 billion industry that encompasses pharmaceuticals, gyms, diet aids, books, and surgical and nonsurgical interventions. Obesity and weight reduction are global issues; current data show that one third of adults in the United States are obese and another third are overweight. Estimates indicate that these numbers are increasing worldwide. Plastic surgeons have long been involved in fat reduction and body-contouring procedures. According to data from the American Society for Aesthetic Plastic Surgery, liposuction is currently the second most frequently performed aesthetic surgical procedure in the United States, with approximately 283,000 operations performed by core specialists in 2009. This number may be far greater when laser liposuction procedures are factored in, performed by the emerging market of non-core specialists.

Nonsurgical fat reduction is part of the noninvasive body-contouring industry and includes devices for fat reduction, cellulite treatment, and skin tightening. There is some overlap of these devices, because some are marketed for multiple clinical uses. Medical Insight, a California-based aesthetic market research company, forecast that when data are available for 2009, the global market for all body-shaping platforms will be \$361.9 million and that the market will expand by 21% per year, on average, to reach \$752.9 million in 2012.

At this writing there are no devices expressly approved by the FDA for noninvasive fat reduction, although the devices discussed in this chapter are approved for nonsurgical fat removal in many countries outside the United States. We will explore nonsurgical technologies used for fat reduction and examine some of the current devices touted as fat reducers. We will also discuss laser liposuction in depth.

NONINVASIVE FOCUSED ULTRASOUND

Physicians are most familiar with the use of diagnostic ultrasound for imaging; they are less familiar with therapeutic ultrasound, but most have heard of the use of lithotripsy for kidney stones. The actual use of ultrasound in medicine started in 1927, and therapeutic use began in the 1930s with low-energy, unfocused devices. Focused ultrasound was used clinically in the 1950s for treating Parkinson's disease and other brain-related disorders. There was a period of relatively few developments in ultrasound therapy until 1994, when high-intensity focused ultrasound was in-

troduced to treat prostate cancer. Since that time, focused ultrasound has been used to treat many different organs, including, very recently, adipose tissue.

Ultrasound is an interesting medium for fat removal: it can be focused below the skin without causing injury to the skin. This differs from the use of lasers, in which light energy traverses the skin and may be absorbed, scattered, transmitted, or reflected. Ultrasound physics is a bit different from laser physics; a brief overview will help differentiate ultrasound fat removal devices. Ultrasound waves are defined as frequencies higher than the audible spectrum (20 to 20,000 Hz). These are used in medicine and industry, from imaging systems with low energy to focused high energy forms. Terms used to describe ultrasound waves are frequency, sound velocity, and wavelength, which are related by this equation:

$$\text{Velocity} = \text{Wavelength} \times \text{Frequency}$$

The frequencies of the devices may differ, which may have an impact on the treated tissue. The goal of focused ultrasound technology is similar to that of targeted laser therapy: to maximize energy accumulation at the target area to induce a significant biologic reaction without causing collateral damage to the intervening tissues, such as skin and the tissues and structures surrounding and within the target area. The specific goal of ultrasound fat removal devices is to destroy adipose tissue without disruption of nonadipose tissue. The therapeutic devices discussed here are referred to as *high-intensity focused ultrasound* (HIFU) devices; these use high-energy ultrasound waves that are focused on a small spot. The sound intensity (SI) (energy) is measured in Watts/cm². High-intensity ultrasound generally refers to ultrasound with SI higher than 5 W/cm². This type of ultrasound, if used in continuous mode, can cause coagulation necrosis of tissue and is usually used for ultrasonic surgery (such as cancer therapy), as opposed to low-energy physiotherapy ultrasound devices (SI less than 3 W/cm²), which cause nondestructive heating with stimulation or acceleration of physiologic responses to injury.

There are currently two major companies manufacturing noninvasive focused ultrasound devices for body contouring: UltraShape (Tel Aviv, Israel) and LipoSonix (Medicis, Scottsdale, AZ). Other companies have devices in development. There are differences among the devices, and only time and further clinical trials will determine which device is safest and most effective.

UltraShape



Courtesy UltraShape, Yokneam, Israel

The UltraShape device uses nonthermal selective focused ultrasound technology. It received its CE mark in 2005, Canadian approval in 2007, and is currently available in 57 countries. The UltraShape device operates at 200 ± 30 kHz and uses a pulsed ultrasound wave to deliver maximal intensity (580 W/cm^2) and pressure (4.0 MPa) per “burst” of energy. This pulsed ultrasound limits temperature increase and delivers mechanical effects to target and selectively destroy fat cells without harming surrounding structures. UltraShape introduced a new model, Contour I Ver3, in early 2010 with a smaller footprint and higher efficacy.

The original device focused energy at 1.5 cm below the skin surface; the updated device has a multifocal mode. The fat cells within the focal volume are immediately disrupted, and the triglycerides and cellular debris are released into the interstitial space. The triglyceride debris is then cleared through the body’s natural metabolic and physiologic pathways. It is thought that the disrupted adipose tissue is absorbed through the lymphatic system.



UltraShape tracking system

The UltraShape procedure is performed by placing a transducer on the skin surface. No topical anesthetic or tumescent solution is used. A real-time computer tracking and guidance device tracks the ultrasound pulses directed into the adipose tissue. The operator moves the transducer along the skin according to a computer-guided treatment algorithm, and the tracking mechanism ensures complete, uniform treatment and smooth results. There is minimal or no patient discomfort.

Outcomes

The UltraShape device has been used extensively around the world, with more than 150,000 patient treatments performed to date. The safety profile is excellent, with very few adverse events reported. The initial device delivered a 3-second pulse of energy, but recent technologic advances have shortened this to a 1-second pulse, which reduces the overall treatment time with no change in device efficacy. The latest device combines a radiofrequency head into the machine, along with suction to increase the efficacy of the treatment.

More than 20 clinical studies have been published and presented around the world with this device. Circumferential reductions averaged from 2.0 cm in a single treatment to 6.3 cm in a three-treatment series. Patient satisfaction varied from 86% to 93%. Early studies used a single treatment protocol, whereas later studies used multiple treatments. Measurements of blood lipid levels in all studies showed no increase after treatment. An FDA IDE clinical trial was completed in six U.S. sites, including our clinic. Our study involved a 125-patient randomized, double-blind study with a sham control. Patients were treated three times at 2-week intervals, and blood chemistries, MRIs, and photographic evaluations were performed. All safety endpoints were met, with no serious adverse events reported; blood chemistry and lipid profile data were normal. At present, final efficacy data are not yet fully analyzed.

The newest version appears to be more efficacious in early series, but no published studies are available yet.

Results



Case courtesy Mark Lupin, MD

These three patients are shown before and after three treatments with UltraShape. Note the change in abdominal contour.

LipoSonix

LipoSonix is a high-intensity focused ultrasound device for fat reduction. It operates at a frequency in the 2 MHz range. The LipoSonix device is available in Europe and Canada at present and has its CE mark. This device's transducer is placed on the skin, and a scanner similar to a laser scanner delivers a series of pulses into the tissue. The handpiece is moved manually by the operator using a grid pattern, and the process is repeated over the treatment area. The depth of damage is selectable between 1.1 and 1.8 cm. The LipoSonix device has been extensively studied in both animals and humans. The adipose tissue disruption is thought to occur through a thermal mechanism very similar to HIFU treatment of cancers. After destruction of a layer of adipose tissue, the body's natural wound-healing response occurs and clears the thermally damaged tissue through the lymphatic system. As with the UltraShape system, there is no evidence of serum lipid level changes. Clinical studies with this device are ongoing.

According to the manufacturers, the major differences between the UltraShape and LipoSonix devices are that the UltraShape device uses a mechanical effect on the adipose tissue, whereas the LipoSonix system employs a thermal effect. The UltraShape device produces nonthermal stable cavitation to selectively disrupt fat cells without harming surrounding critical structures such as skin, blood vessels, nerves, and connective tissue. The UltraShape device operates at low average intensities to achieve the maximal negative pressure needed to create the purely mechanical effect of cavitation. The nonthermal aspect of the UltraShape device delivers a comfortable treatment with no downtime for the patient. The LipoSonix device relies on the mechanism of thermal necrosis to destroy the subcutaneous tissue. It uses time-averaged high-intensity continuous ultrasound energy delivery to create this thermal effect. The protocol for the UltraShape device is for three treatments 2 weeks apart, whereas the LipoSonix protocol is for one treatment. Initial comparisons suggest that the LipoSonix device may be more efficacious but more painful. Further comparative studies are necessary.

CRYOLIPOLYSIS

Another device that was introduced for nonsurgical fat removal is from Zeltiq Aesthetics (Pleasanton, CA). This noninvasive device is not yet FDA cleared for fat layer removal but does have FDA approval for skin cooling during dermatologic treatment. This means that this device may be used in the United States for nonsurgical fat reduction as an FDA off-label use. The Zeltiq device works on the scientific principle of *cryolipolysis*, by which fat cells are naturally more vulnerable to the effects of cold than surrounding tissues are. This principle is used to selectively destroy and eliminate fat cells without harming the skin. The concept stems from early research

performed by Manstein and Anderson and colleagues of Wellman Center for Photomedicine and Massachusetts General Hospital, a teaching affiliate of Harvard Medical School. Their original theory and research stemmed from observations of frostbite patients, who had fat layer reduction without skin injury. This led to animal studies that confirmed that when fat cells are exposed to controlled cooling, it triggers apoptosis, a process of natural fat cell removal that gradually reduces the thickness of the fat layer. The fat cooling causes crystallization of the fat and fat cell death without injury to adjacent structures. The fat is gradually removed through a macrophage-mediated process similar to that observed through thermally induced fat cell death.



Courtesy Zeltiq, Pleasanton, CA

The device consists of an applicator with cooling panels and mild suction, which is placed directly on the tissue being treated. The fat is cooled over a period of 1 hour per procedure site. No anesthesia is used, and patient discomfort is mild to none. There may be transient erythema and a transient decreased sensitivity to touch following the procedure. The patient can resume normal activities the same day. Fat loss occurs over a 2- to 4-month period. The treatment may be repeated 60 to 90 days later for even greater efficacy.

This device was extensively studied with animal models, followed by human trials. Initial reports of the human trials show very promising results, with 84% of patients showing noticeable improvement. Ultrasound measurements of fat reduction averaged 22.4% for one treatment. Lipid blood levels showed no changes during the postprocedure period. We have had the device in our practices for a few months, and one of the authors (J.N.P.) was treated, with excellent results.



The patient is shown before and 3 months after one Zeltiq treatment of the abdomen.

OTHER NEW TECHNOLOGIES

Other devices that manufacturers claim may cause fat reduction include radiofrequency energy, such as the Alma Accent (Caesarea, Israel) and Thermage (Solta, CA). These devices are used for nonsurgical skin tightening and cellulite treatment. Some reports have suggested that there may be some fat removal when these devices are used at high enough energies. Further research is ongoing.

Another device that has been promoted for nonsurgical fat removal is the Zerona laser (McKinney, TX). This device is a low-level light therapy device (laser 650 nm) that has FDA approval for pain control following liposuction. The claims from the Zerona manufacturer are that an adipose cell has a pore that is opened with exposure to this low-level light. The adipose cell then extrudes its contents, which are absorbed by the body. Initial studies of a predecessor of this device showed no efficacy. Further studies are ongoing.

LASER-ASSISTED LIPOSUCTION

As we have seen, technology has presented several ways of attacking fat. Laser has a unique position in this armamentarium. The fat practice of the future will most likely have three divisions: completely noninvasive for mild cases, minimally invasive for moderate cases, and invasive, reserved for larger patients. Laser-assisted liposuction (LAL) uses a small laser fiber (300 to 1000 microns) delivered through a small cannula of approximately 1 mm. The distinct advance in laser delivery over the past 10 to 15 years is the delivery of laser energy under rather than through the skin. This allows more energy to be placed directly at the target instead of passing through epidermis and dermis, with concomitant cooling mechanisms for protection of the surface from intense heat. The advantages reserved for laser at this point in research are

the proven efficacy in skin tightening, and the safety mechanism has been defined and delineated. Another advantage, because the cannula is small, is the ability to treat scarring, dimpling, and cellulite in the superficial layers without the higher risk of contour irregularity seen with larger cannulas. Disadvantages are the high cost of the equipment, the need for exact temperature measurement, and the potential for burns or blisters without this monitoring. Previous disadvantages were related to time of the procedure; however, as technology progresses, additional wavelengths have been proved to be 40 times more efficient in fat disruption, yet keeping the same small cannula size. This is how technology can advance our treatments in ways mechanical or analog devices could not in the past.

Indications and Contraindications

The indications for LAL take into account analysis of the fat thickness, the physical area in square centimeters to be treated in one setting, and the loss of skin elasticity with increased laxity. Therefore indications include biolysis in patients with mild to moderate thickness of the adipose layer (1 to 6 cm), although larger volumes can be undertaken with the new wavelengths. Patients with mild to moderate skin laxity can now be considered liposuction candidates; in the past, mechanical suction alone would have produced an unpleasant result in these patients. This enhances the age and skin quality range of potential lipoplasty candidates. Those with contour irregularities, scar tissue, or dimpling in the superficial layers of the skin have few other choices for fat removal.

Contraindications include patients with severe skin laxity requiring a surgical solution, patients with a tremendous volume of fat by thickness of area to be treated at one session, and patients with cardiac or similar medical conditions that preclude the use of epinephrine.

Patient Profiles

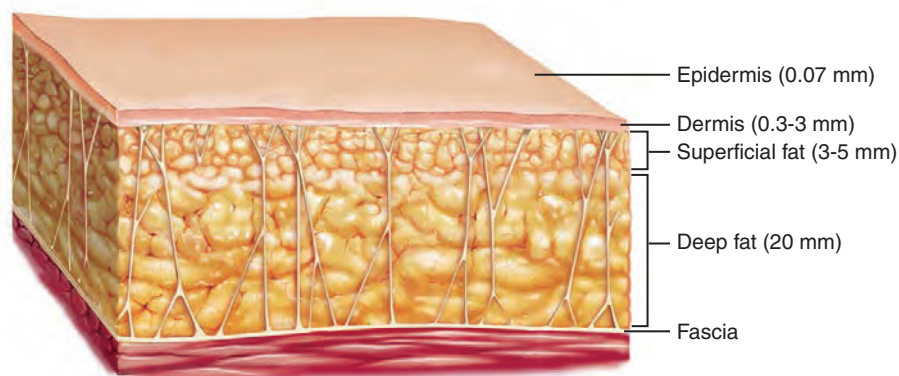
Good Candidate

A woman in her mid-fifties with moderate fat thickness across 5 cm of the upper and lower abdomen is an example of a prime candidate for LAL. She will have had previous liposuction approximately 10 years ago to the lower abdomen and has residual scar tissue and mild contour irregularity. Her upper abdomen has significant fibrous tissue. Most significant is a mild to moderate skin laxity with loss of elasticity. She is a good candidate because she meets the area and thickness guidelines, and her defects—namely skin laxity and superficial contour defects—are precisely those that can be improved by LAL.

Poor Candidate

A young woman weighing 100 kg (220 pounds) with 10 cm of fat excess in the abdomen as well as excess in the flanks and hips is an example of a poor candidate for this procedure. There is a pannus of skin and fat hanging 4 cm in the lower aspect. She is a poor candidate because of the amount of tissue requiring treatment, and the skin excess, which is far beyond the capabilities of the laser.

Pertinent Anatomy



Superficial and deep treatment planes for laser lipolysis

The pertinent anatomy for LAL treatment is the skin and just below it. The laser initially treats the deep fat. The next zone of treatment is just below the dermis. The third and final step is small cannula suction removal of any debris, oils, and fat cell remnants in the superficial and deep layers.

Pretreatment Assessment

Physical examination is consistent with the patient descriptions noted earlier. Otherwise, general liposuction rules apply.

Patient education focuses primarily on the fact that the skin-tightening effects are variable and that the stimulation of fibroblasts making more collagen and elastin will not be evident until approximately 3 months after the procedure.

Pretreatment Planning



Immediately before the procedure, the areas of fat to be removed are marked. In addition, 5 by 5 cm areas, as measured with a ruler, are marked over the treatment area. This ensures that specific energy levels will be supplied to the deep fat as well as discrete areas for application of heat for stimulation and subsequent tightening of the skin. Incision points (1 to 2 mm) are marked in specific areas to maximize cannula access to the grid, taking into account cannula length and the curvature of the tissue. Treatment becomes more difficult at a distance of more than two or three sectors away from the incision.

If local anesthesia only is used, then the incision points are anesthetized with lidocaine 1%, just forming a wheal in the area; then photographs are taken of the new markings, and oral medications are given. Oral diazepam (Valium) 20 mg and oxycodone/acetaminophen (Percocet), two tablets of 5 mg/325 mg, are used in local cases.

Technique



77-1 Laser
liposuction



Once the patient is positioned on the table and the monitoring equipment has been placed, additional lidocaine 1% with epinephrine 20 to 30 ml is given via a spinal needle through the previously anesthetized incisions to provide additional comfort before the tumescent fluid is administered. The patient is then prepared and draped. Before tumescent fluid is injected, the skin and fat in the area to be treated are pinched and measured for thickness; this information will be used for energy administration guidelines. The surgeon can use the tumescent formula of choice. To ensure proper reaction with the laser, approximately 50 to 100 ml of fluid is given per 5 by 5 cm sector. The next step is the first laser application in the deep tissue. From the previous thickness measurement, 1000 to 2000 Joules of energy are given per centimeter of pinched thickness. Therefore if 3 cm was determined, the deep energy level would be 3000 Joules for normal soft adipose tissue and up to 6000 Joules of energy in thick fibrous or scar tissue. This amount of energy is given to all deep sectors first. The wavelength used for this layer is currently 1440 nm, combined with 1064 nm. In this instance, 1440 has a higher affinity for the fat tissue by approximately 40 times. The mechanism is a higher absorption in fatty tissue, translating to a more intense photomechanical effect. The power density concentrated at the tip of the canula creates pressure-filled microbubbles that eventually collapse, creating both a mechanical as well as a thermal disruption on the adipocyte cell wall.

Next, the laser settings are changed to 1320 nm and 1064 nm; hence the 1320 wavelength has a high absorption coefficient for water, thus enhancing the dermal heating component.

Temperature Monitoring



Courtesy Cynosure, Westford, MA

Safety requires precise temperature monitoring for the skin-tightening phase. The basis of the temperature goals and safety parameters were published, establishing the 42° C (107.6° F) temperature goal in this layer. Too little heat will not achieve the clinical goals; too much heat will risk blistering or burning with subsequent scars. Currently there are three methods for monitoring temperature:

1. A handheld, laser-guided thermometer (least accurate)
2. A thermistor placed at the tip of the operating cannula
3. An overhead infrared thermal camera

The latter two have the capability to be tied into the laser computer to stop the laser from firing as goal temperatures are achieved. These systems, although highly accurate and safe, come at a significantly higher cost.

Once laser applications have been completed in all sectors, the last phase is to remove fat oils, cell fragments and other debris with small liposuction cannulas. Wounds are either closed or left open in the dependent positions. Foam and a compression garment are placed, and the rest of the postoperative care is similar to that for other liposuction procedures.

Posttreatment Care

Although posttreatment care is similar to that in other liposuction protocols, laser treatment patients can usually return to sedentary work in 2 to 3 days. Although the laser and the 1064 nm wavelength help to coagulate small vessels, which results in less bruising, swelling is still a factor. Therefore routine compression, massage, and limitation of activity are required.

Problems and Complications

As with any liposuction, associated complications are similar to the laser procedure. Complications can occur in three categories: systemic, local, and device based. The box lists the complications per category.

Potential Complications

Systemic

Infection
Hemorrhage
Hypovolemia
Third space fluid shift
Deep vein thrombosis
Fat embolism
Pulmonary embolism
Abdominal perforation
Necrotizing fasciitis
Lidocaine toxicity
Epinephrine toxicity
Visual loss (idiopathic intracranial hypertension)
Death

Local

Undercorrection (insufficient fat removal)
Overcorrection (excess fat removal)
Contour irregularities
Unevenness
Seroma
Hematoma
Incision scarring
Cutaneous slough
Hyperpigmentation
Poor skin tone

Device-Based

End hits
Blisters
Burns
Blowholes
Prolonged edema
Heat/pressure problems
Neurapraxia
Permanent nerve damage
Hyperlipidemia
Contour irregularity
Insufficient effect

Outcomes

Patient outcomes are very closely related to the efforts by the surgeon to apply appropriate energy in the deep layers, obtaining a temperature as close as possible to the 42° C (107.6° F) goal and performing a thorough suction at the end. These procedures require time and work, but the results should be worth the efforts. Ten consecutive patients were presented at an American Society of Plastic Surgeons meeting; there was high patient satisfaction, safety, and a minimum of complications. One patient was noted to have had a temporary postinflammatory hyperpigmentation. In the initial few months of use of the device, some blisters and burns were reported, but these occurred before we gained experience with the technique and with proper temperature monitoring.

Results



This 29-year-old woman is shown before and 2 months after a SmartLipo MultiPlex (Cynosure) treatment on the neck, with a total of 16,198 Joules. Note the fat removal and skin tightening.



This 55-year-old woman is shown before and 2 months after a SmartLipo MultiPlex treatment on the arms, with a total of 31,684 Joules. Regular liposuction would not have been able to provide this tissue contraction.



This 50-year-old patient is shown before and 3 months after SmartLipo treatment on the neck. Note the skin contraction.



This 47-year-old patient is shown before and 1 month after a SmartLipo treatment on the lower abdomen and flanks. She has excellent skin contraction.

Concluding Thoughts

Nonsurgical fat removal is still in its infancy. The nonsurgical devices in use today differ in their mode of operation—cryolipolysis versus ultrasound—and differ in their efficacy and the level of pain the patient experiences. Future technology may make it possible to visualize and remove specific fat deposits with greater efficacy and minimal pain. We have proved that laser liposuction destroys fat and tightens skin; however, the biologic mechanism of tightening needs to be elucidated. We need further study to ascertain the time and temperature levels that lead to new collagen formation. We believe the questions will be answered in the ensuing years.

Clinical Caveats

Proper patient selection is critical.

The safety and efficacy of the laser device selected must be researched thoroughly.

There are no shortcuts to proper energy application.

The face and neck have much thinner skin and require additional caution.

Annotated Bibliography

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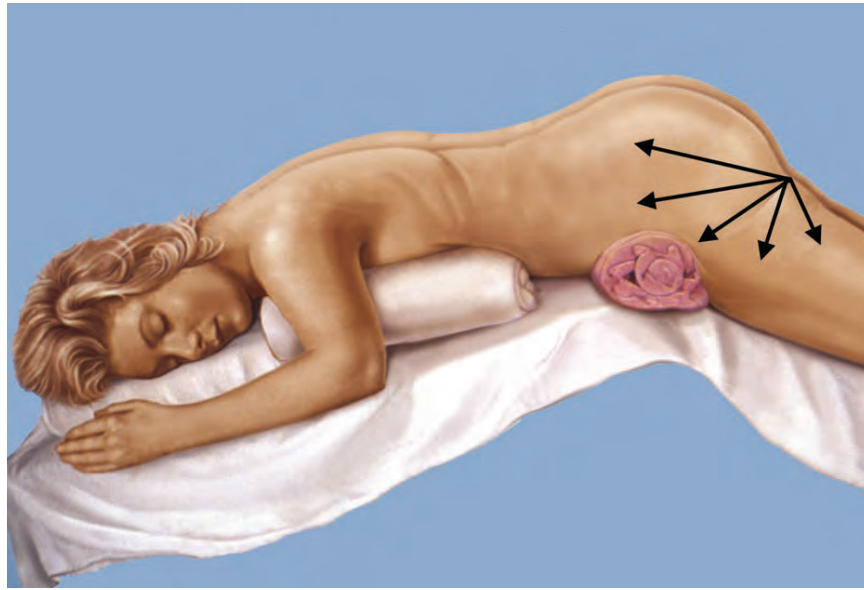
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Suggested Readings

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CHAPTER 78



Liposuction:

Basic Techniques and Safety Considerations

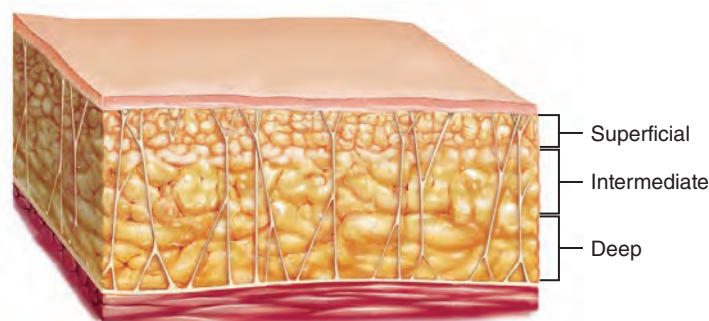
JORDAN P. FARKAS, PHILLIP J. STEPHAN,
JEFFREY M. KENKEL

Suction-assisted lipectomy, or lipoplasty, more commonly referred to as liposuction, originally introduced by Illouz in the early 1980s, continues to be one of the most popular body-contouring and overall treatment modalities offered in aesthetic surgery today. According to the American Society for Aesthetic Plastic Surgery, in 2009 more than 283,000 liposuction procedures were performed in the United States, which placed it second among all types of invasive cosmetic procedures. With greater understanding of the biochemical and physiologic properties of liposuction as well as biomedical technologic advancements, suction-assisted lipoplasty has undergone a tremendous evolution, leading to overall improvements in technique, patient safety, and outcomes. Over the past two decades, it has grown from a procedure that facilitates small or spot reductions to one that has become an almost irreplaceable tool in aesthetic surgical procedures of the neck, breast, and circumferential body contouring. Liposuction has become a useful adjunct to other areas of plastic surgery, including breast reconstruction and postoperative contouring in upper and lower extremity reconstruction. Important innovations and modifications to standard suction-assisted lipoplasty (SAL) involving the introduction and/or refinement of wetting solutions and cannulas have assisted in refining the procedure, and other novel technologies have been introduced, including ultrasound-assisted liposuction (UAL), power-assisted liposuction (PAL), vaser-assisted liposuction (VAL), and laser-assisted liposuction (LAL). There has been a strong movement toward defining appropriate safety guidelines for liposuction and other body-contouring procedures, with a focus on deep venous thrombosis prophylaxis and fluid resuscitation.

Even with these refinements, liposuction, as with all invasive procedures, is still not without risk. Aesthetic body contouring with liposuction requires a comprehensive knowledge of the anatomic, biochemical, and physiological components of the various modalities and their limitations and indications to perform the procedure in a safe, controlled manner. Using a coordinated approach along with a thorough understanding, liposuction can be performed safely with relatively predictable results and outcomes.

Pertinent Anatomy

Anatomy texts divide subcutaneous fat throughout the body into superficial and deep layers or compartments separated by Scarpa's fascia, or the superficial fascial equivalent. However, for the purposes of liposuction and body contouring, subcutaneous fat is arbitrarily divided into three layers: superficial, intermediate, and deep.



The importance of this distinction is that the superficial layer is rarely violated. If this layer is treated, there is a significantly increase risk of vascular compromise and/or contour irregularities. The relative consistency and thickness of each of these separate layers vary in different anatomic areas. For example, the fat of the back has a more fibrous, compact superficial and intermediate layer with an underlying loose, areolar layer. This contrasts with the fat of the inner thigh, which is not as fibrous and is less compact. This information is crucial for an aesthetic surgeon to perform safe and appropriate suctioning of the targeted area and to minimize potential contour irregularities and skin necrosis.

In this chapter we will discuss the variation in fat consistency and depth as it relates to safe suctioning techniques, and which modalities may be preferred for the most effective treatment.

ZONES OF ADHERENCE



Previously described anatomic zones of adherence (see Chapter 77), which are present in both men and women, should be identified and marked during the preoperative consultation. These are areas of relatively dense fibrous attachments to the underlying deep fascia that help define the natural shape and curve of the body. There are sex-specific variations with respect to each of these zones. It is important to recognize these zones, because they are high-risk areas for contour irregularities after surgical intervention if not properly respected.



However, these zones of adherence are not areas to avoid in all cases, and on occasion they help to guide the surgeon in establishing contour goals. Regardless of the type of liposuction selected, it is helpful to consider the treatment area in terms of the three surgical layers. These arbitrary layers delineate areas of safety during liposuction. The most common area treated is the intermediate layer, and often the deep layer. Treatment of these layers allows uniform reduction without risk of injury to the subdermal plexus and skin.

Indications and Contraindications

Liposuction patients often present with a variety of expectations, concerns, and/or complaints. To achieve optimal contour with liposuction appropriate patient selection is imperative. As a general rule, liposuction is performed in healthy patients who maintain realistic goals and expectations. Studies have shown that patients who undergo appropriate long-term lifestyle changes will in fact achieve the highest level of postoperative satisfaction from their liposuction-assisted body-contouring procedure. Broughton et al found that patients who were committed to positive lifestyle changes involving a healthy diet and regular exercise or who were already practicing a healthy lifestyle that continued postoperatively scored the best on self-assessment and satisfaction evaluations after liposuction. To achieve and maintain optimal results, a body-contouring patient must satisfy four key elements: (1) lifestyle change, (2) regular exercise, (3) a well-balanced diet, and (4) body contouring.

Appropriate candidates for liposuction are not morbidly obese, are at a stable weight, and have incorporated the above lifestyle changes into their preoperative regimen. It is preferable for patients to commit to the necessary changes in diet, exercise, and lifestyle modification before undergoing surgery. It is the responsibility of the surgeon to address all concerns, expectations, and goals with the patient before the procedure to establish realistic expectations of the procedure. Preoperative consultation with a dietician may prove beneficial for long-term patient satisfaction. Liposuction

is contraindicated in patients who are pregnant or in poor general medical health. Patients with morbid obesity, cardiopulmonary disease, body image perception issues, unrealistic expectations, wound-healing difficulties, or with extensive or poorly located scars should be excluded from consideration for liposuction.

Patient Profiles

There are three types of lipodystrophy and skin redundancy.

TYPE I: LOCALIZED LIPODYSTROPHY Type I patients tend to be younger, with normal skin tone and minimal skin irregularities.



This 21-year-old woman is in good health but has mild lipodystrophy in her abdomen, hips, and thighs.



This 20-year-old man is an extremely active cyclist who has refractory lipodystrophy and mild skin redundancy in his lower abdomen.

TYPE II: GENERALIZED LIPODYSTROPHY Type II patients tend to have slightly diminished skin tone with some skin irregularities and circumferential lipodystrophy throughout their trunk and extremities.



This 33-year-old woman has diffuse lipodystrophy in her abdomen, hips, and thighs that has been resistant to diet and exercise.



This 27-year-old woman has diffuse lipodystrophy and some mild skin laxity in her abdomen.

TYPE III: SKIN REDUNDANCY AND LIPODYSTROPHY Type III patients have significant skin redundancy that would be more amenable to excisional surgical techniques to improve shape and contour. If necessary, liposuction may be performed as an adjunct procedure to achieve an optimal result.



This 59-year-old woman is interested in truncal rejuvenation. She is unhappy with the central lipodystrophy that has recurred after menopause. She will benefit from liposuction to her thighs and back as well as circumferential abdominoplasty.



This 47-year-old woman has lost more than 45 kg (100 pounds) and desires improvement of her central trunk. She has minimal lipodystrophy and will benefit from circumferential abdominoplasty.

Preoperative Assessment

Initial Evaluation

During this initial interaction, it is imperative that the plastic surgeon be able to assess the patients' goals from surgery and be able to determine whether the patient has realistic expectations regarding outcome and postoperative body image. It may be useful to have the patient prioritize the body regions that he or she is most concerned with, focusing on specific complaints within these areas. A detailed medical history should be obtained, including any allergies, and whether the patient uses tobacco. Especially important data include a history of diabetes, massive weight loss, previous surgery, previous liposuction, and a full detailed list of medications and supplements. Any concerns about a patient's medical suitability to undergo anesthesia and/or an operative procedure should result in referral for preoperative clearance by an internist or a cardiologist. Patients should be asked specifically about herbal and over-the-counter medications, because they frequently fail to mention these. Nonessential medications should be discontinued at least 3 weeks before surgery. In selected patients, a preoperative evaluation by a primary care doctor, internist, or cardiologist may be warranted. This typically includes anyone with a significant medical history or patients older than 50 years of age.

It is often prudent to notify the consulting physician of expected operative times and the amount of expected aspirate and infiltrate. Often our medical colleagues view liposuction as a very benign operation with minimal operative time and morbidity, when in fact a large-volume liposuction procedure can involve significant fluid shifts and time under general anesthesia. Massive-weight-loss patients should undergo the same preoperative evaluation and clearance for liposuction as they would for any excisional type of body-contouring procedure (including nutrition, hemoglobin and iron assays, B₁₂, and so on). Herbal remedies and supplements are not regulated by the FDA and thus may place the patient at potential risk of untoward complications, including bleeding or hypercoagulability; these products should be avoided in the perioperative period. Avoiding aspirin, NSAIDs, and hormonal therapy can help prevent such complications as well. We advise patients to discontinue use of all NSAIDs, aspirin products, fish oil, and supplements 3 weeks before surgery. Of course, if there is a medical indication and necessity for these drugs, consultation with the primary physician or appropriate specialist should be completed before the medical therapy is discontinued. A frank discussion of the risk of oral contraceptives and estrogens is held with the female patients, regardless of the magnitude of the procedure. We strongly recommend that these medications be discontinued 1 month before the procedure.

Physical Examination

A detailed physical examination is performed at the first visit. Specific attention to prior scars, the presence or absence of hernias, evidence of venous insufficiency, and any preexisting asymmetry or contour irregularity should be discussed and noted in the chart. At the initial and subsequent visits, the patient's height and weight are measured and BMI calculated. This is of paramount importance for safety as well as to track long-term trends during follow-up. For liposuction candidates, six key elements are documented:

1. Evaluation of areas of lipodystrophy and contour deformities
2. Skin tone and quality
3. Asymmetries
4. Dimpling and cellulite
5. Myofascial support
6. Zones of adherence



The physical examination is best performed with the patient in front of a full-length mirror. This allows an open dialog between the patient and physician during the exam so that the patient's concerns can be addressed, and previously unrecognized problem areas can be assessed and discussed. Any areas of cellulite should be pointed out to the patient, and the expected outcome in these areas should be discussed. At the initial evaluation, high-quality medical photographs should be obtained, with anterior, posterior, and lateral views as well as anterior and posterior oblique views. These images will allow documentation of results and aid objective evaluation of outcomes by both the patient and physician. Professional medical photography can be a very useful tool for accurate and consistent preoperative and postoperative documentation.



With the patient facing away from the physician, the spine is assessed for abnormal curvature. This is more easily appreciated with the patient bending at the waist with the hands held forward and together in front of the body. This is often the first clue that significant asymmetries may exist. Skin tone and quality are assessed using the pinch test. The patient is examined from the anterior direction, both lateral directions, and finally in the supine position.



While the patient is in a supine position with the head elevated, abdominal integrity is assessed. This is helpful for detecting hernias or myofascial diastases. Findings may be difficult to interpret in larger individuals or in patients with multiple scars. An ultrasound examination or CT scan may further clarify findings in this region and prevent intraabdominal injury. During the initial consultation, when the patient is in front of the mirror, it is important to point out potential problem areas that may cause less than optimal results so the patient can visualize and appreciate these areas.

A follow-up visit is typically scheduled 2 to 3 weeks after the initial consultation. During this visit, computer images are reviewed, which allows the patient to establish realistic expectations. These objective images portray the advantages, disadvantages, and limitations of body-contouring surgery. The patient should understand that imaging is for educational purposes only and is *not* a guarantee of the final result. During the second visit, the patient can ask any remaining questions, such as concerns about recovery time, pain control, bruising, and postoperative changes. Such discussions help to strengthen the patient's confidence in the procedure and decrease the likelihood of any uncertainties or surprises in the perioperative period.

Patient Education and Informed Consent

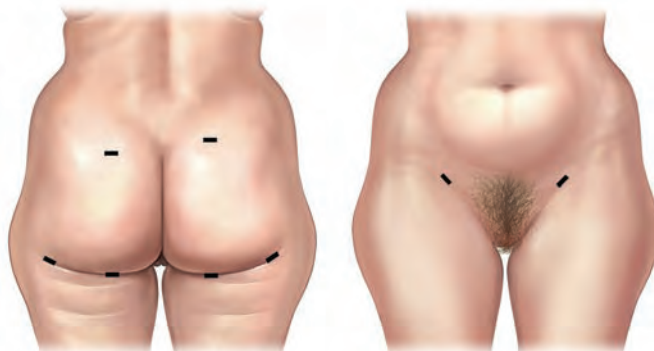
Patient education is stressed throughout the course of the initial evaluation, physical examination, and follow-up visit so the patient has sufficient information about the procedure, postoperative course, and long-term results to make a truly informed decision. The patient and physician should discuss the procedure itself, alternative treatments, and complications and risks. The risks for liposuction include, but are not limited to, bleeding, infection, pain, thermal injury, seroma, dyspigmentation, paresthesias, contour irregularities, and dysesthesias. The informed consent process is necessary to protect the patient and surgeon. The patient coordinator explains financial obligations (including those for further surgeries if required).

Preoperative Planning

Markings

Preoperative marking is essential to perform successful liposuction. Patients should be marked in the standing position and in front of a mirror, if possible. This allows the patient to contribute to the process and further confirms exactly what will be addressed during the procedure. The four-position stance is preferred. Areas to be suctioned are marked with a circle; zones of adherence and areas to avoid are marked with hash marks. Asymmetries, cellulite, and dimpling are marked for their respective treatment. When complete, the marks are once again reviewed with the patient to ensure that all areas of concern are addressed.

Access incisions are also marked at this setting. With liposuction, it is beneficial to choose access points that can treat multiple areas. Incisions should also allow each area to be treated from different directions for optimal contouring.



Incisions should be no longer than 3 to 4 mm in length and placed in well-concealed areas. The surgeon should not hesitate in placing additional incisions if access is insufficient with the existing markings.



The preoperative markings and preferred placement of access incisions based on areas to be suctioned are shown.



Cosmetically, it is preferable to stagger incisions asymmetrically to camouflage their appearance.

Anesthesia Technique/Location of Operation

The choice of anesthesia technique for liposuction varies based on multiple factors: operating surgeon preference, anesthesiologist preference, amount of expected lipoaspirate, length and extent of procedure, patient positioning, and overall health of the patient. Local anesthesia, various forms of sedation (mild, moderate, heavy) and general anesthesia are described in the literature. No single anesthesia technique has proved superior over another. However, the practice advisory on liposuction does recommend avoiding epidural and spinal anesthesia in office-based settings because of potential hypotension and volume overload issues.

Small-volume liposuction cases can be performed with a local anesthetic, with or without mild sedation. Complex, large-volume liposuction and combined cases should be performed with the patient under general anesthesia. We perform the majority of cases with a general anesthetic. Deep-sedation cases and general anesthesia procedures are performed under the supervision of board-certified anesthesiologists in licensed surgery centers or hospitals. All cases in which the patient is in a prone position are performed with general endotracheal anesthesia for airway control.

The operative location should be determined after careful patient evaluation, assessment of the complexity of the procedure required, and appropriate review of medical comorbidities. The anticipated postoperative course and the need for possible overnight observation both factor into the choice among inpatient, observation, or outpatient hospital settings.

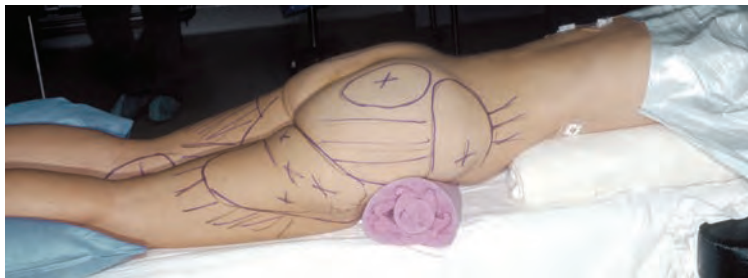
Special importance should be given to medical comorbidities, such as obstructive sleep apnea. The current American Society of Anesthesiology recommendations are that for patients with signs or symptoms that suggest moderate to severe obstructive sleep apnea, surgery be performed in a hospital setting with extended recovery and observation to prevent postoperative respiratory complications. It is recommended that liposuction procedures, whether inpatient or outpatient, be performed in an accredited facility equipped to manage any postoperative insult or sequela.

It is useful to have the circulating nurse maintain an accurate liposuction data sheet to facilitate consistent and accurate communication among the surgeon, the anesthesiologist, and the operating room team.

Patient Positioning

The patient is placed in a forced-air warming blanket 30 to 60 minutes before the procedure. Pedal or calf sequential compression devices are also applied in the holding area at this time.

Prone/Supine



Once the patient is in the operating room, the compression devices are reapplied and the patient is placed under general anesthesia. We prefer to position the patient prone. A soft hip roll is placed beneath the iliac crests to elevate the treatment areas off the bed, and either pillows or longitudinal rolls are used to support the upper chest. The breasts should be placed medially and the nipples protected.



The patient's arms are extended on padded arm boards at less than 90 degrees from the long axis of the table. The patient's face must be appropriately padded, the cervical spine is placed in a neutral position, and the eyes are protected. Patients in the prone position are subjected to pressure changes over the forehead, malar areas, iliac crest, and bony prominences of the arms and legs. Special attention also needs to be given to the genitals. In the prone position, up to 70% of the contouring can be performed and may include liposuction of the arms, back, hips/flanks, and lateral, posterior, and medial thighs.



With the patient transferred to the supine position, the remainder of the trunk and extremities can be addressed. This may include treatment of the arms, abdomen, anterior medial thighs, and knees. This position does not have significant effects on the cardiopulmonary system. Brachial plexus injuries can occur if the arm is abducted at greater than a 90-degree angle. The hips and knees should be flexed at approximately 30 degrees with a pillow. Pressure points in the supine position include the occiput, scapula, posterior iliac crest, sacrum, and heels.

Wetting Solutions and Perioperative Fluid Management

At one time, liposuction was performed without the use of any infiltrated wetting solution, which resulted in blood loss of up to 45% of aspirate in some areas. Liposuction has since evolved to include the addition of infiltrating subcutaneous wetting solutions before suctioning to provide hydrodissection, improve hemostasis, and potentially provide some perioperative analgesia.

The current options for wetting solutions are dry, wet, superwet, and tumescent. The dry technique uses no wetting solution and has few if any indications in liposuction. The wet technique involves preinfiltrating 200 to 300 ml of solution per region to be treated, regardless of the anticipated amount to be aspirated. The superwet technique employs infiltration of 1 ml of solution per estimated cubic centimeter of expected aspirate. Finally, the tumescent infiltration popularized by Klein involves extensive infiltration of wetting solution that creates significant tissue turgor and results in total infiltration of 3 to 4 ml of wetting solution per cubic centimeter aspirated. Regardless of the technique used, the infiltrate should be allowed to set for 7 minutes and no longer than 30 minutes before suctioning is initiated because of the estimated onset of action of the anesthetic and vasopressor agents in the solution. Negligible blood loss, less than 1% of the lipoaspirate, is observed when using either the superwet or tumescent technique.

Estimated Blood Loss With Different Liposuction Techniques

Technique	Estimated Blood Loss as a Percentage of Volume Aspirated
Dry	20-45
Wet	4-30
Superwet	1%
Tumescent	1%

Techniques of Liposuction and Infiltrates

Technique	Infiltrate	Volume Aspirate
Dry	No infiltrate	To treatment endpoint
Wet	200-300 ml/area	To treatment endpoint
Superwet	1 ml infiltrate:1 cc aspirate	1 cc aspirate/infiltrate (treatment endpoints)
Tumescent	Infiltrate to skin turgor	2-3 cc aspirate/ml

Some authors have popularized different variations of these solutions, but all of the formulations include some variant of fluid (normal saline solution or Ringer’s lactate solution), epinephrine, and lidocaine. Bupivacaine (Marcaine) should be avoided because of its potential cardiac effects and duration of action; it has yet to be proved clinically as a suitable anesthetic in wetting solutions. The most common solution mixtures are shown in the table on p. 2761.

Lidocaine

Lidocaine is the local anesthetic that most surgeons choose to include in the wetting solution. It has been reported to provide analgesia for up to 18 hours postoperatively when injected in dilute concentrations into the subcutaneous space. The recommended maximum dose of lidocaine with epinephrine is 7 mg/kg, according to the *Physicians’ Desk Reference*; however, numerous studies have documented the safety of lidocaine in concentrations greater than 35 mg/kg and as high as 55 mg/kg in large-volume cases. These higher doses have proved to yield peak plasma levels below the toxic range. It is thought that the dilute nature of lidocaine and slow infiltration delay absorption and reduce the peak plasma concentration. Additionally, the inclusion of epinephrine, the relative avascularity of fatty tissue, and the high lipid solubility of lidocaine all seem to contribute to the delayed absorption. There are many variables to consider when incorporating lidocaine into a wetting solution. First, the lidocaine absorption rate is extremely variable and dependent on multiple factors, including the activity of the cytochrome P450 system, drug interactions, fluids, and concentrations of the drug administered. Medications that tend to increase lidocaine levels include oral contraceptives, beta-blockers, and tricyclic antidepressants.

Most Common Wetting Solution Mixtures

Ingredient	Amount (ml)
Klein's Formula	
Normal saline solution	1000
1% lidocaine	50
1:1000 epinephrine	1
8.4% sodium bicarbonate	12.5
Hunstad's Formula	
Ringer's lactate solution	1000 at 38° to 40° C
1% lidocaine	50
1:1000 epinephrine	1
Fodor's Formula	
Ringer's lactate solution	1000
Aspirates <2000 cc 1:500 epinephrine	1
Aspirates 2000 to 4000 cc 1:1000 epinephrine	1
Aspirates >4000 cc 1:1500 epinephrine	1
UT Southwestern Formula	
Ringer's lactate solution	1000 at 21° C
Aspirates <5000 cc 1% lidocaine	30
Aspirates >5000 cc 1% lidocaine	15
1:1000 epinephrine	1

One area that is still under investigation is the importance of *monoethylglycinexylidide* (MEGX). MEGX is an active metabolite of lidocaine that is less protein bound and thus pharmacologically more active. It has been reported to be up to 83% active, meaning that it will contribute to the overall activity of lidocaine and ultimately its potential toxic effects. It has been demonstrated that the peak levels of the metabolite MEGX occur within 8 to 32 hours after initial infiltration. The peak systemic level was greater than initially thought, but still below the level of toxicity. Based on a recent study, this may increase the concentration of active metabolite up to 1 mg/ml.

At our institution, a concern about the volume of infiltrated lidocaine and possible toxicity levels led to a modification in the mixture of wetting solution in large-volume liposuction cases. In cases with aspirate greater than 5000 cc, the initial five bags of solution are mixed in a standard UT Southwestern protocol (see the table above). After 5 L of infiltration, the remaining bags of infiltrate contain lidocaine 1% plain at half the volume (15 ml).

However, a recent study at our institution showed that tissue levels of lidocaine beyond 8 hours postoperatively are subtherapeutic. A well-designed study by Hatef et al prospectively randomized liposuction patients to receive preoperative subcutaneous infiltration of 10, 20, or 30 mg/kg of lidocaine wetting solution before the pro-

cedure, observing patients' intraoperative anesthesia requirement, postoperative pain, and need for postoperative analgesia. Surprisingly, no significant difference was found among any of the three groups. We have since eliminated lidocaine in our wetting solutions and have noted no difference in our patients' postoperative recovery or pain levels.

Further investigation on the use of bupivacaine in low doses may provide another alternative for postoperative analgesia. A recent article by Failey et al demonstrated no significant difference in the incidence of adverse events or postoperative length of stay for patients who underwent liposuction procedures in which bupivacaine was administered, compared with other wetting solutions.

Epinephrine

The importance of epinephrine in subcutaneous infiltrates has been well recognized. In addition to its vasoconstrictive effect, it also decreases the rate of vascular absorption of lidocaine, potentiating the local anesthetic effect. Epinephrine toxicity can result in tachycardia, hypertension, and arrhythmias. Many investigators have studied the doses of epinephrine in wetting solutions. It has been reported to have an upper safety limit of 15 mg per surgical procedure. Regardless, it is known that epinephrine, even in small concentrations, may still have a profound effect on the cardiovascular system.

In a study to evaluate the hemodynamic effects of epinephrine during liposuction surgery, we found a linear correlation between the epinephrine concentration and cardiac index. Although the doses of epinephrine are low and its half-life is less than 2 minutes, peak concentrations do not occur until about 5 hours after infiltration. In larger-volume cases, we recommend that infiltration be staged, decreasing the peak effect of epinephrine and its subsequent effect on the cardiovascular system. Regardless, a thorough preoperative patient evaluation with special attention to the presence of cardiovascular disease should be performed to avoid the untoward effects associated with epinephrine infiltration in some patients.

Although rarely used, halothane may sensitize the heart to catecholamines, resulting in ventricular arrhythmias. *Despite the protective effect of lidocaine against arrhythmias, halothane should not be used during liposuction procedures.*

Regardless of the technique used, the infiltrate should be allowed to set for a minimum of 7 minutes and no longer than 30 minutes before suctioning because of the estimated onset of action of the anesthetic and the vasopressor in the solution.

Current Recommendations for Perioperative Fluid Management

Guidelines were developed by Rohrich et al in 1998 (and updated in 2006) after a thorough review of 100 consecutive procedures using the superwet technique (see the box below). Perioperative fluid management during liposuction procedures requires attention to maintenance intravenous fluids, third-space losses, wetting solution infiltration, and volume of lipoaspirate. We tend to diminish any preexisting fluid deficits, because our current preoperative guidelines allow patients to consume clear liquids up to 2 hours before surgery. Liposuction in our hands is considered a moderate surgical stress; therefore 3 to 5 mg/kg/hr of crystalloid solution is adequate volume for maintenance replacement and third-space losses. Additional fluid may be given during procedures in which the lipoaspirate amount is more than 5 L. A ratio of 0.25 ml of crystalloid solution for each aspirated cubic centimeter over 5 L is used.

Fluid Resuscitation

Body-contouring procedures can result in significant fluid shifts and intravascular volume changes for the patient. The operating surgeon should maintain a dialog with the anesthesia provider so that patients receive adequate replacement volume and proper fluid resuscitation intraoperatively. Awareness of four key elements will guide the intraoperative fluid management of liposuction patients: intravenous fluid maintenance (body weight dependent), third-space losses, the volume of the wetting solution infiltrated, and total lipoaspirate volume. Large-volume liposuction patients can present an especially difficult challenge for fluid resuscitation. We routinely place Foley catheters in patients undergoing large-volume aspiration to assist us in resuscitation.

Fluid Management

1. Replace losses from preoperative oral intake loss as needed.
2. Maintain fluid throughout the procedure and manage it based on vital signs and urine output.
3. Employ the superwet infiltration technique.
4. Administer crystalloid replacements, 0.25 ml for each cubic centimeter of lipoaspirate over 5 L.

These recommendations serve as a guideline for fluid management of these complicated patients and are not meant to replace sound clinical judgment based on specific patient needs.

Treatment Options

Once having determined that lipoplasty would be the best treatment option to accomplish the planned aesthetic goals, the surgeon focuses on selecting the appropriate modality. Factors that influence the selection of a particular type of treatment include surgeon preference, target area, expected volume of aspirate, and history of previous liposuction. Current options include traditional liposuction, as popularized by Illouz, which today includes SAL, PAL, UAL, VAL, LAL. Traditional SAL remains the most common and popular modality for lipoplasty among plastic surgeons.



SAL is a two-stage technique in which the site is infiltrated with a predetermined wetting solution and then evacuated after allowing time for the epinephrine to take effect. The advantages of this technique include the ease of use, wide variety of cannulas, availability of malleable cannulas, and decades of experience and results. The disadvantages of SAL include its being more difficult to use in fibrous areas and typically requiring more effort to perform than other liposuction modalities.



PAL electric handpiece



Complete PAL system

PAL uses an externally powered cannula, variable in size and flexible, and oscillates in a 2 mm reciprocating motion at rates of 4000 to 6000 cycles per minute. Advocates of PAL contend that it is best used for large volumes, fibrous areas, and revision liposuction. Because the PAL cannula breaks up fibrous fat much more readily, the procedure is significantly faster and less labor intensive for the surgeon than traditional SAL. Suction is still a major component of PAL, and most units are compatible with standard aspiration equipment. Both the power source and the suction are attached to the proximal end of the handpiece. If the surgeon prefers, syringe suction is a useful adjunct and can be used with an adapter. As with SAL, many probe tip configurations and diameters are available. PAL systems have multiple power settings, especially the computer-controlled systems that can be programmed.

Some of the disadvantages of earlier PAL systems, which ran on compressed air, included significant noise generation and the mechanical vibration experienced by the operating surgeon. However, these modalities now run on electrical power sources, decreasing the degree of noise and vibration. We find that the PAL system is bulky and somewhat cumbersome, making fine contour changes more difficult.



UAL applies ultrasonic energy to break down fat and facilitate suction-assisted removal. Its mechanism of action is also primarily mechanical in nature, but cavitation and even thermal effects are purported to occur. With this technique, fat is emul-

sified, which allows removal through traditional liposuction cannulas. UAL comprises three stages: infiltration, emulsification, and evacuation and contouring.



To help protect the skin from thermal injury, some operators limit their application of energy and bathe the access site with saline solution. A towel should cover the region behind the access site to prevent direct contact of the probe with the skin during excursion. As with the other technologies, a variety of probe tip configurations and lengths are available, including hollow and solid devices.

For UAL, we begin at a depth of approximately 1 to 2 cm, depending on the body area. The plane is treated uniformly, beginning at one side of the area and moving in a radial fashion to the contralateral side. We continue in this manner until the endpoint is reached. Then we move to a deeper plane. Most treatment sites will have a minimum of two planes and sometimes three. When the last plane is completed, evacuation begins in the deeper plane to remove the emulsified fat. Next, we begin final contouring, if necessary. We are fairly conservative in our choice of cannulas. Smaller cannulas are less efficient at evacuating fat but decrease the likelihood of contour irregularities. It is important that UAL endpoints be respected to avoid overzealous resection of fat. The advantages of UAL include less surgeon fatigue as well as improved results in fibrous areas and in secondary procedures. We have found that our revision rate over the years has dropped from just under 10% to less than 3%. We think that UAL allows a more uniform and homogenous treatment of the fatty layers. The disadvantages have been reported to include the need for larger incisions, longer operative times, and the possibility of thermal injury. Although there is a potential for thermal injury, this does not typically occur with the application times we use today. UAL requires a superwet environment and cannot be performed without a wetting solution. Finally, UAL requires continuous movement to prevent excessive exposure of the tissues to heat.

VAL employs a newer-generation ultrasound-assisted liposuction device that incorporates less energy with more efficient solid probes. The probes come in an array of sizes and grooving, and their selection depends on the tissues in which they will be used. The system uses less energy, decreasing its thermal component to the tissues.



Left, Smartlipo system; center, ThermoView; right, ThermoGuide probe

LAL has been at the forefront of marketing efforts for the past several years. The treatment involves insertion of a laser fiber through a small skin incision. Depending on the manufacturer, the fiber may either be housed within a cannula or stand alone. There are several commercially available lasers on the market under different product names. The most common available wavelengths in the United States are 924/975 nm, 1064 nm, 1319/1320 nm, and 1450 nm.

Most companies and physicians using these LAL devices employ a four-stage technique: infiltration, application of energy to the subcutaneous tissues, evacuation, and subdermal skin stimulation. The laser fiber purportedly acts to disrupt fat cell membranes and emulsify fat. Evacuation then commences through traditional liposuction cannulas. For smaller regions, such as the neck, some manufacturers suggest skipping the evacuation phase, allowing the body to absorb the liquefied contents.

These devices are being heavily marketed for their purported skin-tightening effects. The belief is that the heating of the subdermal tissue may in fact be the contributing factor for LAL's possible skin-tightening effect. No large prospective trials have been undertaken to examine the benefits of LAL over existing technologies, so unfortunately, these reports remain completely anecdotal. DiBernardo and Reyes evaluated skin tightening and skin shrinkage after treatment with a 1064/1320 nm laser in the abdomens of five patients and found a 26% improvement in skin elasticity and an average reduction in area of 17%.

A randomized, double-blind, controlled study by Prado et al showed no difference in the outcomes of LAL compared with those of traditional SAL. In that study, each patient served as his or her own control. Factors evaluated included cosmetic result, postoperative pain, length of operation, lipocrit, and free fatty acids. Besides the lack of difference in the cosmetic outcome of LAL versus SAL, the authors reported a longer operative time with LAL, less early postoperative pain with LAL, and elevated free fatty acids/triglycerides in the laser-treated lipoaspirate. Regardless of its efficacy in tightening skin, we must recognize that there is a fine line between dermal contraction and full-thickness injury when applying heat to the subdermis.

Surgical Endpoints

The surgical endpoints for UAL are different from those of SAL and PAL; these have been divided into primary and secondary endpoints. In UAL, the most important endpoint is reached when one encounters a loss of tissue resistance, which is appreciated through the treatment hand as well as the nondominant guiding hand. Additionally, the aspirate may become more blood tinged, indicating adequate emulsification of the treatment site. Experience helps dictate energy application times in particular regions of the body. Secondary endpoints for UAL include site-specific treatment time and the volume to allow for comparison of size and symmetry of treatment on either side. Contour should not be judged during emulsification or the evacuation phase. Once evacuation is complete, the contour may be assessed. Alternatively, treatment with SAL or PAL uses final contour and symmetrical pinch test results as their primary endpoints. Similarly, treatment time and volume can be used to help ensure that treatment is symmetrical.

We do not hesitate to add multiple sites for evacuation and final contouring to create a smoother, more uniformly treated area and to minimize the risk of contour deformities. As a general rule, we reserve superficial liposuction for patients who have significant superficial irregularities. Only surgeons with extensive experience in liposuction should perform this procedure because of the significant potential for skin injury and contour irregularities of the superficial soft tissues.

Finally, when contour irregularities are recognized intraoperatively, they are treated at this setting with autologous fat grafting at the site of the deformity. Trying to feather the edges of the defect most often leads to an even greater problem, further complicating its treatment.

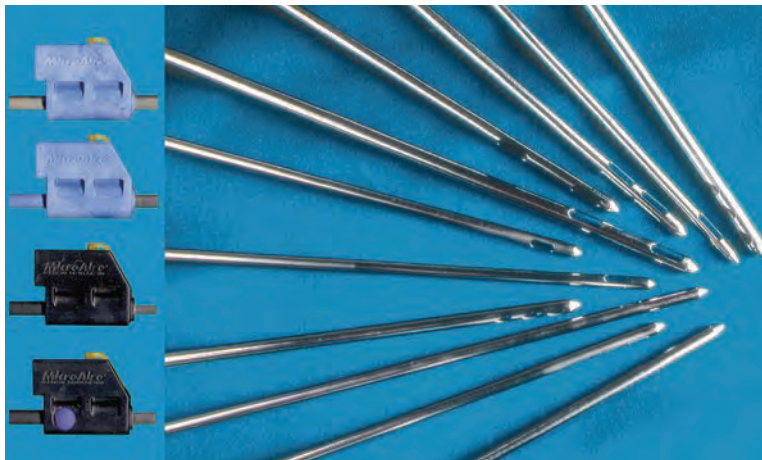
Surgical Endpoints for UAL and SAL/PAL

Endpoint	UAL	SAL/PAL
Primary	Loss of tissue resistance Blood aspirate	Final contour Symmetrical pinch test results
Secondary	Treatment time Treatment volume	Treatment time Treatment volume

Cannulas and Probes*Traditional Suction-Assisted Lipoplasty*

Most traditional liposuction cannula tips are rounded and somewhat tapered to allow easier movement through the tissues. Most cannulas have multiple distal openings that are set back from the tip to avoid contour irregularities. These openings vary in size and are generally proportional to the diameter of the cannula. Multiple openings allow improved efficiency in fat removal. Single- and double-aperture cannulas are safe because the opening can be directed away from the skin; however, they do aspirate fat at a slower rate. The most common cannula type is the Mercedes, which has three apertures set back from the tip to allow efficient circumferential fat removal. There are multiple variations with either larger or smaller openings that can be tailored to the surgeon's preference or for a desired effect.

Power-Assisted Liposuction



An array of cannulas is also available for the PAL systems (Microaire Surgical Instruments, Charlottesville, VA). These cannulas are small and malleable, which is very useful when working along curved surfaces. They are comparable in length and diameter to SAL cannulas, which permit the use of small access incisions.

Ultrasound-Assisted Liposuction

Ultrasonic technology uses either a hollow cannula or a solid probe. Vaser probes (Sound Surgical Technologies, Louisville, CO) are solid and have rings circumscribing them. The rings allow lateral fragmentation; therefore the greater the number of rings, the more lateral fragmentation that is possible.

Vaser-Assisted Liposuction



Two- or three-ring probes are generally used in areas that have soft, nonfibrous fat, and the single ring probe is reserved for more fibrous secondary areas.



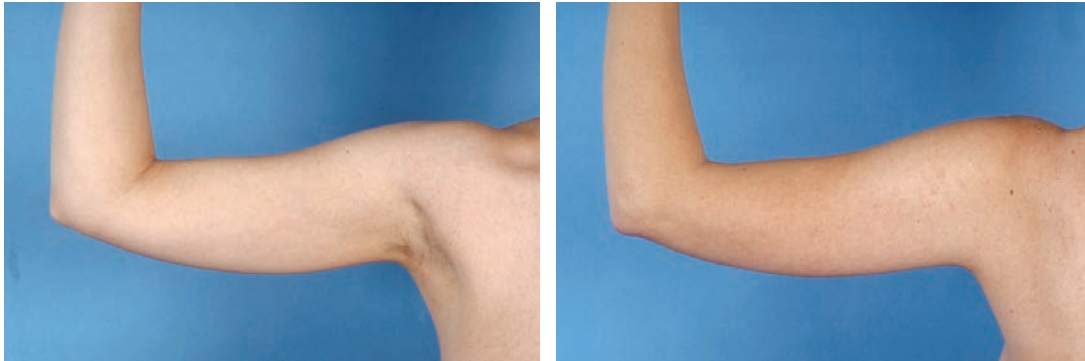
A cannula with a golf-tee-shaped tip allows greater fragmentation than a rounded bullet-shaped tip.

Cannula Size		
Site	Evacuation (mm)	Contouring (mm)
Neck	2.4	2.4 and 1.8
Arms	3.7	3.0 and 2.4
Back	3.7	3.0
Hips	4.6 (deep plane only)	3.7 and 3.0
Abdomen	3.7 (deep plane only)	3.7 and 3.0
Thighs	3.7 (deep plane only)	3.0
Knees	3.0	2.4
Calves/ankles	3.0	2.4

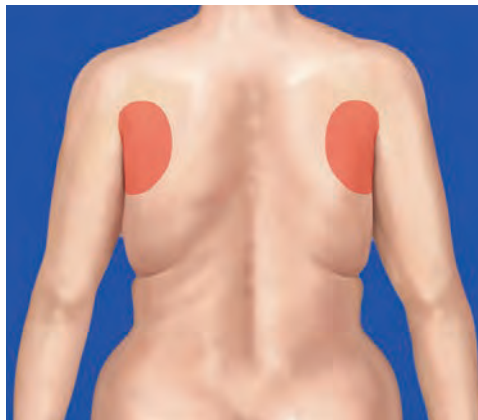
Treatment Areas

Arms

Upper arm contouring can be performed with any number of the modalities listed earlier. Caution must be exercised when suctioning toward the ulnar aspect of the elbow. The fatty layer is thin and mobile in this region, and the ulnar nerve courses superficially just beneath the investing fascial layer; this can be inadvertently injured during treatment, resulting in either temporary or permanent nerve injury. Arm thickness and composition of fat and muscle are variable; however, fat is usually most abundant in the posterior third of the arm.

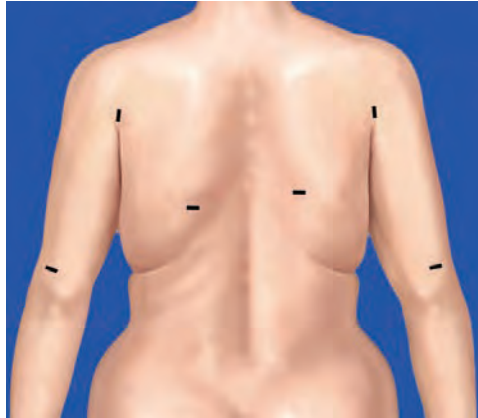


Ideally, the arm is lean and has a convexity overlying both the deltoid and biceps muscles. On the posterior surface, the arm is slightly convex from axilla to elbow. Poor skin quality and/or excess skin will likely require excisional surgery. For patients who lack definition overlying the biceps and deltoid region, a circumferential approach to the arm may be preferable.



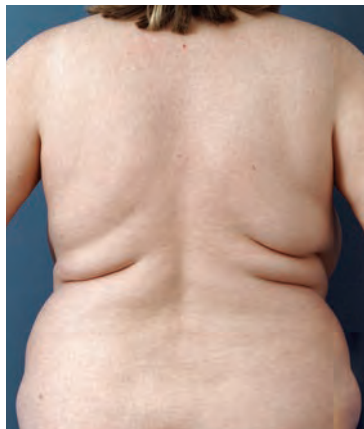
It is important to consider the area posteriorly where the arm joins the trunk. This region creates fullness with the arm in adduction and is often accentuated by a bra and/or other clothing. Liposuction of the arms is usually suited for patients with an excess of 1.5 cm of fat by the pinch test. Patients with less fat and more skin excess may benefit from excisional surgery rather than liposuction. The role of LAL in these patients has not been clearly defined.

Liposuction of the arms may be performed with the patient in either the supine or prone position. Regardless, care must be taken to avoid injury to the ulnar nerve, especially when using UAL. With UAL, the access incision is placed more radially around the elbow. Contouring on the ulnar side is reserved for SAL. If a patient requires circumferential liposuction of the arms or excisional surgery, we prefer to position the patient supine.



Proximal access may be achieved through a posterior axillary incision. The area where the arm joins the trunk may be accessed either through this incision or a back access incision in the case where the back is being treated as well. Overall, the fat is loose and areolar. The superficial nature of the fat requires the use of smaller cannulas. Evacuation begins with a 3.0 mm cannula and may transition to a 2.4 mm cannula for further contouring and feathering. In our hands, UAL tends to be particularly useful in the posterior third of the arm and the area adjacent to the back, because these areas tend to be more fibrous. PAL is also effective in these areas.

Back

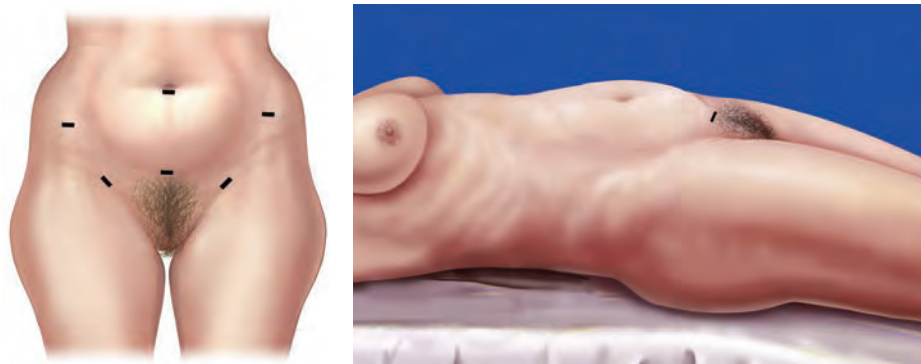


The anatomy of the subcutaneous fat and skin in the back is uniquely different from other regions of the trunk and extremities; it has a very thick dermis and a dense, fibrous characteristic to the underlying fat. For liposuction in the back, we prefer to treat patients in the prone position with the bed in a head-down flexed position. UAL or PAL tends to work well in the fibrous tissue of the back. The quantity of fat removed can be moderate, but improved results are often observed with release of folds and attachments to deeper tissue. Access incisions will depend on the distribution of lipodystrophy and can be placed medially or laterally; the incisions should be placed in the bra/bathing suit line for the best cosmetic result. Forceful excursion of the cannula should be avoided, because fibrous areas may redirect the cannula to an unsafe location. Suctioning from areas off the thoracic cage (the hip region) toward the posterior back should not be performed to avoid intraabdominal penetration of the cannula.

Abdomen

The abdomen is bordered superiorly by the xyphoid process and costal margin, inferiorly by the pubis and inguinal ligament, and laterally by the anterior superior iliac spines. Lipodystrophy of the abdomen is predominantly seen in the infraumbilical region. Careful preoperative evaluation and physical examination are vital, with careful attention to the distribution of fat, scars, skin laxity, and the presence or absence of hernias. The physical examination may be challenging for patients who are overweight, those who have a large pannus, or patients with extensive scarring necessitating preoperative imaging to rule out any abdominal wall defects or hernias. Patients with diastasis, abdominal wall laxity, or significant intraabdominal fat should be counseled on the possible benefit and/or need for skin excision or plication to achieve an optimal contour and aesthetic result.

Subcutaneous abdominal fat is amenable to all of the various modalities of liposuction and continues to be one of the most desired areas for liposuction. We reserve superficial liposuction for the linea alba or for correction of secondary deformities. There have been published reports of superficial sculpting of the abdomen, *but we strongly urge that this be attempted only in experienced hands*. Overaggressive treatment of the abdomen, as with other regions, may result in untoward contour irregularities and/or skin injury.



Access to the abdominal region may be gained through an umbilical incision, bilateral lower abdominal incisions, and/or suprapubic incisions.

It is also useful to extend the table at the waist up to 15 or 20 degrees to allow excursion of the cannula from the suprapubic region. In patients with a long torso and a moderate degree of lipodystrophy overlying their costal margin, an inframammary fold incision can be made to access this fatty area. As with other body regions, *the surgeon should never approach an area of convexity from an area of concavity to avoid intraabdominal or thoracic penetration*. In the abdomen, it is imperative that short, controlled strokes be used to avoid the potential for inadvertent fascial perforation, particularly when working around scars.

Hips/Flanks

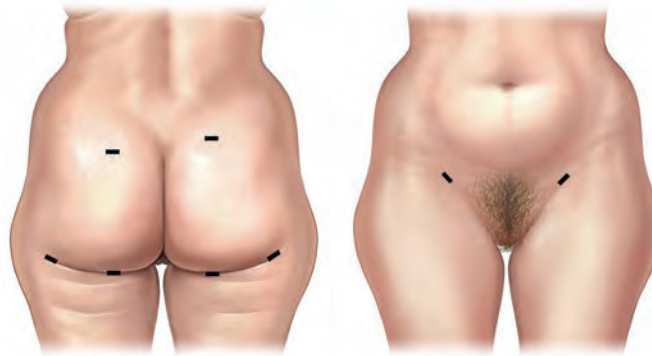
We often treat the hip/flank area with the patient in the prone position, although some surgeons prefer the lateral decubitus position. This common area of suctioning in both men and women is accessible through the bilateral or single midline paraspinous region and/or incision in the lateral gluteal fold. Suctioning in this area can provide excellent results, and all modalities have proved effective. The fat is loose and in some cases fibrous, with thick overlying skin. Significant striae may be seen in patients with weight fluctuations or in women who have had a child. Liposuction in these patients may reduce the lipodystrophy but can result in superficial contour irregularities or skin redundancy. Knowledge of the differing aesthetic considerations of the hips and flanks in men and women is crucial to preventing inappropriate masculinization or feminization. In general, men tend to have fullness in the superior and lateral region, whereas women usually have prominence more inferiorly and posteriorly.



In male patients the term *flank* describes an area immediately superior and posterior to the iliac crest. It begins in the paraspinous area and enlarges as it expands laterally. Anteriorly, the flank blends with the tissue of the lower abdomen. The inferior margin is defined by the zone of adherence along the iliac crest.

In contrast, the female hip is located more inferiorly and typically is centered over the iliac crest. The hip extends down to the level of the lateral greater trochanteric adherent zone. The fat in this region is typically loose but fibrous. The skin may be attenuated by striae and have some degree of laxity.

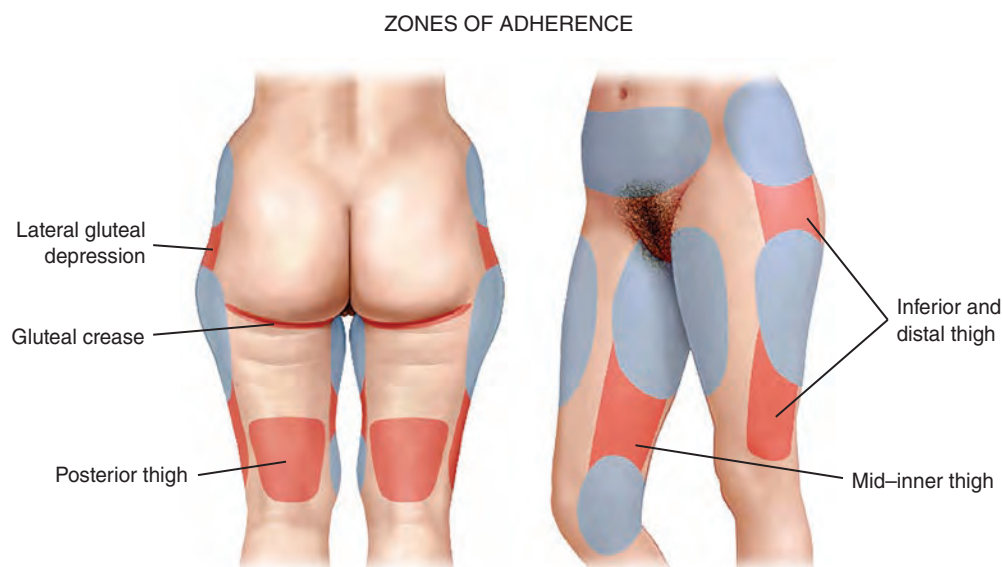
It is essential to mark the lateral gluteal depression before liposuction, because violation of this important area can lead to irregular contours and deformity. Often this adherent zone is a landmark to which both the hips and lateral thighs are reduced. In other patients, this area may be an area of significant depression that may benefit from autologous fat grafting.



The hip and flank can be accessed through two inferiorly placed lateral paraspinous incisions that are easily concealed by undergarments or a bathing suit. With more laterally displaced lipodystrophy, incisions may be moved more laterally. In contrast, patients with more posteriorly oriented fat may be adequately treated through a single lower midline access incision. This may be moved more superiorly if the fat overlies the area of the inferior posterior costal margin. However, it should be noted that this midline incision typically does not heal as well as paraspinous incisions do; this should be discussed with the patient. The lateral gluteal fold access incision may also contour the more inferior portion of the hip/flank, which allows an aesthetic blending between the lateral thigh and hip/flank area. This incision, in combination with a single midline access site, facilitates effective contouring and avoids incisions overlying the buttock area, which may have a tendency to dimple. However, caution should be used when contouring through the lateral gluteal fold incision, because overzealous resection through the trochanteric adherent zone is very likely to result in a contour deformity.

Thighs and Buttocks

Liposuction of the thighs is one of the more difficult procedures, where overaggressive treatment may result in an unsatisfactory contour. For most patients, a circumferential approach in the prone or supine position is best. Although patients may present with an isolated medial or lateral deformity, it has been shown that superior results are obtained with a circumferential approach, which provides the best contour and the highest patient satisfaction. The degree of contouring of specific regions of the thigh depends on the analysis and needs of each patient.

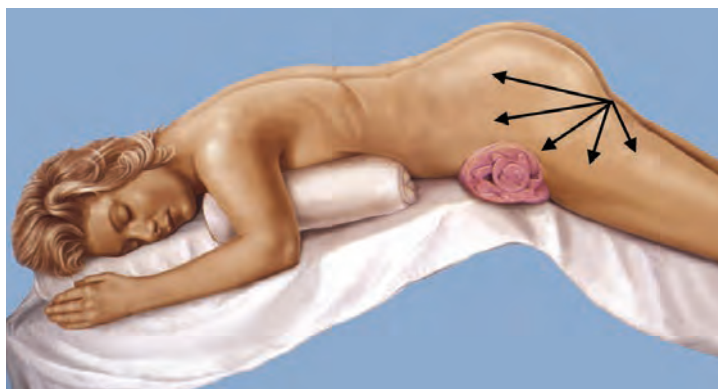


Because the majority of contour irregularities occur within the thigh region, again it is of paramount importance to recognize and understand the significance of the thigh zones of adherence: the lateral gluteal depression; the gluteal crease; the posterior, inferior, and distal lateral thigh; and the mid-inner thigh. In addition to these zones of adherence, the buttock area must also be approached with caution. A uniform reduction of the buttocks can be achieved through cautious treatment of the intermediate layer, resulting in a decrease in anteroposterior buttock projection. Access incisions are placed asymmetrically to avoid an operated look. Avoiding deep, aggressive suctioning and ensuring the length, position, and integrity of the inferior gluteal crease are of critical importance. Overzealous treatment in the deep or superficial plane may result in buttock ptosis. This area is most easily accessed through paraspinous or gluteal access incisions. Excessive contouring of the lateral proximal posterior thigh may result in an extension of the gluteal fold in women and masculinization of the gluteal area.

The surgeon must exercise special care when addressing the proximal posterior thigh. Aggressive suctioning in this difficult area may result in disfiguring skin rolls and redundancy. These problems can be very difficult to correct, requiring either autologous fat grafting or skin excision. In women, overtreatment of this area may elongate the gluteal fold, masculinizing the female silhouette. Suctioning of the lateral thigh and posterior thigh is easily facilitated through the previously described lateral gluteal fold access incision.



This 36-year-old patient underwent previous liposuction elsewhere and was unhappy with the appearance of her buttocks. Overzealous liposuction of the buttocks and proximal posterior thighs resulted in elongation of the gluteal fold and skin fold redundancy of the skin just caudal to the gluteal fold.



For evacuation and further contouring of the lateral thigh, a small midlateral incision may be made if necessary. Treatment of the posterior medial thigh is accomplished through the gluteal access incision with the patient in the prone position. If necessary, a second, more medial incision within the fold may facilitate treatment of this region.



With the patient supine, the anterior and medial thighs may be contoured through an inguinal crease incision and often an incision in the distal medial thigh. A shelf between the lateral and anterior thigh is often created when contouring the lateral thigh in the prone position. This transition should be treated and may be approached

through either the inguinal crease incision or a separate midlateral or anterolateral access incision. The anterior thigh has superficially located, relatively compact fat that has a tendency to develop contour irregularities. It is often necessary to treat the anterior thigh to allow adequate blending of the lateral and anterior thigh to avoid a shelf between the two regions. A more superficial approach within the femoral triangle will avoid injury to the lymphatic structures and prolonged lymphedema.

The medial thigh can be unpredictable with regard to redraping of the skin after liposuction. It is important to maintain a uniform, superficial layer of fat to prevent contour irregularities. Skin tone and quality need to be adequately assessed preoperatively so that the patient will have realistic expectations about liposuction of the medial thighs. In our experience, this is the most difficult area in which to achieve consistent results.

Knees

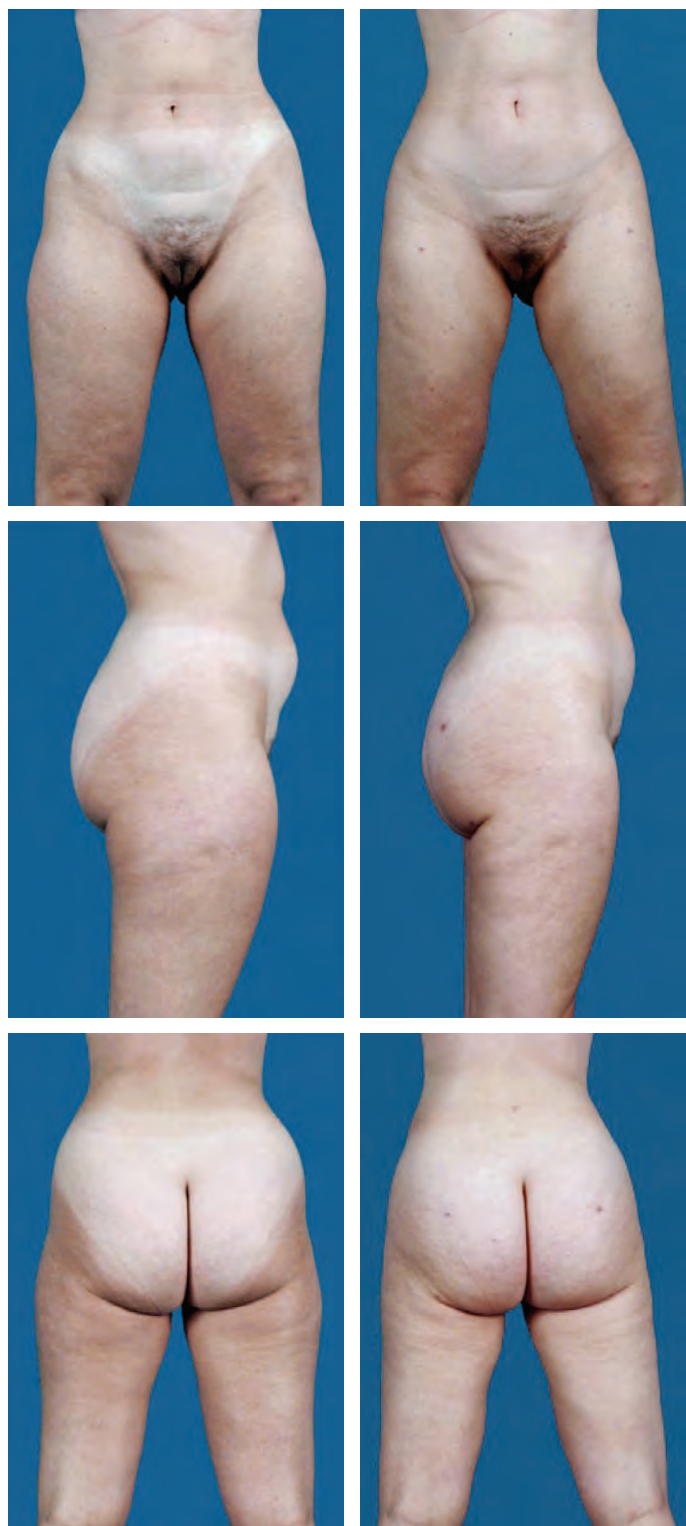


Treatment of the knees varies, depending on the patient's anatomy. Isolated fat of the knee medially is easily treated through a posterior incision with the patient in the prone position. For patients with suprapatellar fullness, the incision is usually placed within a skin fold anteriorly to adequately treat this fibrous area.

Neck

Liposuction in the neck region is often performed with traditional SAL and small cannulas or hand syringe suctioning. Access is typically via a submental incision and often is just posterior to the mandible on either side. Suctioning should proceed in a controlled fashion, and the superficial dermis should be avoided. Continuous assessment of contour is important. Overzealous treatment of this area may result in hollowing and skeletonization of the neck or potential neuropraxia of the marginal mandibular nerve. Fortunately, this is usually reversible and resolves within a few weeks of the procedure.

Results



This 36-year-old woman desired improvement in her abdomen, hips, and thighs. She underwent liposuction with UAL. A total of 3825 ml was infiltrated, and 3650 cc was removed. She is shown 5 months postoperatively.



This 60-year-old woman requested improvement in her abdomen, hips, and thighs. She was in good overall health and had some areas of skin inelasticity. The possibility of skin laxity was discussed with the patient, who wanted to look better in her clothing; 6100 ml was infiltrated and 6600 cc was removed. The patient was monitored overnight. She is shown 6 months postoperatively.



Preoperative

Imaging

9 months postoperatively

This 45-year-old patient had undergone liposuction of her abdomen and thighs approximately 10 years earlier. She had gained about 7 kg (15 pounds) since then and desired further improvement in her abdomen, hips, and thighs. She had some skin laxity of her abdomen but did not desire excisional surgery. She underwent secondary liposuction with UAL; 4300 ml was infiltrated and 4550 cc was removed. She is shown 9 months postoperatively. Particularly noteworthy is the final result in the posterior view.



This 47-year-old woman requested circumferential body contouring of her arms, back, hips, abdomen, and thighs. She underwent UAL/SAL of these regions. A total of 4750 ml was infiltrated and 5035 cc was evacuated. At 6 months postoperatively, her dress size has decreased from 12 to 8, and she has lost approximately 7 kg (15 pounds). Her circumferential trunk and thighs are improved, and modest improvement is seen in her abdomen.



This 32-year-old man requested improvement in his trunk. He underwent liposuction of the abdomen and flanks. A total of 1900 ml was infiltrated, and 1350 cc was evacuated. He is shown 1 year after surgery with improvement in the centralized lipodystrophy of his abdomen and the fullness in his flanks.

Adjunctive Uses of Liposuction

Breast Reconstruction



Liposuction can be a useful adjunct to many other procedures. During breast surgery it is often necessary to contour the lateral chest area. Liposuction may improve the contour and shape of the upper torso.

Flap Debulking



Liposuction may also be useful in flap debulking, specifically in breast reconstruction, as seen in this woman, who had 150 cc of fat removed from her transverse rectus abdominis musculocutaneous (TRAM) flap during a second-stage reconstruction. It is also very useful in treating TRAM flaps that have firm areas consistent with fat necrosis. Treatment may proceed without resorting to direct excision, thereby decreasing or minimizing skin incisions. In the past, these areas have not been amenable to treatment with SAL.

Postoperative Care

At the conclusion of surgery, patients are placed in an appropriate compression garment; some type of compression foam may also be used. In general, patients who have undergone any large-volume procedure (more than 5000 cc of aspirate), liposuction of multiple areas, or liposuction in addition to abdominoplasty or other excisional body contouring procedure are kept overnight for 23-hour observation. Patients are asked to ambulate the night of the surgery; sequential compression devices are placed on the patient in the preoperative holding area and are continued until discharge. The patient is allowed to shower beginning 1 or 2 days postoperatively.

and is instructed to wear the compression garment 24 hours a day for 2 weeks, removing the garment only for bathing. Initial postoperative visits are scheduled for 5 to 7 days postoperatively; the patient may return to activity and work as early as 3 to 4 days or 2 weeks, depending on the procedure. Walking is encouraged immediately, and light exercise is allowed 2 weeks after surgery, unless the patient underwent an associated abdominoplasty. Patients should expect to gain anywhere from 2.25 to 4.5 kg (5 to 10 pounds) after liposuction. Edema tends to peak 3 to 5 days after surgery; bruising should be minimal and dissipate by 7 to 10 days after surgery. Patients should begin to see contour changes in their waist by 2 weeks after the procedure and at 6 weeks be able to appreciate significant changes in their shape. As their activity level improves and necessary lifestyle changes proceed, further changes may be noticed. The final aesthetic result can be seen 3 to 6 months after surgery. Postoperative lymphatic massage is encouraged to help with swelling and induration and is often started before surgery and resumed shortly after the procedure.

Complications

Liposuction is not a procedure without risks. Much attention has been directed toward outcomes and prevention in the past few years, with the ultimate goal of improved results while maintaining patient safety. Complications can vary from mild postoperative nausea and vomiting to deep venous thrombosis/pulmonary embolism and even death. Complications can occur in the perioperative period, early postoperative period, and/or late postoperative period.

In a questionnaire to board-certified members of ASAPS, a significant increase in complications was reported when liposuction was combined with other contouring procedures, most notably when paired with abdominoplasty. Perioperative complications can include anesthesia and cardiac complications, cannula trauma to skin and/or internal organs, and volume loss or overload from bleeding or excess fluid administration. Cannula injury to blood vessels, bowel, and other solid intraabdominal organs has been reported in the literature. Although rare, these complications are related to incomplete preoperative examination (overlooking the presence of a hernia, for example) and overaggressive suctioning or penetration by the infiltration cannula. Hypothermia occurs commonly in liposuction cases. Hypothermia is generally defined as a core body temperature less than 36.4° C (97.5° F). It is common in anesthetized patients as a result of an interthreshold shift in thermoregulation. Its risk is amplified in larger volume cases in which a greater surface area of the patient is exposed at one time and patients are under anesthesia longer. The core body temperature can drop up to 2.8° C (37° F) in the first hours of surgery as a result of the anesthesia effect on autonomic regulation of core temperature. Warming of the wetting and preparation solutions, increase of the ambient temperature, and use of warming devices (Bair Hugger, Arizant, Eden Prairie, MN) all help reduce tem-

perature loss. Prewarming the patient with forced air for 1 hour has also been shown to significantly reduce the incidence of hypothermia.

Fluid management is crucial to the prevention of volume overload and anesthesia-related complications. As stated previously, careful management of intraoperative and postoperative fluids, as well as use of an intraoperative data sheet, helps prevent volume-related complications from liposuction. The tumescent liposuction technique has been implicated in volume overload and pulmonary edema; however, this can often be attributed to incorrect patient selection and/or poor fluid management. Fluid overload and untoward sequelae from large-volume liposuction (more than 5 L) prompted a warning by the ASPS that physicians performing liposuction should be trained in comprehensive fluid resuscitation and the physiology of large-volume liposuction.

Other early postoperative complications can include venous thromboembolism, infection, and skin slough or loss. The incidence of deep venous thrombosis in liposuction has been reported at less than 1%, but a marked increase in this percentage is demonstrated when liposuction is combined with other surgery (such as abdominoplasty or belt lipectomy). Physicians should familiarize themselves with the American College of Chest Physicians (ACCP) current recommendations and the modified Davison-Caprini Risk Assessment models currently available. Administration of enoxaparin has resulted in a decreased incidence of deep venous thrombosis but has been associated with an increased risk of perioperative bleeding and hematoma. Clinical signs of lower extremity swelling, Homan’s sign, shortness of breath, chest pain, and/or tachycardia should alert the provider to the possibility of deep venous thrombosis/pulmonary embolism and warrant immediate evaluation and treatment. Sequential compression devices are placed on all patients in the preoperative holding area and remain in place throughout the procedure and postoperatively while the patient is in bed until the time of discharge.

UT Southwestern Modification of Davison-Caprini Model			
Suggested Revisions to the Davison-Caprini Risk Assessment Model: Exposing Risk Factors			
One Factor	Two Factors	Three Factors	Five Factors
Minor surgery	Major surgery Immobilization Central venous access	Previous MI/CHF Severe sepsis Free flap Circumferential abdominoplasty	Hip, pelvis, leg fracture Stroke Multiple trauma

CHF, Congestive heart failure; MI, myocardial infarction.

Suggested Revisions to the Davison-Caprini Risk Assessment Model: Predisposing Risk Factors

	Number of Factors
Age 40-60 years	1
Age >60 years	2
History of venous thromboembolism	3
Current pregnancy	1
Current malignancy	2
Obesity	2
OCP/HRT	2
Hypercoagulable disorder	3

HRT, Hormone replacement therapy; OCP, over-the-counter progesterone.

Fortunately, wound infections and necrotizing soft tissue infections are rare but have been reported following liposuction. Persistent postoperative fevers and/or cellulitis should be closely monitored and aggressively treated. First-generation cephalosporins are administered perioperatively at our institution within 30 minutes of the incision unless the patient has a known history of methicillin-resistant *Staphylococcus aureus* (MRSA), in which case vancomycin is administered preoperatively.

Late complications of liposuction include delayed seroma formation, edema, ecchymosis, paresthesias, and contour irregularities. Seromas following aggressive liposuction are rare; they are thought to be caused by overzealous treatment of an area, denuding the fascia. It appears to be technique dependent rather than technology specific. A loose closure of cannula sites, postoperative compression garments, and expressing residual fluid over liposuction areas at the end of the procedure can potentially reduce the incidence of seroma formation.

Postoperative edema and ecchymosis occur to a varying extent in all patients. Prolonged edema may be present for up to 3 months after surgery and is best treated with supportive care and lymphatic massage. Postoperative paresthesia/dysesthesia can occur in all forms of liposuction. The sensory changes are usually reversible and can take up to 10 weeks to recover, but recovery is generally felt to be quicker with SAL than with UAL. Paresthesias in newer technologies have not been investigated.

The most common postoperative complication from liposuction is contour deformity or irregularities, which can occur in up to 20% of patients. Mild irregularities are often present after suctioning; these are treated conservatively with lymphatic massage as swelling and edema resolve. Once a contour deformity is identified, it is

best to determine the cause. Treatment can either be directed at reinjecting fat in the overresected region or suctioning the adjacent areas to reduce the prominence of the concavity and blending the adjacent areas. UAL has a decreased incidence of contour deformities compared with traditional SAL in our hands. We prefer UAL for secondary liposuction cases in which fat grafting is not indicated. Careful preoperative analysis and planning help to minimize the risk of postoperative contour irregularity, and thorough patient education about this potential and informed consent are essential.

Emerging Technology

Mesotherapy or lipolysis is an emerging technology, the goal of which is a reduction in fat by dissolution. The concept, which dates back to 1952, involves injection of phosphatidylcholine, deoxycholate, and/or other agents to dissolve fat deposits. It has gained popularity because of its “noninvasive” nature, and the marketing efforts have reached mainstream media and patients. Park et al showed no discernible difference after treatment in lower extremities with mesotherapy by measurement or CT evaluation. Lipodissolve is considered by some (but not all) practitioners to be a variant of mesotherapy. It involves injection of a standardized solution into the subcutaneous fat, rather than the mesoderm. The use of these products in the United States is controversial and is not supported by the FDA. A stern warning from the FDA cautions providers against its unproven use and false marketing claims. Several studies on safety and efficacy are available for review. The common side effects listed include hyperpigmentation and persistent pain; 12% of patients had cosmetic outcomes that were less favorable than expected. Further study and evaluation of safety on all forms of mesotherapy are warranted before clinical use can be endorsed.

Focused external ultrasound therapy is one of the most popular fat-reducing technologies currently being evaluated and has considerable popularity in Israel, Spain, and Japan. Depending on the technology, it can be thermally or non-thermally mediated (by cavitation). There is no “evacuation” phase; the process relies primarily on removal of fat by the body’s own phagocytic mechanisms. Preliminary data by Brown et al have shown it to be effective in a preclinical porcine model, in which the UltraShape device (UltraShape, Tel Aviv, Israel) was target specific for the adipocyte, preserving the surrounding neurovasculature. Two clinical studies have validated its safety. Currently the company is performing a multicenter, prospective, randomized, blinded study evaluating its safety and efficacy.

LipoSonix technology uses high-intensity focused ultrasound (HIFU) to disrupt fat in a thermally mediated mechanism. The device is currently undergoing clinical trials outside the United States and is being marketed in Europe. LipoSonix disrupts fat through a thermocoagulation-mediated mechanism (compared with UltraShape, which acts by cavitation, causing disruption of fat cell membranes). Neither the UltraShape nor LipoSonix is FDA approved or available in the United States.

Liposuction combined with radiofrequency ablation of fat cells is currently being investigated under the trade name BodyTite (New York). The purported benefits are thermal destruction of fat cells, removal via aspiration cannula, and subnecrotic heating of the dermis for skin tightening. This device is not currently approved by the FDA.

Cryolipolysis is a new and vastly different technology currently being evaluated for fat destruction under the trade name Zeltiq (Pleasanton, CA). The concept is a controlled cooling of the subcutaneous fat, with destruction of selective fat cells without epidermal or dermal injury. Zeltiq is currently undergoing evaluation but is not FDA approved.

Unfortunately, the devices mentioned here are still in the preliminary stages of development but represent exciting and novel approaches to noninvasive body contouring. We must keep in mind that until adequate scientific validation of these novel devices is performed outside of the manufacturers' influence, any discussion of potential benefit is strictly advertisement and market driven. As new technology is continually being introduced, we must temper our enthusiasm and base our treatments on solid, scientific evidence. Device manufacturers often provide scant, if any, objective data to support claims such as skin tightening, reduced pain, and improved aesthetic results.

Concluding Thoughts

Liposuction has evolved tremendously over the years since its initial description by Illouz. In the past 25 years there have been significant advances in the techniques and technologies available, resulting in improved safety and outcomes. We are confident that liposuction will remain one of the most popular procedures performed in the years to come. As each new therapy is developed, plastic surgeons must remain committed to the common goals of patient safety and improved aesthetic outcomes.

Clinical Caveats

It is useful to classify patients based on their degree of lipodystrophy and skin redundancy.

Recognition of the zones of adherence is essential. These areas are vulnerable to contour irregularities.

The patient's taking over-the-counter herbal and diet medications may have unfavorable interactions with anesthetics and/or consequences for surgical outcomes.

The intermediate fatty layer is the most common layer treated.

Superficial liposuction should be reserved for significant superficial irregularities and be performed by those experienced in liposuction techniques.

One should avoid treating convexities from adjacent concavities.

The utilitarian access site for UAL is the lateral gluteal fold.

Patients with surgical scars on their abdomen must be thoroughly examined to rule out the presence of a hernia.

Treatment with UAL begins superficially and ends in the deeper plane. In contrast, evacuation proceeds from the deeper layers to the more superficial layers.

The compression garment should first be removed with the patient in the supine position to avoid a vagal response.

Incorporation of a diet and exercise program in conjunction with liposuction will allow patients to achieve their optimal shape and contour.

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This review of a very common problem has completely changed the way we practice. It is not only educational but also something you can and should incorporate into your practice.

Suggested Readings

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CHAPTER 79



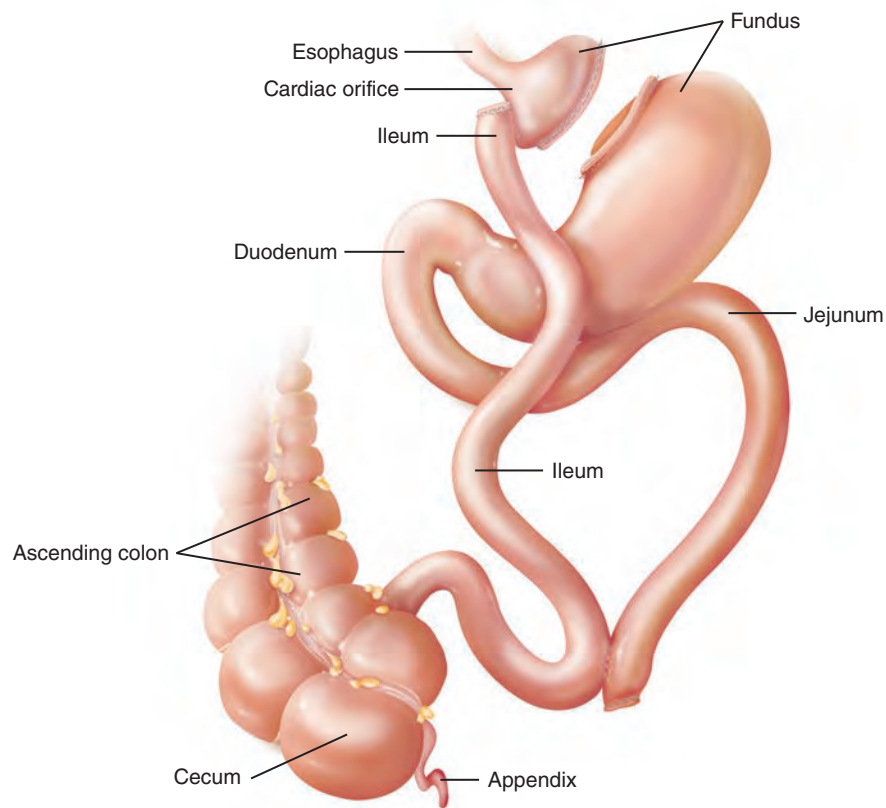
Screening and Safety Issues in the Massive-Weight-Loss Patient

JOSEPH F. CAPELLA, MATTHEW J. TROVATO,
SCOTT WOHRLE

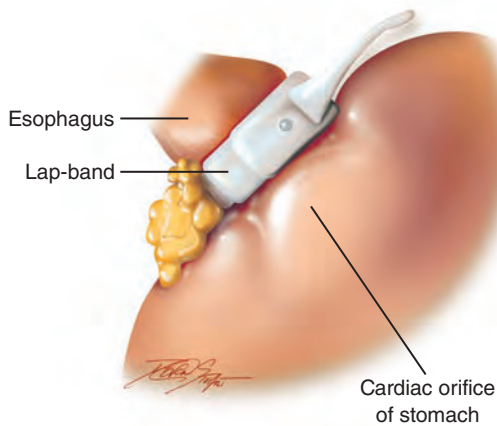
Postbariatric patients represent a distinct population of plastic surgery patients. Unlike routine body-contouring candidates, who are usually healthy and have relatively mild deformities, postbariatric patients frequently have a history of significant illness and virtually all have major contour deformities. The techniques for managing facial aging and characteristic body contour deformities of most postpartum women have become well honed through decades of plastic surgery training. Many of the body-contouring procedures for treating patients after massive weight loss are relatively new and are evolving quickly, and few plastic surgeons have had significant exposure to them during training. It is also generally recognized that postbariatric procedures are associated with higher rates of complications. The combination of improved techniques in bariatric surgery and a worsening epidemic of obesity in the United States has led to a significant increase in demand for body-contouring procedures. Thus it has become increasingly important for plastic surgeons to have a protocol in place to screen and manage these individuals safely.

Effective evaluation of postbariatric patients requires some familiarity with morbid obesity and the surgical procedures commonly available to treat this condition. Most morbidly obese individuals have been obese since adolescence, and some even since childhood. These patients often have a number of comorbidities, including hypertension, diabetes mellitus, sleep apnea, and urinary incontinence.

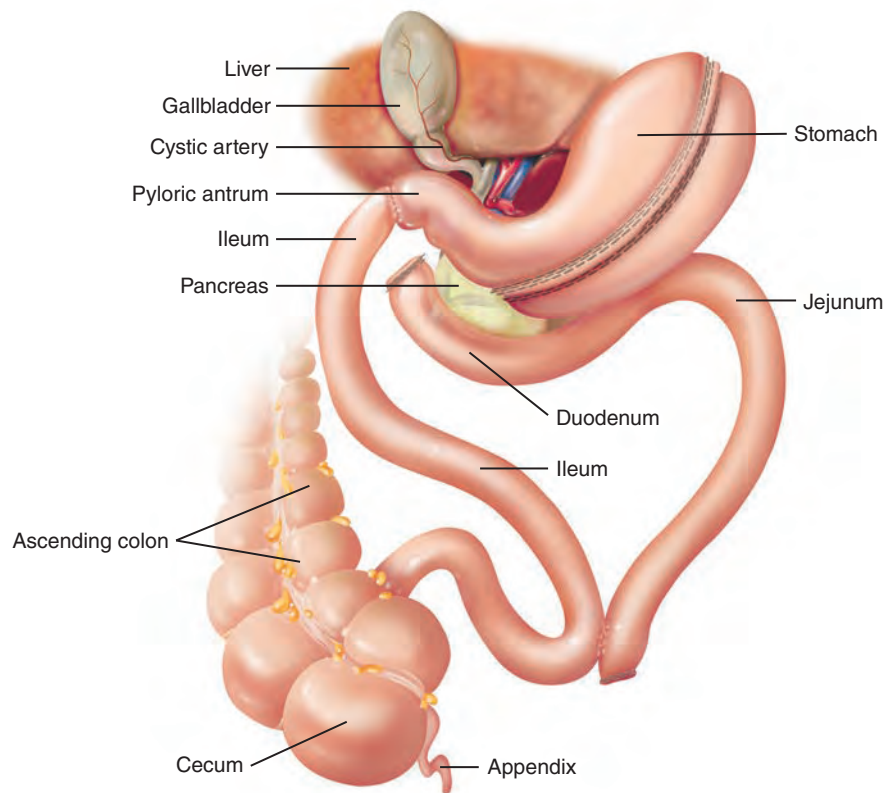
Conditions Associated With Morbid Obesity	
Asthma	Hypertension
Back and disc disease	Increased risk for carcinomas
Cardiac and peripheral vascular disease	Intertriginous dermatitis
Cholelithiasis	Male and female endocrine and reproductive disorders
Depression	Obesity hypoventilation syndrome
Diabetes mellitus/impaired glucose tolerance	Peripheral osteoarthritis
Dyslipidemia	Peripheral venous insufficiency
Fatty metamorphosis, cirrhosis, and carcinoma of the liver	Pseudotumor cerebri and carpal tunnel syndrome
Gastroesophageal reflux disease	Sleep apnea



Following weight loss, these conditions may be cured, improved, or stabilized. Last year more than 220,000 surgical procedures were performed in the United States to treat morbid obesity. The present criterion (suggested by the National Institutes of Health and adapted by health insurance providers) for surgery requires that patients have a body mass index (BMI) of 40 or greater. Those with a BMI as low as 35 may qualify if they have a disease-related comorbidity, such as hypertension or diabetes mellitus. Many variations of bariatric procedures have been performed over the past several decades. At present, gastric bypass surgery is the benchmark procedure and is the most commonly performed. Ten years ago, gastric bypass was usually performed as an open procedure; today it is commonly done laparoscopically.

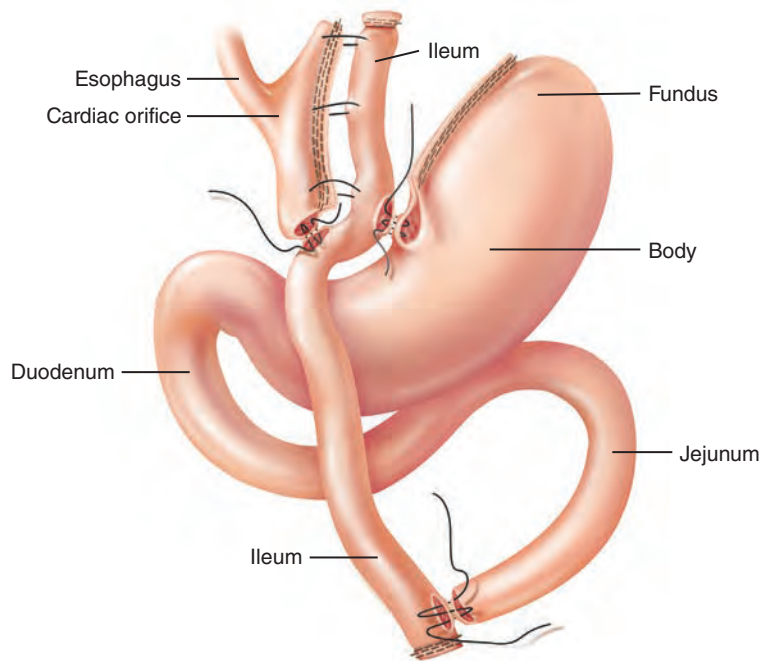


In recent years laparoscopic adjustable gastric banding (LAGB) has gained popularity. In some centers, it is now the most commonly performed bariatric procedure.



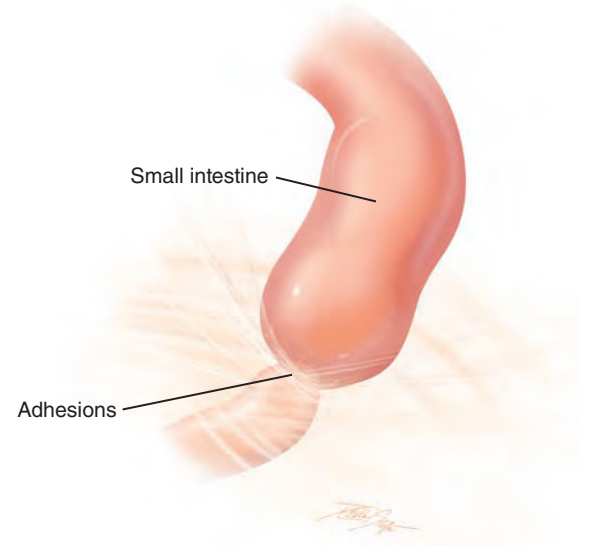
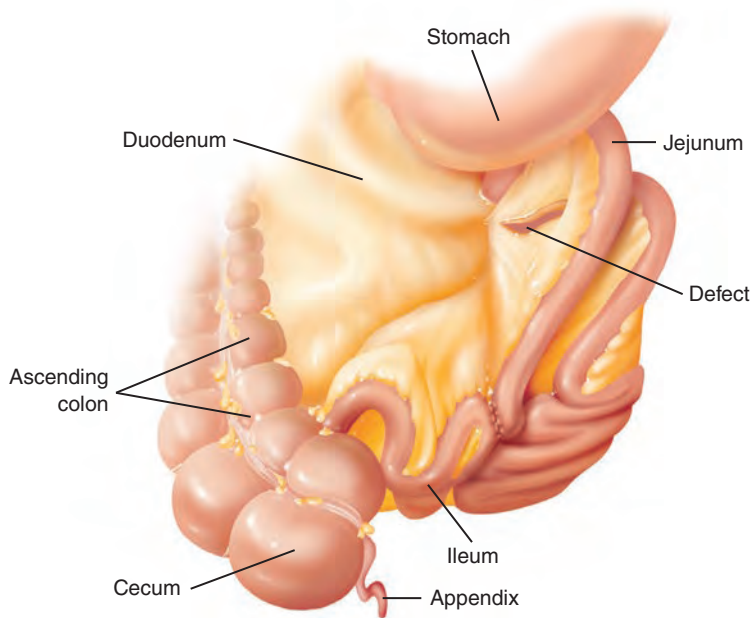
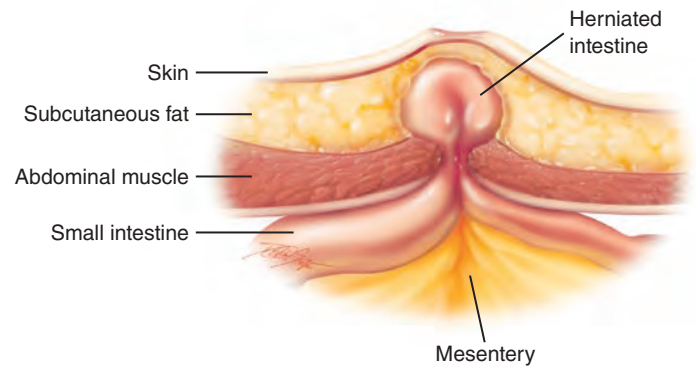
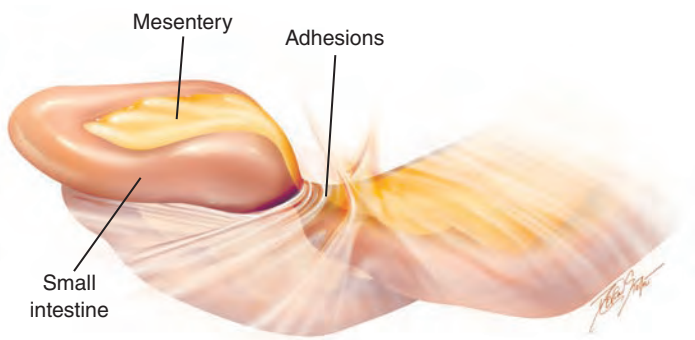
A less common procedure is biliopancreatic diversion with duodenal switch (BPD-DS). Each of these techniques is associated with different rates of weight loss and complications. Therefore each procedure has separate implications for plastic surgeons.

Gastric bypass surgery produces rapid weight loss during the first 8 to 10 postoperative months, with some patients reaching their lowest weight during this time. Generally, patient weights stabilize 12 to 18 months after the operation. Weight loss with this procedure is achieved through the restriction of food intake and some degree of malabsorption.



Average weight loss following a standard gastric bypass procedure is 60% to 65% of excess weight at 5 years postoperatively and 77% with the banded form of gastric bypass. At 5 years, the typical patient has regained approximately 10% of the excess weight lost. Particularly during the rapid phase of weight loss, gastric bypass patients may have hypoproteinemia. Iron- and folate-deficiency anemias are very common among women after gastric bypass, particularly menstruating women. These side effects can be further complicated by abnormal and frequent vomiting. Supplementation with multivitamins, iron, folate, thiamine (B_1), B_{12} , and calcium is usually prescribed.

After the open form of gastric bypass, incisional or ventral hernias can be found clinically in as many as 10% of patients. This number may be slightly higher on exploration of the abdominal wall fascia during a body-contouring procedure. These forms of hernia rarely lead to bowel obstruction. Internal hernias are a concern after laparoscopic gastric bypass surgery. Most likely because of minimal adhesion formation, after a laparoscopic gastric bypass operation the small bowel has a greater tendency to herniate through mesenteric defects. The frequency of internal hernias appears to be highest during the period patients usually reach their lowest weight, 18 to 36 months postoperatively—often when body-contouring procedures are being performed. A high index of suspicion is necessary to diagnose a hernia promptly. Patients may present with episodic bouts of moderate to severe pain as the bowel becomes partially or completely strangulated in the hernia. Surgeons must not attribute pain of this nature to routine postoperative discomfort. A late diagnosis can lead to necrotic bowel and possibly death.



Various forms of obstruction after gastric bypass surgery are shown: twisting of the bowel around isolated bands or adhesions, incarcerated incisional hernia (trocar hernia), scar formation or fibrosis at the mesenteric defect, and bowel obstruction without a closed-loop component caused by adhesions. Twisting of the bowel, incisional hernia, and scar formation or fibrosis are more common after laparoscopic gastric bypass surgery. Bowel obstruction without a closed-loop component caused by adhesions is more common following open gastric bypass surgery.

In LABG, an adjustable silicone ring is placed around the stomach immediately below the esophagogastric junction. A filler tube from the band traverses the abdominal wall and is connected to a port that is secured to the abdominal fascia and is accessed by transcutaneous injections. The gastric band is inflated and deflated by adding and removing saline solution. Typically the port is placed in a paramedian position, often subcostally. Weight loss is achieved purely through the restriction of food intake and is much slower than with a gastric bypass procedure. A stable reduced weight may take as long as 3 years to achieve. On average, LABG patients have lost 30% to 54% of their excess weight at 5 years postoperatively. The nutritional disorders described for gastric bypass patients are also associated with LABG but are generally less severe, unless there are complications. The band may move from its desired position or cause a stricture, leading to excessive narrowing of the stomach and subsequent vomiting. Some dilation of the esophagus may occur in many gastric-banding patients. The plastic surgeon and anesthesiologist should be aware of this, because aspiration may be of particular concern during intubation.

BPD-DS produces weight loss by some degree of food intake restriction and significant malabsorption. The technique is effective, with patients averaging 73% loss of excess weight at 5 years. However, this procedure is associated with more significant nutritional deficiencies than the two previously described techniques. In particular, the absorption of calcium, vitamin D, protein, and fat-soluble vitamins is more affected. The relatively large gastric pouch resulting from this procedure may allow patients to consume foods at their presurgical rate, leading to frequent, foul-smelling, bulky stools and significant diarrhea.

Postbariatric patients will differ in their comorbidities and postoperative status; some may have significant residual disease from morbid obesity, and others will not. In addition, sequelae from bariatric surgery will vary from patient to patient. An understanding of morbid obesity and bariatric surgery will help the surgeon determine the appropriate management of each massive-weight-loss patient.

Screening

My approach to screening and evaluating postbariatric patients involves a minimum of two office visits: an initial consultation and a preoperative visit, and at least one outside consultation. Throughout this process, patients are encouraged to communicate concerns to the office and to include family members, loved ones, and caregivers.

Initial Consultation

The initial consultation serves multiple purposes: I establish rapport with the patient, obtain a medical and social history, perform a physical examination, and gain an understanding of the patient's goals. Ideally, at the conclusion of this first visit, a preliminary plan can be provided to the patient.

History

Along with a medical and social history, a detailed weight history should be obtained (see p. 2805). Critical information includes the patient's height, current weight, and highest weight. The interval between his or her highest and current weights and the length of time at the current weight should be documented. If weight loss was achieved through bariatric surgery, the technique and when it was performed should be noted. Other important information includes whether the individual is being followed by a bariatric surgeon and the date of the patient's last visit. If supplemental medication was prescribed, is the patient taking it regularly? Problems potentially related to bariatric surgery should be explored, such as frequent vomiting, abdominal pain, weakness, light-headedness, and frequent bowel movements. For patients who have lost weight through lifestyle changes, how this was accomplished should be documented—exercise, diet and exercise, or medication—and whether the patient is being supervised by a professional.

Physical Examination

The examination of a postbariatric patient should be thorough, with particular attention to areas typically affected by weight loss. A standardized examination form is helpful (see pp. 2806-2807). The presence of intertriginous dermatitis should be noted. Lymphedema and/or the stigmata of lymphedema are documented, as are varicosities. Existing scars should be described, particularly abdominal scars. The surgeon should assess for abdominal wall hernias. This portion of the examination can often be challenging because of the presence of a large pannus. Routine maneuvers to identify hernias, such as having the patient attempt to sit up from a supine position, can be very helpful.

Patient Goals

The average patient age in my postbariatric practice is 39. Most of these individuals are very active and eager to minimize their time off from work and time away from family obligations. It is quite common for a patient to express concerns about multiple areas of the body and to ask how quickly all of the areas can be addressed. Perhaps the most important component of screening and minimizing risk in a postbariatric patient is the selection of the most appropriate procedure or combination of procedures and their sequence.

PATIENT INTAKE FORM: WEIGHT INFORMATION

Patient name _____ Date _____

Height _____ Current weight _____ Highest weight _____

Length of time to achieve current weight _____

Length of time at current weight _____

METHOD OF WEIGHT LOSS**1. Bariatric surgery**

Date of surgery _____

a. Gastric bypass: Open _____ / Laparoscopic _____

b. Laparoscopic gastric banding _____

c. Biliopancreatic diversion _____

d. Gastric sleeve _____

e. Vertical banded gastroplasty _____

2. Lifestyle change

a. Diet _____

b. Exercise _____

c. Medication _____

d. Other _____

e. Professional supervision YES / NO

Last visit with bariatric surgeon _____

Do you have any problems that you believe may be related to your bariatric surgery? If so, please list:

Were supplemental medications prescribed? YES / NO

Please list all medications and note whether you are currently taking them:

PHYSICAL EXAMINATION FORM

Patient name _____ Date _____

ARMS

Striae:	Left:	Yes	No	Right:	Yes	No
Scars:	Left:	Yes	No	Right:	Yes	No
Skin excess:	Left:	None	Mild	Moderate	Severe	
	Right:	None	Mild	Moderate	Severe	
Lipodystrophy:	Left:	None	Mild	Moderate	Severe	
	Right:	None	Mild	Moderate	Severe	

AXILLA / FLANK

Skin excess:	Left:	None	Mild	Moderate	Severe
	Right:	None	Mild	Moderate	Severe
Lipodystrophy:	Left:	None	Mild	Moderate	Severe
	Right:	None	Mild	Moderate	Severe

BREAST

Current breast size: _____ Desired breast size: _____

Excess grams of breast tissue: Left _____ Right _____

Diameter of NAC: Left _____ Right _____

Distance from sternal notch to nipple (normal 23-25 cm): Left _____ Right _____

Distance from IMF to nipple (normal 10-12 cm): Left _____ Right _____

Distance from midline to nipple (normal 10-12 cm): Left _____ Right _____

Scars:	Left:	None	Biopsy	Inverted T	Vertical	Periareolar	IM	Axillary
	Right:	None	Biopsy	Inverted T	Vertical	Periareolar	IM	Axillary

Breast ptosis:	Left:	None	Grade I	Grade II	Grade III	Pseudoptosis
	Right:	None	Grade I	Grade II	Grade III	Pseudoptosis

Lymphadenopathy:	Left:	None	Axillary	Supraclavicular
	Right:	None	Axillary	Supraclavicular

Palpable mass:	Left:	Yes	No	Right:	Yes	No
Nipple discharge:	Left:	Yes	No	Right:	Yes	No
Shoulder grooving:	Left:	Yes	No	Right:	Yes	No

Baker capsular contracture:	Left:	None	Mild	Moderate	Severe
	Right:	None	Mild	Moderate	Severe

Gynecomastia:	Left:	Type:	I	II	III	IV	Hypertrophy:	A	B	C
	Right:	Type:	I	II	III	IV	Hypertrophy:	A	B	C

Tuberous breast:	Left:	None	Mild	Moderate	Severe
	Right:	None	Mild	Moderate	Severe

ABDOMEN

Striae:	Yes	No
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Scars:	None	Midline	Epigastric	Hypogastric	Chevron
	Lt Subcostal	Rt Subcostal	Lt Paramedian	Rt Paramedian	
	Lt Inguinal	Rt Inguinal	Pfannenstiel	Abdominoplasty	
	Laparoscopic	Appendix			

Hernia:	None	Ventral	Incisional	Umbilical	Lt Inguinal	Rt Inguinal
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Skin excess:	None	Mild	Moderate	Severe
Lipodystrophy:	None	Mild	Moderate	Severe
Fascial laxity:	None	Mild	Moderate	Severe
Intertriginous dermatitis:	Yes	No		

HIPS

Striae:	Left:	Yes	No	Right:	Yes	No
Scars:	Left:	Yes	No	Right:	Yes	No
Skin excess:	Left:	None	Mild	Moderate	Severe	
	Right:	None	Mild	Moderate	Severe	
Lipodystrophy:	Left:	None	Mild	Moderate	Severe	
	Right:	None	Mild	Moderate	Severe	

PHYSICAL EXAMINATION FORM—cont'd

Patient name _____ Date _____

BACK	Skin excess:	Left:	None	Mild	Moderate	Severe	
		Right:	None	Mild	Moderate	Severe	
	Lipodystrophy:	Left:	None	Mild	Moderate	Severe	
		Right:	None	Mild	Moderate	Severe	
	Sacral fat pad:	Yes	No				
BUTTOCKS	Skin excess:	Left:	None	Mild	Moderate	Severe	
		Right:	None	Mild	Moderate	Severe	
	Lipodystrophy:	Left:	None	Mild	Moderate	Severe	
		Right:	None	Mild	Moderate	Severe	
	Ptosis:	Left:	None	Mild	Moderate	Severe	
		Right:	None	Mild	Moderate	Severe	
THIGHS	Vericose veins:	Left:	Yes	No	Right:	Yes	No
ANTERIOR	Cellulite:	Left:	None	Mild	Moderate	Severe	
		Right:	None	Mild	Moderate	Severe	
	Skin excess:	Left:	None	Mild	Moderate	Severe	
		Right:	None	Mild	Moderate	Severe	
Lipodystrophy:	Left:	None	Mild	Moderate	Severe		
	Right:	None	Mild	Moderate	Severe		
POSTERIOR	Cellulite:	Left:	None	Mild	Moderate	Severe	
		Right:	None	Mild	Moderate	Severe	
	Skin excess:	Left:	None	Mild	Moderate	Severe	
		Right:	None	Mild	Moderate	Severe	
Lipodystrophy:	Left:	None	Mild	Moderate	Severe		
	Right:	None	Mild	Moderate	Severe		
MEDIAL	Cellulite:	Left:	None	Mild	Moderate	Severe	
		Right:	None	Mild	Moderate	Severe	
	Skin excess:	Left:	None	Mild	Moderate	Severe	
		Right:	None	Mild	Moderate	Severe	
Lipodystrophy:	Left:	None	Mild	Moderate	Severe		
	Right:	None	Mild	Moderate	Severe		
LATERAL	Cellulite:	Left:	None	Mild	Moderate	Severe	
		Right:	None	Mild	Moderate	Severe	
	Skin excess:	Left:	None	Mild	Moderate	Severe	
		Right:	None	Mild	Moderate	Severe	
Lipodystrophy:	Left:	None	Mild	Moderate	Severe		
	Right:	None	Mild	Moderate	Severe		
LEGS	Skin excess:	Left:	None	Mild	Moderate	Severe	
		Right:	None	Mild	Moderate	Severe	
	Lipodystrophy:	Left:	None	Mild	Moderate	Severe	
		Right:	None	Mild	Moderate	Severe	
Lymphedema:	Left:	None	Mild	Moderate	Severe		
	Right:	None	Mild	Moderate	Severe		

Formulating a Plan

The information gathered by the patient history and physical examination can now be used to formulate a preliminary plan. The patient's BMI at presentation is one of the most important variables in determining the appropriate course to take in managing a postbariatric patient's contour deformities. My data from the body-lift procedure indicate that individuals with lower BMIs at the time of body-contouring surgery have fewer complications.

BMI and Outcome Data Associated With Body Lift

	Patients	Percentage	LOS (days)	Drain Duration (days)	Complications (%)	Dehiscence (%)	Seroma (%)	Skin Necrosis (%)	Infection (%)	Bleeding (%)	DVT (%)	PE (%)	Transfusions (%)
Total	425*	100.00	2.74	23	49.65	27.29	20.94	8.47	4.94	2.59	2.35	1.18	12.94
Women	361	84.94	2.70	22	40.94	27.42	18.56	9.14	4.99	2.22	2.22	1.39	11.91
Men	64	15.06	2.98	27	57.81	26.56	34.38	4.69	4.69	4.69	3.13	0.00	18.75
Type 1	207	48.71	2.44	21	44.44	25.60	16.91	10.14	3.86	1.45	0.97	0.00	8.21
Type 2	126	29.65	2.84	25	51.59	26.98	26.19	5.56	3.17	3.97	3.97	1.59	15.87
Type 3	92	21.65	3.29	25	58.70	31.52	22.83	8.70	9.78	3.26	3.26	3.26	19.57
Nonsmokers	363	85.41	2.75	23	47.93	26.17	19.83	7.44	5.51	3.03	2.75	1.38	14.05
Type 1 NS	172	83.09	2.35	22	41.86	25.00	15.70	6.98	4.07	1.74	1.16	0.00	8.14
Type 2 NS	110	87.30	2.92	25	50.91	25.45	26.36	6.36	3.64	4.55	4.55	1.82	17.27
Type 3 NS	81	88.04	3.37	25	56.79	29.63	19.75	9.88	11.11	3.70	3.70	3.70	22.22
Smokers	62	14.59	2.68	21	59.68	33.87	27.42	14.52	1.61	0.00	0.00	0.00	6.45
Type 1 S	35	16.91	2.91	20	57.14	28.57	22.86	25.71	2.86	0.00	0.00	0.00	8.57
Type 2 S	16	12.70	2.31	22	56.25	37.50	25.00	0.00	0.00	0.00	0.00	0.00	6.25
Type 3 S	11	11.96	2.73	24	72.73	45.45	45.45	0.00	0.00	0.00	0.00	0.00	0.00

Type 1: BMI <28; type 2: BMI ≥28 and <32; type 3: BMI ≥32.

*Body lift: A simultaneous abdominoplasty with a thigh and body lift.

DVT, Deep venous thrombosis; LOS, length of stay; PE, pulmonary embolus.

I prefer to perform a body lift first as a single procedure, then follow with a combination mastopexy/flankplasty/brachioplasty at least 3 months later. A medial thigh lift, if necessary, would be done at least 3 months after that. Although I think the aesthetic results may be best with this combination and sequence of procedures, primarily because opposing vectors of tension are avoided, many individuals request that their management be limited to two operations, or even one. In an effort to accommodate patient wishes and minimize complications, I make different options available based on BMI. For individuals with a BMI of less than 28, I consider per-

forming upper body work along with a body lift and in some instances a medial thigh lift. For those with a BMI between 28 and 32, upper body work is considered with a body lift, and for those with a BMI above 32 and below 35, I advise a procedure limited to a body lift. Individuals with a BMI greater than 35 are usually candidates for an abdominoplasty rather than a body lift. In this heaviest group of patients, I often consider avoiding fascial plication to facilitate early ambulation.

Contouring Options Available to Appropriate Candidates

BMI <28	BMI 28 to 32	BMI ≥32	BMI >35
Body lift (combination abdominoplasty, thigh and buttock lift)	Body lift	Body lift	Abdominoplasty alone (possibly without fascial plication)
Mastopexy/flankplasty/brachioplasty combination	Mastopexy/flankplasty brachioplasty combination		Body lift alone (possibly without fascial plication)
Medial thigh lift			

BMI criteria are less important for individuals seeking specific upper body procedures alone, such as mastopexy, brachioplasty, and facial procedures. I avoid performing facial procedures with extensive body contouring. A surgeon's experience as well as those assisting in the surgery should factor into what the appropriate approach should be.

Before a patient is considered for any procedure, certain criteria must be met and issues addressed. The patient should be at a stable weight for at least several months. This will vary, depending on the bariatric procedure. Operating during a period of active weight loss may result in an early recurrence of soft tissue laxity, and from a safety perspective, the patient's nutritional and metabolic status is unlikely to be optimal. Patients with symptoms indicating problems related to bariatric surgery should be evaluated by their bariatric surgeon. Those with a history of major or acute mental illness are referred for evaluation by an appropriate health professional. Patients are advised to maintain the supplemental regimen prescribed by their bariatric surgeon. Individuals who use tobacco are urged to stop as soon as possible. The risks of tobacco regarding wound healing and thromboembolic disease are clearly established in the literature and are explained to the patient. I prefer to have patients stop taking any medications that are part of their weight-loss protocol. All patients are referred for medical clearance. Although weight loss dramatically improves the health of morbidly obese individuals, not all medical conditions are resolved by weight loss. Neurologic problems are not uncommon following bariatric surgery, potentially affecting both the central and peripheral nervous systems. Foot drop has been reported following weight loss, and peripheral neuropathies have been described after rou-

tine postbariatric body-contouring procedures in which standard positions and precautions have been used. A careful evaluation of their health is imperative. A consultation with a general or bariatric surgeon may be requested if an abdominal wall hernia has been found.

After I discuss the proposed plan with the patient, we review several topics together. Many individuals are eager to lose more weight before they undergo surgery in the belief that their surgery would be safer and that more skin could be removed if they were at a lower weight. I think that most people whose weight is stable (variation of less than 10 pounds for 3 to 6 months) at the time of consultation are at the weight they are most likely to maintain over the long term. Although many postbariatric patients can lose weight for relatively brief periods—several months, perhaps a year—long-term additional weight loss after bariatric surgery or through lifestyle changes is difficult to achieve. An individual losing weight in short period of time can have several undesirable outcomes. First, he or she may become nutritionally and metabolically unbalanced just at the time body-contouring surgery is to be performed. Second, weight gain in the future will in most instances diminish the aesthetic results of a body-contouring procedure. I advise patients to eat a balanced diet and maintain a stable weight.

I explain that a certain amount of excess soft tissue will be removed during surgery. Their new weight after surgery should be their current weight minus the weight of the tissue removed. If their weight at their 3-month postoperative follow-up is similar to their weight at consultation, this suggests a significant weight gain. I also explain that there will inevitably be some recurrence of skin laxity and that the long-term results of surgery are best maintained by weight stability, avoiding tobacco use, and minimizing exposure to sun (UV light). Scars should not be exposed to UV light while they remain pigmented; UV light will cause or prolong further pigmentation. Once scars have faded to the color of the surrounding skin, they may be exposed to UV light without risk of hyperpigmentation. In general, UV light always accelerates the aging (or damage) of skin. I conclude by giving patients an overview of the most frequent complications associated with each procedure and the relevance of BMI.

Laboratory Workup

A patient history can often suggest problems; however, a thorough laboratory workup is essential for identifying existing deficiencies or abnormalities. It is not unusual for menstruating women to have few if any symptoms despite having severe anemia after bariatric surgery. Along with a complete blood cell count and other studies, our routine includes a complete metabolic panel. Abnormal laboratory values are acted on as they are made available. Individuals found to be malnourished, with a total protein level less than 6 g/dl and/or albumin level less than 3 mg/dl, may be referred to their bariatric surgeon for reevaluation and possible nutritional supplementation. Those findings may be corroborated by edema on physical examination. Protein-depleted patients may have difficulty with wound healing. Severely anemic patients,

those with a hemoglobin less than 10 g/dl, are referred to their primary physician and/or a hematologist. Patients with a hemoglobin level above 10 g/dl are advised to continue on iron, folate, and B₁₂ supplementation and to have their blood cell count repeated in a week. Our preference is for patients to have a hemoglobin level above 12 g/dl before surgery.

Patients are advised of the possible need for a blood transfusion after the operation. I do not have patients bank their own blood. In most institutions, blood can only be given within 1 month of surgery, and 1 month may not be adequate for an anemic patient to replenish his or her blood levels.

Preoperative Visit

At the preoperative visit, usually 2 weeks before surgery, the planned surgical procedure is reviewed in detail, as are the potential complications. The results of requested consultations and recommendations are discussed with the patient. Another critical function of the preoperative visit is to review photographs taken at the first consultation. Patients rarely have a completely accurate sense of their deformities. Key elements of this discussion are to highlight existing asymmetries, which in some cases cannot be completely corrected; review the extent of their deformities; and explain the degree to which the planned procedure or procedures will address their deformities. I prefer not to morph patient images on the computer but rather to show examples of individuals with similar body types who have had the same procedures. Restrictions and recovery guidelines are reviewed. Patients often have the sense that recovery from surgery should involve a lengthy period of bed rest. I emphasize the importance of frequent ambulation. Medications that should be avoided before surgery are reviewed: those that increase the risk of bleeding, such as aspirin and non-steroidal antiinflammatory agents, and those that increase the risk of DVT, such as birth control pills or hormone replacement therapy. Patients are advised not to take any of these medications for 2 weeks before or after surgery. I conclude with a plan for DVT prophylaxis.

Deep Venous Thrombosis Prophylaxis

My approach to DVT prophylaxis is derived from my own data and currently suggested guidelines. My experience confirms the published reports that abdominoplasty creates a significant risk for DVT. Having performed routine lower extremity venous Doppler studies on well over 400 postabdominoplasty patients, I have found a correlation between the patient's presenting BMI and the likelihood of thromboembolic disease (see the table on p. 2808). Therefore, in my practice, patients undergoing an abdominoplasty or body lift alone or with additional procedures and who have a BMI of less than 28 on presentation are not given chemoprophylaxis preoperatively or postoperatively. Instead, a lower extremity venous Doppler study is performed before discharge from the hospital, typically 1 or 2 days postoperatively. Those with a BMI between 28 and 32 are given enoxaparin 40 mg subcutaneously beginning

approximately 12 hours after surgery and each day during their stay in the hospital or recovery facility. Once again, a lower extremity venous Doppler study is performed before discharge. Patients with a BMI above 32 who are undergoing abdominoplasty and/or a body lift follow the same regimen as the previous group but are kept on enoxaparin 40 mg subcutaneously for 10 to 14 days after surgery. Patients with a BMI greater than 32 undergoing a single procedure, such as mastopexy, brachioplasty, or a combination of the two, are given a single preoperative dose of heparin 5000 units subcutaneously before surgery. I perform these procedures or the combination of the two on an outpatient basis. For the combination of brachioplasty, mastopexy, and medial thigh lift, patients with a BMI above 32 are given enoxaparin 40 mg subcutaneously 12 hours after surgery. These patients are typically observed overnight. Lower extremity venous Doppler studies are not routinely performed in non-abdominoplasty/body lift patients. I have chosen not to provide chemoprophylaxis to all patients because of anecdotal observations about increased bleeding with these medications. For similar reasons, ketorolac tromethamine is not used. Patients with a history of DVT and/or PE, a family history of thrombosis or blood-clotting disorders, varicose veins, lower extremity swelling, and recent air travel should be managed on a case-by-case basis.

Deep Venous Thrombosis, Chemoprophylaxis, and Surveillance

	BMI <28	BMI 28 to 32	BMI ≥32
Abdominoplasty or body lift with or without other procedures	No perioperative chemoprophylaxis Lower extremity venous Doppler exam on POD 1	Enoxaparin 40 mg 12 hr postoperatively Lower extremity venous Doppler exam on POD 1	Enoxaparin 40 mg 12 hr postoperatively Lower extremity venous Doppler exam on POD 1 Enoxaparin 40 mg SQ for 14 days postoperatively
Brachioplasty, mammoplasty, thighplasty (any of the procedures alone or a combination of two)	No perioperative chemoprophylaxis	No perioperative chemoprophylaxis	Heparin 5000 units SQ preoperatively (patient usually discharged home)
Brachioplasty/mammoplasty/thighplasty combination	No perioperative chemoprophylaxis	No perioperative chemoprophylaxis	Enoxaparin 40 mg SQ postoperatively (patient usually observed overnight)

POD, Postoperative day; SQ, subcutaneously.

Perioperative Management

Preoperative

Before surgery, patients are marked and scar locations are reviewed, usually for the third time. In cases in which a mastopexy/reduction is being performed, I have the patient reconfirm her desired breast size. If chemoprophylaxis is to be given, it should be administered at this time. If shaving is to be performed, usually the redundant mons pubis, it should be done now. Patients are discouraged from shaving in the 48 hours before surgery to diminish the risk of skin infections.

Intraoperative

Intraoperatively the focus is on minimizing the length of procedure, patient exposure, blood loss, proper patient positioning, and DVT prophylaxis. The room is kept at a comfortable temperature for the patient, usually at least 24° C (75° F). The patient's skin is cleansed while standing with povidone-iodine (Betadine) to minimize the time spent preparing and draping during a surgery involving multiple areas. Sequential compression devices are placed and activated before induction of anesthesia. Intravenous antibiotics are given immediately after placement of the intravenous catheter. Fluids are warmed, and a Bair Hugger and operative table warming blanket are used whenever possible. Blood loss is kept to a minimum by meticulous hemostasis and the use of two electrocauteries, for the surgeon and assistant, set to a relatively high level. Pressure points are carefully padded, and extremities are positioned cautiously during maneuvers to rotate the patient.

Certain circumstances may arise during surgery, some planned and others not, that must be addressed. A post-LAGB patient will have a port that nearly always must be moved to effectively address abdominal wall fascial laxity. Routine midline plication of the abdominal fascia in an LAGB patient may render the port inaccessible. In these patients, the port should first be detached from the fascia by dividing the nonabsorbable sutures. The plication should then be performed as usual, with careful attention to the tube location and verification throughout the process that the tube can move freely. After plication, the port should be resecured with nonabsorbable sutures in a subcostal position. The prominence of the costal margin makes the port less discernible. Lower-BMI individuals may have concerns about the perceptibility of the port. In these patients, the outline of the port may be visible along the anterior abdominal wall. The port may be exchanged for a lower-profile version. If this is to be done, the lower-profile port should be available preoperatively, and obtaining the assistance of a bariatric surgeon for the exchange should be considered.

Ventral hernias may be discovered during elevation of the abdominal pannus that were not evident during preoperative evaluation. I have found that for small incisional fascial defects, where preperitoneal fat is adherent to the fascial edges, no particular maneuver is necessary. The fascial plication can be performed as usual, with the sutures carefully placed through the rectus sheath overlying the rectus muscle. Rectus diastasis can be considerable in these patients. For larger fascial defects, particular those in which the hernia contents readily protrude through the defect, repair is required. The hernia sac contents are separated from the hernia sac, the fascial edges are approximated without tension, and a standard plication is performed. Routine hernias (those not involving a loss of tissue) in a postbariatric patient rarely require mesh for repair. An intraoperative consultation may be sought if an unexpected hernia is discovered.

Postoperative

In the immediate postoperative period, the patient should be assessed for anemia, hypovolemia, and hypothermia. Warming techniques like those used during surgery should be used. Vital signs, urine output, and drainage output should be monitored closely. Only three postoperative doses of antibiotics are routinely given. Following postbariatric body-contouring procedures, significant blood loss may occur from oozing. Tissue surfaces with the potential for bleeding can be extensive. Drains can help to monitor this. Ideally, the fluid in the drains should take on a watery consistency and pinkish color soon after the procedure. A thick consistency and dark red color is a reliable indicator of continued bleeding. Although a routine CBC may not be necessary, blood should be drawn for this purpose if there is any question of anemia and/or hypovolemia. The initial CBC usually does not reflect the actual blood loss that has taken place. I prefer to maintain hemoglobin levels above 8 g/dl.

Aggressive DVT prophylaxis should be continued postoperatively. In addition to the protocol just described, all patients should have sequential compression devices in place until they are ambulating regularly. Ambulation with assistance is attempted the evening after surgery. Some patients may experience light-headedness despite being adequately resuscitated; narcotics are the likely cause. Initial attempts at ambulation should always be done with assistance—a syncopal episode without supervision can easily result in head trauma. Patients are strongly encouraged to shower for the first time with supervision. A warm shower can induce a syncopal episode. Following discharge from the hospital, postbariatric body-lift patients remain at risk for a wide array of complications; DVT and pulmonary embolism represent the most important potential problems. A high index of suspicion is the safest approach to thromboembolic disease. Physical findings or patient reports of lower extremity

swelling and/or discomfort, particularly unilaterally, should be evaluated promptly. The signs and symptoms associated with DVT and pulmonary embolism are many and should be familiar to all physicians.

It is not unusual for patients to become depressed several weeks after surgery; particularly after major procedures such as a circumferential body lift, the patient may regret having chosen to have the operation. In some cases, patients remark that they are not even sure why they are depressed. I have found it very helpful to inform patients that this is normal and will most likely resolve over the next several weeks. Our patients are encouraged to contact other patients who have had similar procedures to discuss their experiences. Discussions with other patients can be helpful for understanding different emotional states following surgery.

Concluding Thoughts

Body contouring of the postbariatric patient can be a gratifying experience for both the patient and plastic surgeon. To achieve this end, every effort must be made to minimize risk and avoid complications. The surgeon must thoroughly understand morbid obesity and the procedures to treat this condition and should implement a screening protocol that identifies patients who are satisfactory candidates for surgery. Candidates should then be offered the appropriate procedures in the appropriate sequence. The patient's BMI should be considered as one of the primary variables in the decision process. Finally, the perioperative care of these patients must be meticulous and involve great dedication by the plastic surgeon.

Clinical Caveats

A postbariatric patient's BMI is the most important factor for determining appropriate management of contour deformities.

There is a correlation between a patient's presenting BMI and the likelihood of thromboembolic disease.

A patient's weight should be stable for several months before a body-contouring procedure is performed.

A thorough laboratory workup, including a complete blood cell count and a metabolic panel, is essential before body-contouring surgery.

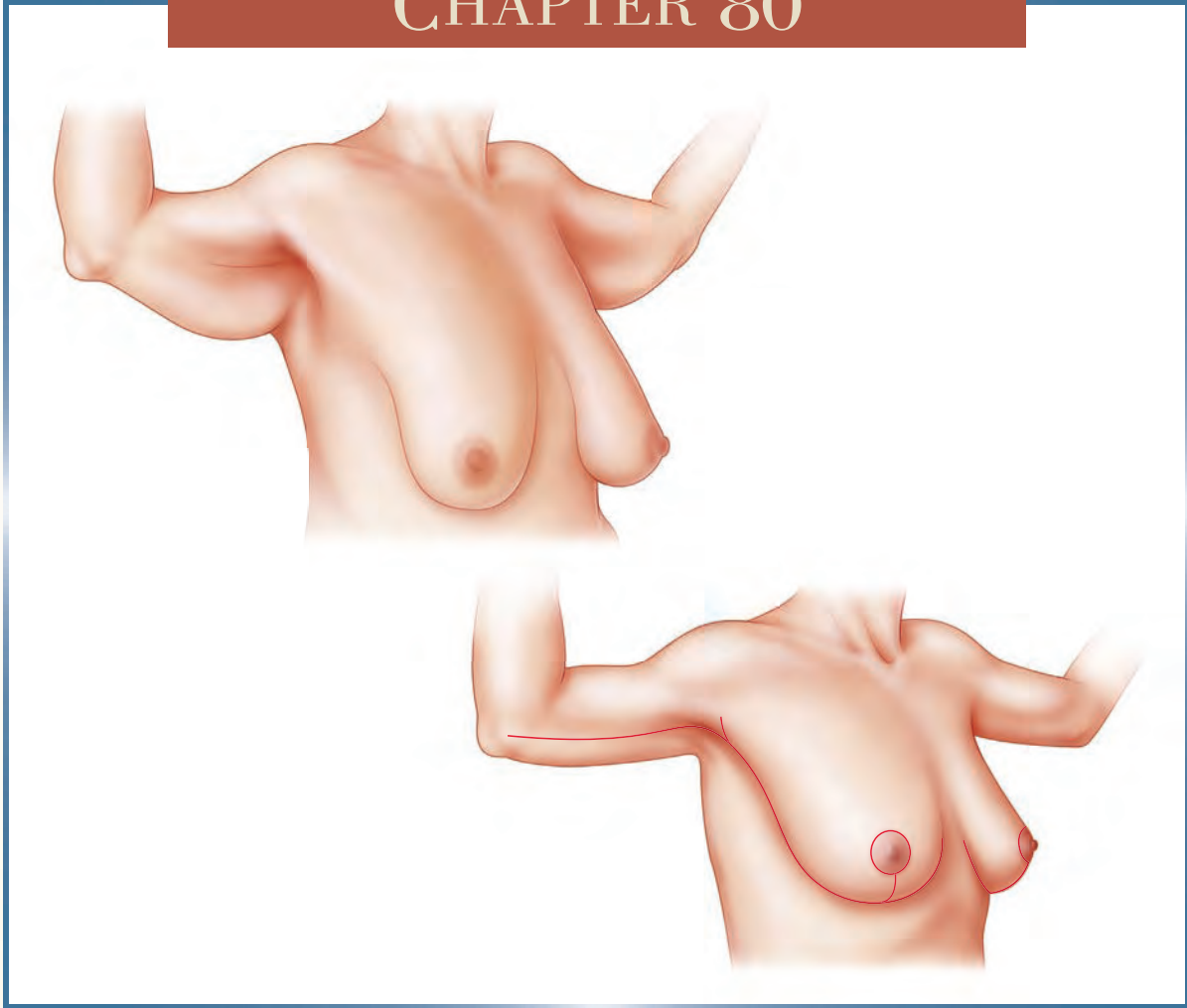
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CHAPTER 80



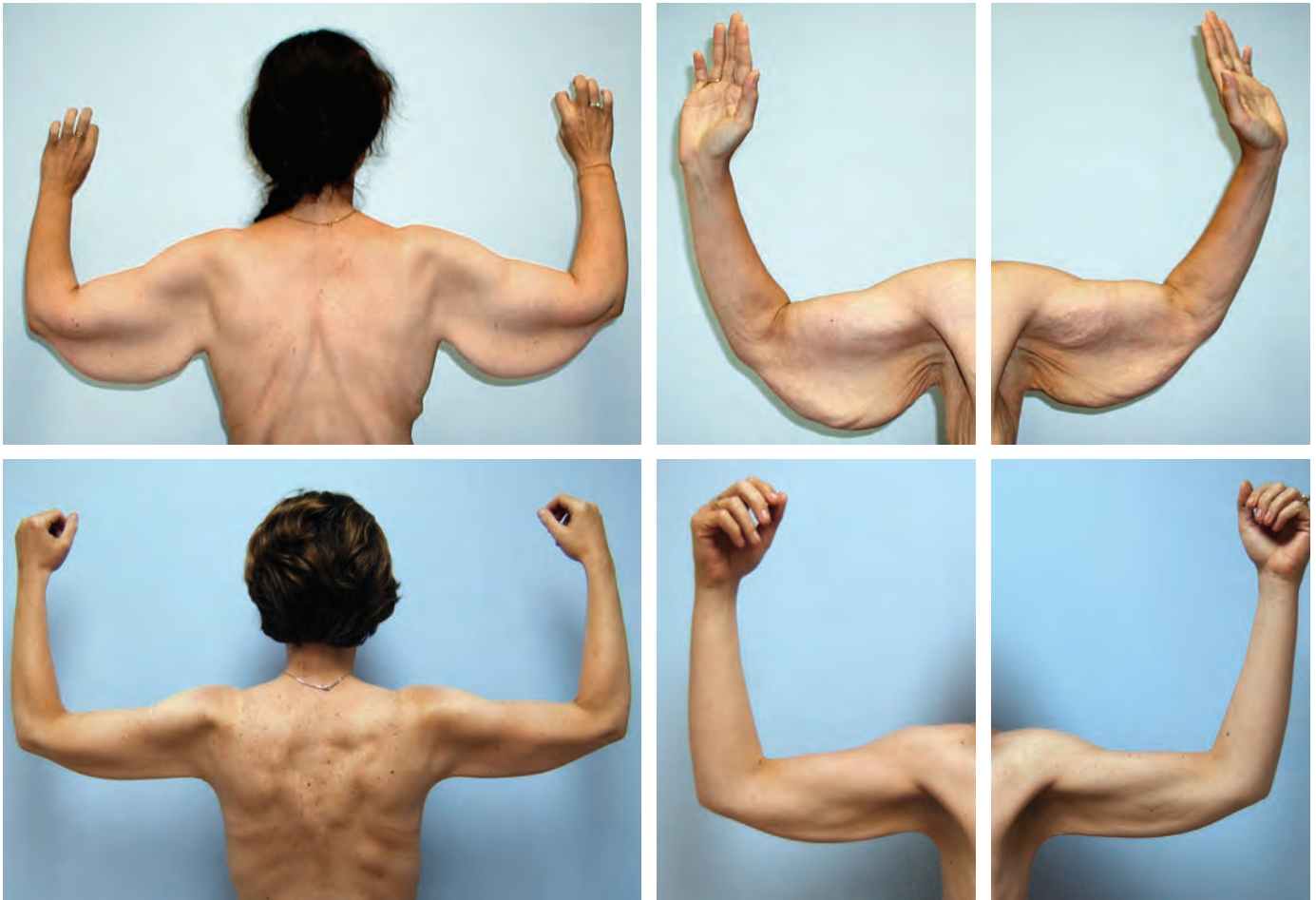
Brachioplasty

JOSEPH F. CAPELLA,
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The rapid growth in bariatric surgery over the past decade has led to an increase in demand for surgical procedures to address the contour deformities of the arm following massive weight loss. According to the American Society of Plastic Surgeons, from 2000 to 2008 there was a 4059% increase in the number of brachio-plasty procedures performed in the United States. Although weight loss affects the entire body, the arms for many individuals are often of greatest concern because of their visibility during everyday activities. The arm deformity associated with weight loss is often dramatic and is influenced by multiple factors, including patient body mass index (BMI); highest BMI ever obtained; change in BMI; age; and sex.



In a morbidly obese individual, fat deposits are usually most prominent along the axilla and the anterior, posterior, and medial arm.



After weight loss, these regions of the arm manifest the greatest excess in soft tissue. Patients with a lower BMI, particularly those who had reached a very high BMI before weight loss, are likely to have more soft excess than an individual who has had a smaller change in weight.



Older patients, particularly women, perhaps because of attenuated connective tissue, often have large amounts of excess tissue despite relatively small changes in BMI. In men, the majority of their deformity tends to be limited to the proximal arm and axilla. Women may have this appearance as well but are more likely to have a deformity that extends to the elbow and beyond.

Evolution of Technique

Before 2000, brachioplasty procedures were rarely performed by most plastic surgeons. The earliest descriptions of brachioplasty were relatively simple techniques involving the removal of an ellipse of soft tissue. The axilla was not addressed, and candidates for surgery were usually moderately overweight individuals. In the 1970s, multiple articles were published that described different patterns of excision for soft tissue of the arm. Several of these publications included techniques to avoid scar con-

tracture at the arm-axilla transition. Pitanguy described addressing deformities of the axilla and lateral thoracic region concurrent with correction of excess tissue of the arm. The first case report of a massive-weight-loss patient undergoing brachioplasty was published in this period. In the 1980s, articles appeared on performing brachioplasty as part of an upper body lift and near-total body lift, and Goddio reported on an innovative technique of burying soft tissue excess. Brachioplasty continued to evolve in the 1990s. Liposuction became a more integral component of these procedures. Lockwood proposed that the posteromedial soft tissue of the arm is suspended to the clavipectoral periosteum by means of the clavipectoral fascia and axillary fasciae. He argued that when these structures loosen, they lead to a “loose hammock” effect, or arm ptosis. Lockwood’s technique for brachioplasty described securing the arm flap to the axillary fascia and incorporating a superficial fascial system repair in wound closure to help reduce the incidence of wide scars and unnatural contours.

In the past decade, many articles have been written on brachioplasty. In an effort to minimize scar length, several authors have described excisional techniques limited to the axilla and proximal arm in combination with liposuction. The majority of recent articles on brachioplasty involve weight-loss patients almost exclusively, and the size of the series analyzed has increased considerably from that of a decade ago. Much of the discussion today in the literature is on scar position, the timing and use of liposuction, and incorporation of short-scar techniques in the management of postbariatric patients.

Scar Placement, Use of Liposuction, and Scar Length

Advantages and disadvantages can be proposed for the various recommendations regarding scar placement, the use of liposuction, and short-scar versus traditional scar techniques. Scar location in brachioplasty is often the most important consideration for postbariatric candidates, and one of the most frequently discussed topics among plastic surgeons. Traditional locations range from the bicipital sulcus to the posterior aspect of the arm. Advocates of a more posterior approach argue that scar visibility is diminished in this location. Proponents for the bicipital sulcus prefer this location for the same reason.

The use of liposuction in brachioplasty is often debated. Some argue that liposuction should be performed before an excisional procedure. These surgeons advocate a staged approach. Liposuction is performed first to “debulk” the arm, and at a later date an excisional procedure is performed. Those recommending the concomitant use of liposuction argue that liposuction reduces arm volume and provides greater

tissue mobilization without damaging nerves and other vessels. Various approaches have been suggested to address the postbariatric arm deformity with a scar limited to the axilla or extending only partially down the arm. Advocates argue that some postbariatric patients have limited arm deformities that can be effectively addressed with scars only in the axilla or axilla and proximal arm, usually in combination with liposuction. The obvious advantage is that a scar is avoided in the far more visible middle and distal thirds of the arm. Proponents of the classic approach, scar extension to the medial epicondyle, would argue that a limited approach to most postbariatric patients leads to suboptimal results.

Our Approach to Brachioplasty

We prefer to use a posteromedial approach with extension to the medial epicondyle in combination with liposuction in the vast majority of massive-weight-loss patients. In the first half of our series, our scars were placed along the bicipital sulcus. We have not found that an approach limited to the axilla or proximal arm was effective for a significant number of individuals in this patient population.

Indications and Contraindications

The best candidates for brachioplasty are healthy individuals who have achieved a stable weight, have a BMI of less than 28, and who have lost substantial weight, generally more than 23 kg (50 pounds). Dramatic results can be achieved in individuals with a BMI greater than 28; however, the final aesthetic result is less likely to be ideal. The value of performing a brachioplasty depends greatly on the extent of the deformity to be corrected, which in turn usually depends primarily on the degree of weight loss. Variables representing relative contraindications to brachioplasty are high patient BMI and a small BMI change from the highest weight; significant patient reservations regarding arm scars; a history of poor scars, such as hypertrophic or hyperpigmented scars; and unrealistic patient expectations, particularly with regard to short-scar versions of brachioplasty. In our practice at present, absolute contraindications are a history of lymphedema and/or arterial or venous insufficiency of the upper extremity. A high risk for developing one of these conditions, such as a patient who has undergone axillary lymph node dissection or radiation, would also represent an absolute contraindication for brachioplasty.

Patient Profiles



This 25-year-old woman, who lost 58 kg (128 pounds) as a result of bariatric surgery, was an ideal candidate for brachioplasty. She presented 4 years after surgery at a weight of 62 kg (137 pounds); her highest weight before bariatric surgery was 120 kg (265 pounds). Liposuction was performed along the posterior and medial aspects of her arms immediately before tissue undermining and excision. No liposuction was performed at the axilla. The scar was placed along the posteromedial aspect of the arm in an effort to minimize visibility.



This 31-year-old woman lost 92 kg (203 pounds) following bariatric surgery. She presented 4 years after surgery at a weight of 88 kg (195 pounds); her highest weight before bariatric surgery was 181 kg (398 pounds). Liposuction was performed along the posterior and medial aspects of her arms immediately before tissue undermining and excision. No liposuction was performed at the axilla. The scar was placed along the posteromedial aspect of the arm in an effort to make it less conspicuous. The patient had concerns about the constrictive band along the distal aspect of her left arm. One option to address this band was to perform a Z-plasty along the band; however, this option was not pursued, primarily because of the possibility of a scar in a more visible location.

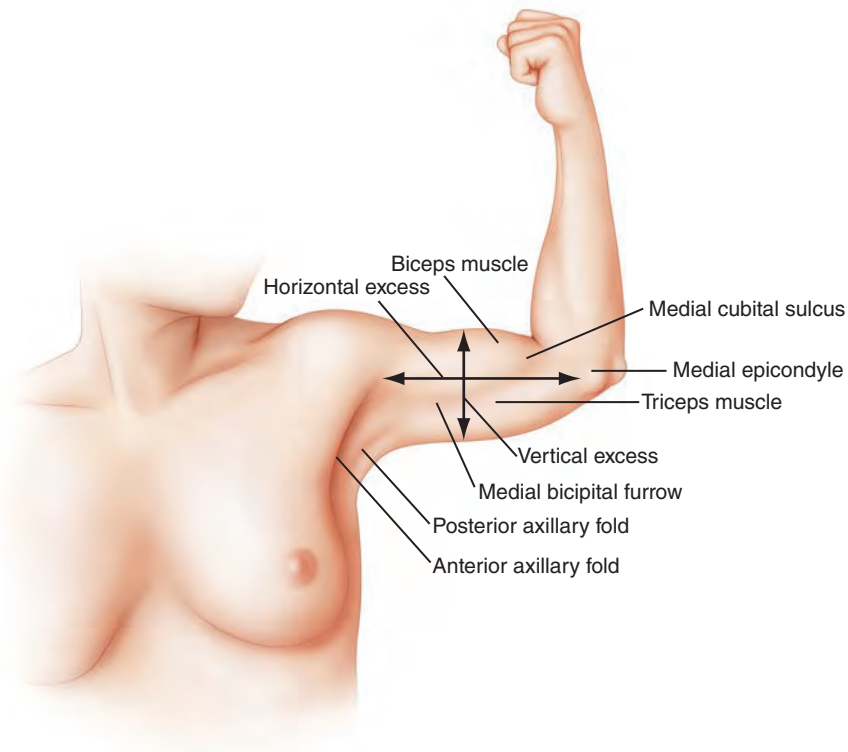


This 70-year-old woman lost 52 kg (115 pounds) as a result of bariatric surgery. She presented 4 years after surgery at a weight of 61 kg (135 pounds); her highest weight before surgery was 113 kg (250 pounds). She had a relatively large amount of excess soft tissue despite moderate weight loss. She presented with concerns about her axillae, arms, and forearms. We performed liposuction along the posterior and medial aspect of her arms immediately before tissue undermining and excision. No liposuction was performed at the axillae. The scar was placed along the bicipital sulcus, our choice for scar placement at the time. Note that the scar continued onto the proximal forearm in an effort to address contour concerns in that area.

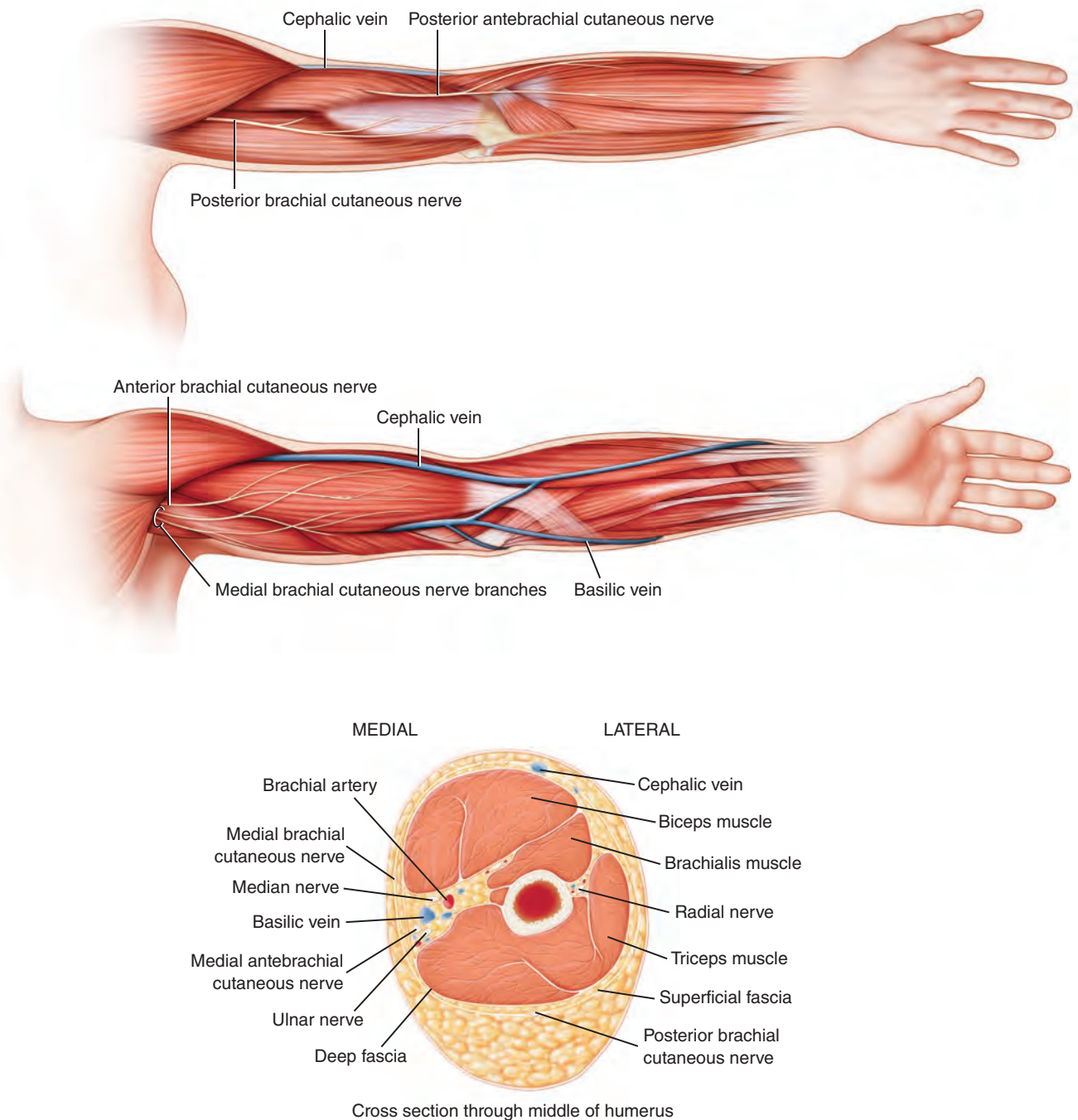


This 55-year-old man had lost 68 kg (150 pounds) as a result of bariatric surgery. He presented 2 years after surgery at a weight of 110 kg (242 pounds); his highest weight before bariatric surgery was 178 kg (392 pounds). As is typical of men, his arm contour deformity was primarily limited to the axillae and proximal half of the arms. Liposuction was performed along the posterior and medial aspect of his arms immediately before tissue undermining and excision. No liposuction was performed at the axillae. The scar was placed along the bicipital sulcus, our choice for scar placement at the time. Note that the scar does not extend to the medial epicondyle, reflecting the limited extent of his deformity.

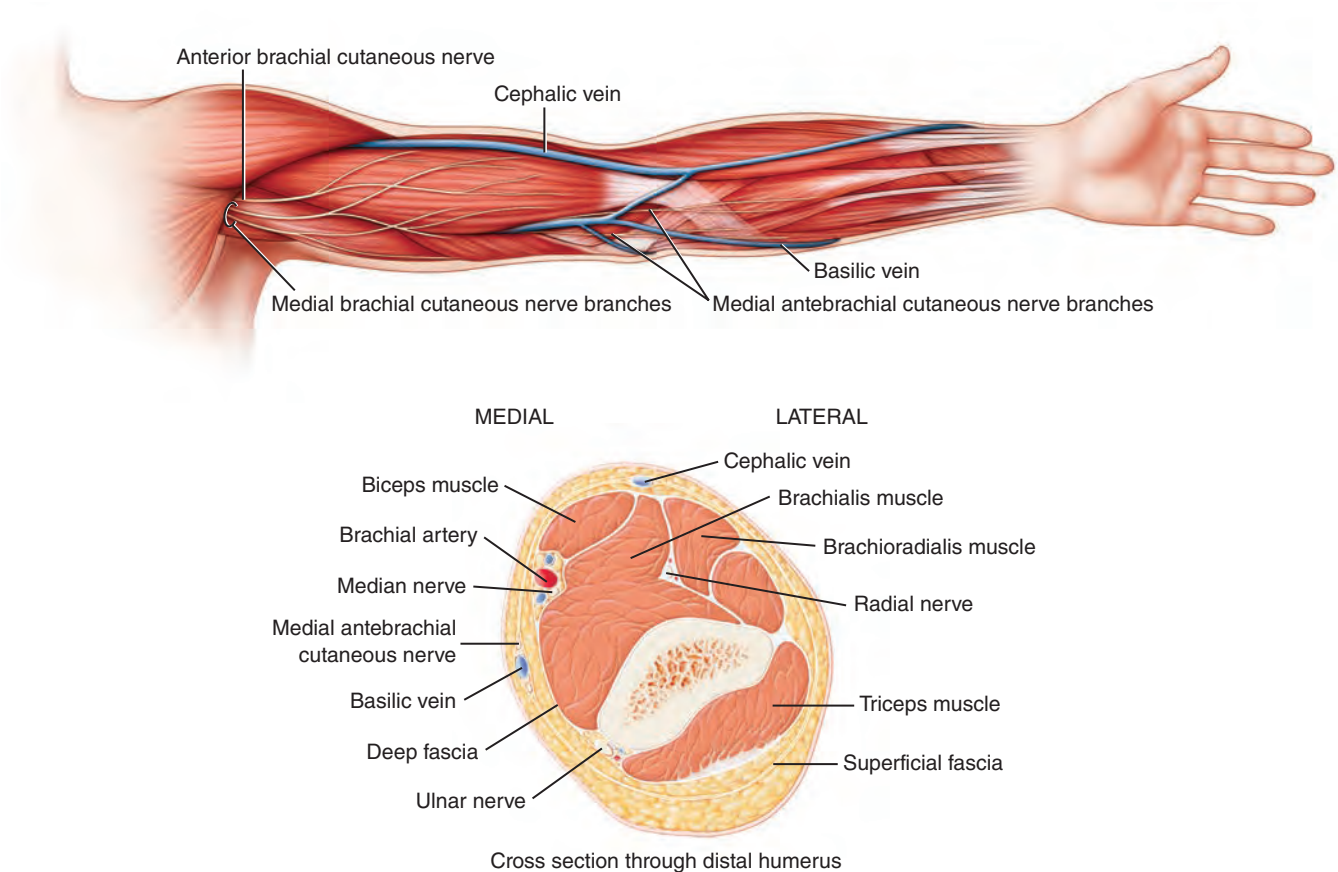
Pertinent Anatomy



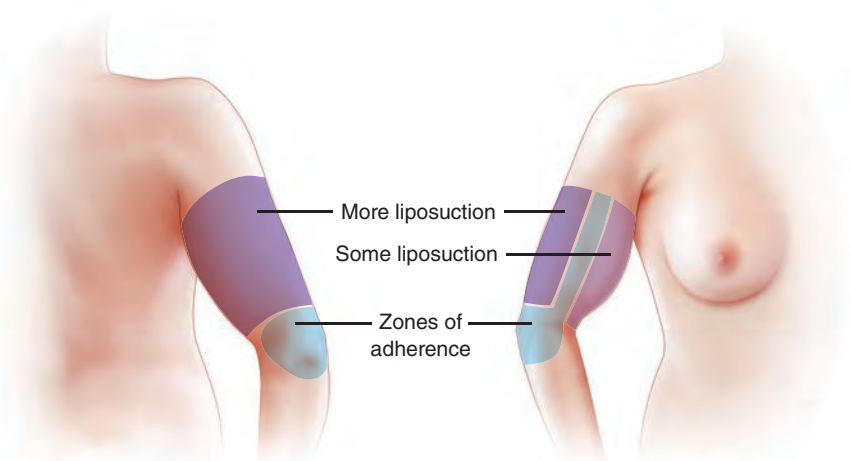
When considering the posteromedial approach to brachioplasty, it is essential that the surgeon identify several superficial anatomic landmarks for consistent scar placement. Important surface anatomy includes the anterior and posterior axillary folds, biceps and triceps muscles, medial epicondyle, medial bicipital furrow, and medial cubital sulcus. A posteromedial approach to brachioplasty in virtually all instances involves the axillary dome, the area between the anterior and posterior axillary folds. An incision in this region should remain superficial, involving only skin and a small amount of subcutaneous fat. Liposuction is not usually performed in this region. The superficial-lying intercostobrachial nerve is sometimes encountered and inadvertently cut, with resulting numbness along the proximal medial aspect of the arm. This condition is well tolerated by patients and rarely noted. Liposuction before dissection of the medial and posterior arm should provide an easily identifiable plane immediately deep to the superficial fascial system and superficial to the deep fascia of the arm. Along the entire arm and elbow, vital structures remain deep to the deep fascia and are unlikely to be injured.



Along the proximal two thirds of the medial and posterior aspects of the arm, lying superficial to the deep fascia, are the medial and posterior brachial cutaneous nerves and small superficial unnamed veins. The cephalic vein and anterior brachial cutaneous nerve should remain out of the field of sharp dissection. Prior liposuction and careful dissection should spare the medial and posterior cutaneous nerves. Injury to these nerves would result in corresponding numbness to these areas of the arm.



Along the distal third of the arm and in the elbow region, the basilic vein and medial antebrachial cutaneous nerve lie superficial to the deep fascia and are vulnerable to injury. Once again, liposuction before sharp dissection in this area is helpful in visualizing these more important structures.



Zones of adherence along the arm are limited primarily to the lateral arm and elbow region. The posteromedial approach does not involve sharp dissection along the lateral arm, and fat deposits in this area are not common. Liposuction along the medial and posterior arm addresses the fat deposits commonly encountered along the posterior elbow and facilitates sharp dissection along the medial elbow.

Preoperative Assessment

Candidates for brachioplasty should undergo thorough history-taking and physical examination. Photographs of the areas of concern are obtained. As for all post-bariatric patients, special attention should be directed toward the patient's weight history. Critical information includes the patient's height, current weight, and maximum weight. The time interval between their maximum and current weight and length of time at the current weight should be documented. If weight loss was achieved through bariatric surgery, the technique and when surgery was performed should be recorded. Other important weight-related information includes whether the individual is being followed by a bariatric surgeon, the date of the last visit, and whether supplemental medication has been prescribed and is being taken regularly. Problems potentially related to bariatric surgery should be explored, such as frequent vomiting, abdominal pain, weakness, light-headedness, and frequent bowel movements. For patients who have lost weight through lifestyle changes, the surgeon should determine how this was accomplished: through exercise, diet and exercise, and/or medication, and whether the patient is being supervised by a professional. Physical examination of a postbariatric brachioplasty candidate should be thorough, with particular attention to the upper body. Along with the degree of soft tissue excess present along the forearm, arm, and axilla, an assessment should be made of the breasts, flanks, and back. The fat content of all these areas should be noted. A standardized examination form is helpful. The examiner should note whether intertriginous dermatitis is present, potentially along the axilla. Lymphedema and/or the stigmata of lymphedema should be documented, as should the presence of arterial or vascular insufficiency. Existing scars, banding, and striae along the upper extremity should be documented.

Patient Goals

For some individuals following weight loss, the appearance of the arms is their primary or only concern. More often, however, the arms are one of many concerns. The average age in our postbariatric population is 39. Most of these patients are very active and eager to minimize time off from work and time away from family obligations. It is therefore quite common for a patient to express concerns about multiple areas of the body and to request that all areas be addressed as soon as possible. One of the most important components of patient assessment is determining in what order and with what other procedures a brachioplasty should be performed. The patient's goals should be carefully considered in formulating a plan. With regard to the arms, it is important to gain a clear understanding of the patient's tolerance for scars and of the degree of contour improvement he or she is expecting. A postbariatric patient anticipating an optimal result from a procedure with a scar limited to the proximal arm is likely to be disappointed.

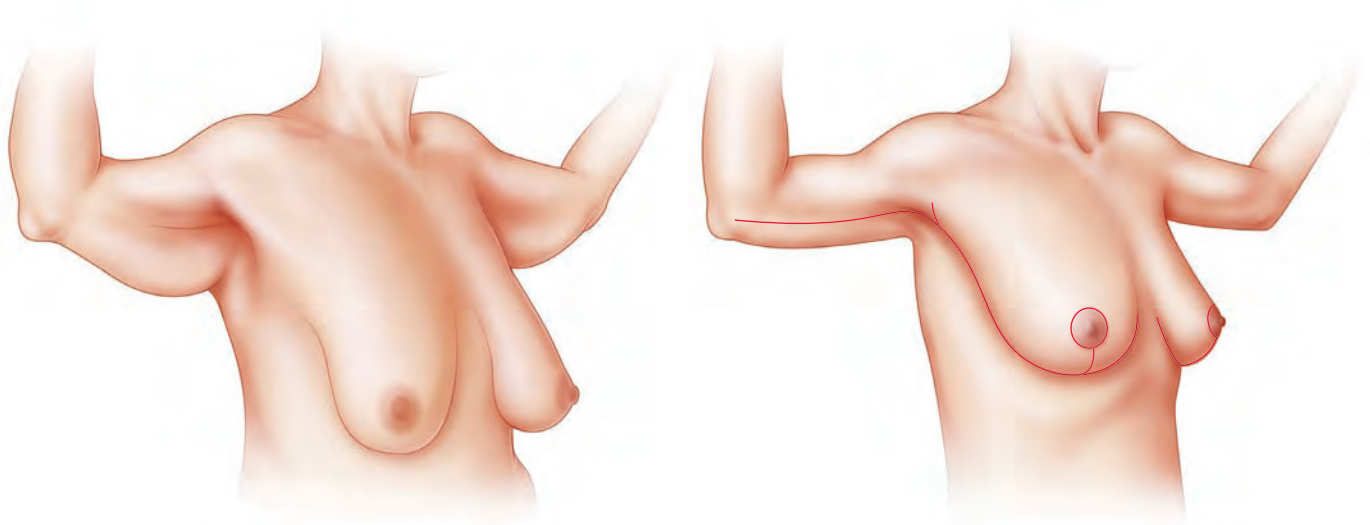
PREOPERATIVE ASSESSMENT FOR BRACHIOPLASTY

Patient name _____ Date _____

ARM	Left:	Striae:	Yes	No				
		Skin excess:	None	Mild	Moderate	Severe		
		Lipodystrophy:	None	Mild	Moderate	Severe		
		Scars:	Yes	No				
		Constrictive band	Yes	No				
	Right:	Striae:	Yes	No				
		Skin excess:	None	Mild	Moderate	Severe		
		Lipodystrophy:	None	Mild	Moderate	Severe		
		Scars:	Yes	No				
		Constrictive band	Yes	No				
AXILLA / FLANK	Left:	Lipodystrophy:	None	Mild	Moderate	Severe		
	Right:		None	Mild	Moderate	Severe		
	Left:	Skin excess:	None	Mild	Moderate	Severe		
	Right:		None	Mild	Moderate	Severe		
BREAST	Current breast size:		Desired breast size:					
	Excess grams of breast tissue:		Left	Right				
	Diameter of nipple-areola complex:		Left	Right				
	Distance from sternal notch to nipple (normal 23-25 cm):		Left	Right				
	Distance from inframammary fold to nipple (normal 10-12 cm):		Left	Right				
	Distance from midline to nipple (normal 10-12 cm):		Left	Right				
	Scars:	Left:	Biopsy	Inverted T	Vertical	Periareolar	Inframammary	Axillary
		Right:	Biopsy	Inverted T	Vertical	Periareolar	Inframammary	Axillary
	Breast ptosis:	Left:	None	Grade I	Grade II	Grade III	Pseudoptosis	
		Right:	Biopsy	Inverted T	Vertical	Periareolar	Inframammary	
	Lymphadenopathy:	Left:	None	Axillary	Supraclavicular			
		Right:	None	Axillary	Supraclavicular			
	Palpable mass:	Left:	Yes	No				
		Right:	Yes	No				
	Nipple discharge:	Left:	Yes	No				
		Right:	Yes	No				
	Shoulder grooving:	Left:	Yes	No				
		Right:	Yes	No				
	Baker capsular contracture:	Left:	None	Mild	Moderate	Severe		
		Right:	None	Mild	Moderate	Severe		
	Gynecomastia:	Left:	Type I	II	III	IV	Hypertrophy:	A B C
		Right:	Type I	II	III	IV	Hypertrophy:	A B C
Tuberous breast:	Left:	None	Mild	Moderate	Severe			
	Right:	None	Mild	Moderate	Severe			
ABDOMEN	Striae:	Yes	No					
	Scars:	None	Midline	Epigastric	Hypogastric	Left subcostal		
		Right subcostal	Chevron	Left paramedian	Right paramedian			
		Left inguinal	Right inguinal					
	Hernia:	None	Ventral	Incisional	Umbilical	Left inguinal	Right inguinal	
	Skin excess:	Left:	None	Mild	Moderate	Severe		
		Right:	None	Mild	Moderate	Severe		
	Lipodystrophy:	Left:	None	Mild	Moderate	Severe		
		Right:	None	Mild	Moderate	Severe		
	Fascial laxity:	Left:	None	Mild	Moderate	Severe		
		Right:	None	Mild	Moderate	Severe		
	Intertriginous dermatitis:	Yes	No					

Preoperative Planning

The information gathered from the patient history and physical examination is instrumental in formulating a preliminary plan. For patients expressing concerns only about their arms, the plan is clear. For these patients, it is important to clarify the importance of addressing the axilla in rejuvenating the arm (see pp. 2821-2822). Most patients following massive weight loss express concerns about more than just their arms; usually the breasts, flanks, back, abdomen, thighs, and buttocks are sources of dissatisfaction as well. Multiple options are available to the plastic surgeon.



We prefer to perform a body lift first as a single procedure, then follow with a combination mastopexy/lateral thoracoplasty/brachioplasty a minimum of 3 months later. A medial thigh lift, if necessary, would be performed at least 3 months after that. Our rationale for this sequence and combination of procedures derives from the observation that the body-lift procedure greatly affects the rolls frequently present along the upper and lower back (see p. 2835). In the vast majority of patients, any remaining rolls along the back and flanks following a body lift can then be addressed by the combination mastopexy/lateral thoracoplasty/brachioplasty.



This 30-year-old woman had a 59 kg (130-pound) weight loss. She is shown 10 months after a body lift and 4 months after a medial thighplasty. Improvement to the back contour is evident.

Although the upper body procedures may be performed before the body lift, it is often difficult to accurately estimate the appropriate amount of tissue to be excised in the lateral thoracic region. The vast majority of postbariatric patients are candidates for a body lift.

Before an individual can be considered for any procedure, certain criteria must be met and issues addressed. The patient should be at a stable weight for several months; this will vary, depending on the bariatric procedure. Operating during a period of

active weight loss may result in early recurrence of soft tissue laxity, and from a safety perspective, the patient's nutritional and metabolic status is unlikely to be optimal. Patients with symptoms that suggest problems related to bariatric surgery should be evaluated by their surgeon, and patients are advised to maintain the supplemental regimen prescribed by their bariatric surgeon. Individuals with a history of major or acute mental illness are asked to undergo evaluation by an appropriate health professional. Individuals with a history of tobacco consumption are urged to stop as soon as possible. The risks of tobacco use are clearly established in the literature, and patient education includes explanations of potential wound-healing problems and thromboembolic disease. We ask patients who are on medications as part of their weight-loss protocol to stop taking them. All patients are referred for medical clearance. Although weight loss dramatically improves the health of morbidly obese individuals, not all conditions are eliminated. A careful medical evaluation of their health is imperative.

After discussing a possible plan with the patient, we review several topics. Many individuals are eager to lose more weight before surgery, feeling that their surgery will be safer and that more skin can be removed if they are at a lower weight. We think that most people whose weight is stable at the time of consultation are at the weight they are most likely to maintain over the long term. Many weight-stable postbariatric patients can lose additional weight for relatively brief periods of time—several months, perhaps a year—but long-term sustained additional weight loss is difficult to achieve. Weight loss over a short period of time can lead to several undesirable outcomes. First, the individual may become nutritionally and metabolically unbalanced just at the time contouring surgery is to be performed. Second, weight gain in the future will in most instances diminish the aesthetic results of a procedure. We advise patients to eat a balanced diet and maintain a stable weight. We also explain that a certain amount of excess soft tissue will be removed during surgery. Their new weight after surgery should be their current weight minus the weight of the tissue removed. A 3-month postoperative weight similar to their weight at consultation suggests a significant weight gain. We also explain that the long-term results of this surgery are best maintained by weight stability, minimizing exposure to sun (ultraviolet light), and no tobacco consumption.

Laboratory Tests

The patient's history can often suggest the presence of problems; however, a thorough laboratory workup is essential to identify existing deficiencies or abnormalities. It is not unusual for menstruating women to have few if any symptoms despite having severe anemia as a result of bariatric surgery. Along with a complete blood cell count and other studies, our routine includes a complete metabolic panel. Ab-

normal laboratory values are acted on as they are made available. Individuals found to be malnourished (regarded as a total protein level less than 6 g/dl and/or albumin less than 3 g/dl) may be referred to their bariatric surgeon for reevaluation and possible nutritional supplementation. Those findings may be corroborated by the presence of edema on physical examination. Protein-depleted patients may have difficulty with wound healing. Severely anemic patients (those with a hemoglobin level less than 10 g/dl) are referred to their primary physician and/or a hematologist. Patients with a hemoglobin level above 10 g/dl are advised to continue taking iron, folate, and B₁₂ supplementation and to have their blood cell count repeated in 1 week. We prefer that patients have a hemoglobin level above 12 g/dl before surgery. Patients are advised of the possible need for a blood transfusion. We do not have patients bank their own blood: in most institutions, blood can only be given within 1 month of surgery, and 1 month may not be adequate time for an anemic patient to replenish his or her blood levels.

Preoperative Visit

At the preoperative visit, usually 2 weeks before surgery, we review the planned surgical procedure in detail with the patient, as well as the potential complications. Any requested consultations and recommendations are discussed at this time. Another critical function of the preoperative visit is to review the photographs taken at the first consultation. Patients rarely have a completely accurate sense of their deformities. Key elements of this discussion are to highlight existing asymmetries, the presence of constrictive bands (which in many cases cannot be completely corrected), review the extent of their deformities, and to explain the degree to which the planned procedure or procedures will address these deformities. We prefer not to morph patient images on the computer but rather to show preoperative and postoperative examples of individuals with similar body types who have had the same procedure. Perhaps more than any other postbariatric body-contouring procedure, candidates for brachioplasty must have a very clear understanding of the scar involved. The process of scar maturation must be discussed, as should the potential risks for hypertrophic and hyperpigmented scars. Failure to discuss the full spectrum of scar quality can lead to a disappointed patient despite an excellent contour result. Restrictions and recovery guidelines are reviewed. Patients often have the sense that recovery from surgery should involve significant bed rest; instead, we emphasize the importance of early and frequent ambulation. Medications that should be avoided before surgery are reviewed: those that increase the risk for bleeding, such as aspirin and NSAIDs, and medications that increase the risk for deep venous thrombosis (DVT), such as birth control pills or hormone replacement therapy. Patients are advised not to take either for 2 weeks before or after surgery. We conclude the consultation with an explanation of the plan for DVT prophylaxis.

Restrictions and Recovery Guidelines

1. Dressings are removed 2 days postoperatively. Showering is permitted at this time. You should keep your underarms dry at all times when not showering.
2. No special garments are required.
3. Avoid perspiring excessively for 2 weeks.
4. Deodorants or antiperspirants may be applied 2 weeks after surgery. (Many patients report that they have no need or less need to apply these products, because in most cases a significant number of sebaceous glands and hair follicles have been removed.)
5. Avoid lifting your arms (not the forearms) above shoulder level for 2 weeks after surgery (the forearms and hands may be used for grooming).
6. Vigorous activities involving the lower body may be resumed 2 weeks after surgery. Vigorous activities of the upper body, including the arms, may be resumed 6 weeks after surgery.

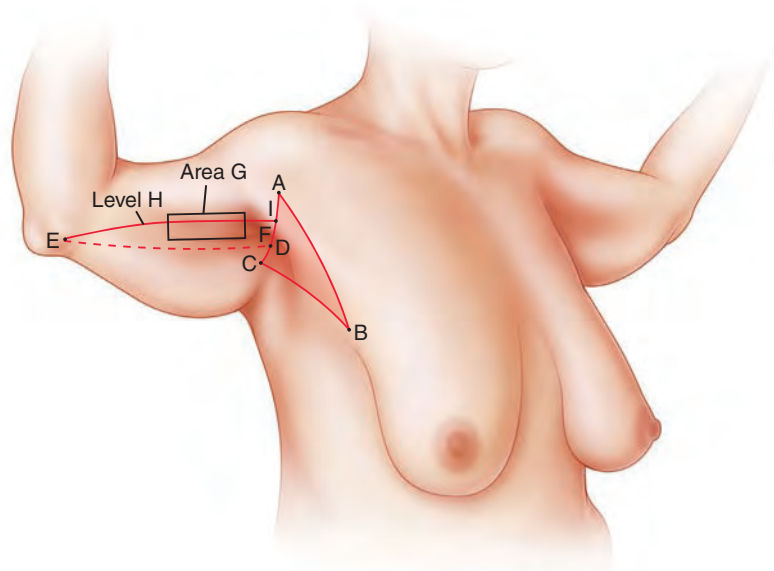
Thromboembolic Disease Prophylaxis

Thromboembolic disease has been very rare in our brachioplasty series. All patients undergoing brachioplasty have activated lower extremity sequential compression devices in place before surgery, during surgery, and until they are regularly ambulating. After surgery, patients are encouraged to walk shortly after the procedure. Patients with a BMI above 32 are given 5000 units of heparin subcutaneously before surgery. Individuals with risk factors other than obesity are treated on a case-by-case basis. Thromboembolic disease prophylaxis for patients undergoing brachioplasty and additional procedures, particularly abdominoplasty, is outside the scope of this chapter but is discussed in detail in Chapter 79.

PERIOPERATIVE MANAGEMENT

Preoperative Planning

The goal of our technique is for the scar to lie along the posterior medial arm, approximately at the level of the triceps muscle. At the axilla, the scar should lie within the axillary dome.



Marking begins with the patient standing and the arm extended perpendicular to the body. A line is drawn along the lateral inferior border of the pectoralis major muscle from point A, the superior portion of the axillary dome to point B, the inferior portion of the dome. A point C is found, usually at the level of the triceps muscle that can be advanced easily to a point D at the most superior portion of the axillary dome. The points at A, B, and C are connected to complete the ellipse at the axilla. These steps determine the soft tissue excess to be excised from the axillary dome. A dashed line is then drawn from the medial epicondyle, point E, to the lateral aspect of the axillary dome over the triceps muscle, point F. In heavier individuals, the posterior portion of the arm may need to be grasped to determine the location of the triceps muscle. Finally, area G above the dashed line E-F is identified, corresponding to the region of maximum soft tissue excess on the posterior aspect of the arm. Moderate downward traction is placed on the area using multiple digits, typically the index, long, ring, and small fingers, to identify level H, which descends to the height of point E, or the medial epicondyle. A line is then drawn from point E through H and onto the lateral aspect of the ellipse, point I. The line from E through point H should mirror the corresponding soft tissue excess of the posterior arm in that region. Typically the line rises gradually over the distal arm and rises more as it reaches the proximal arm.

Operative Technique



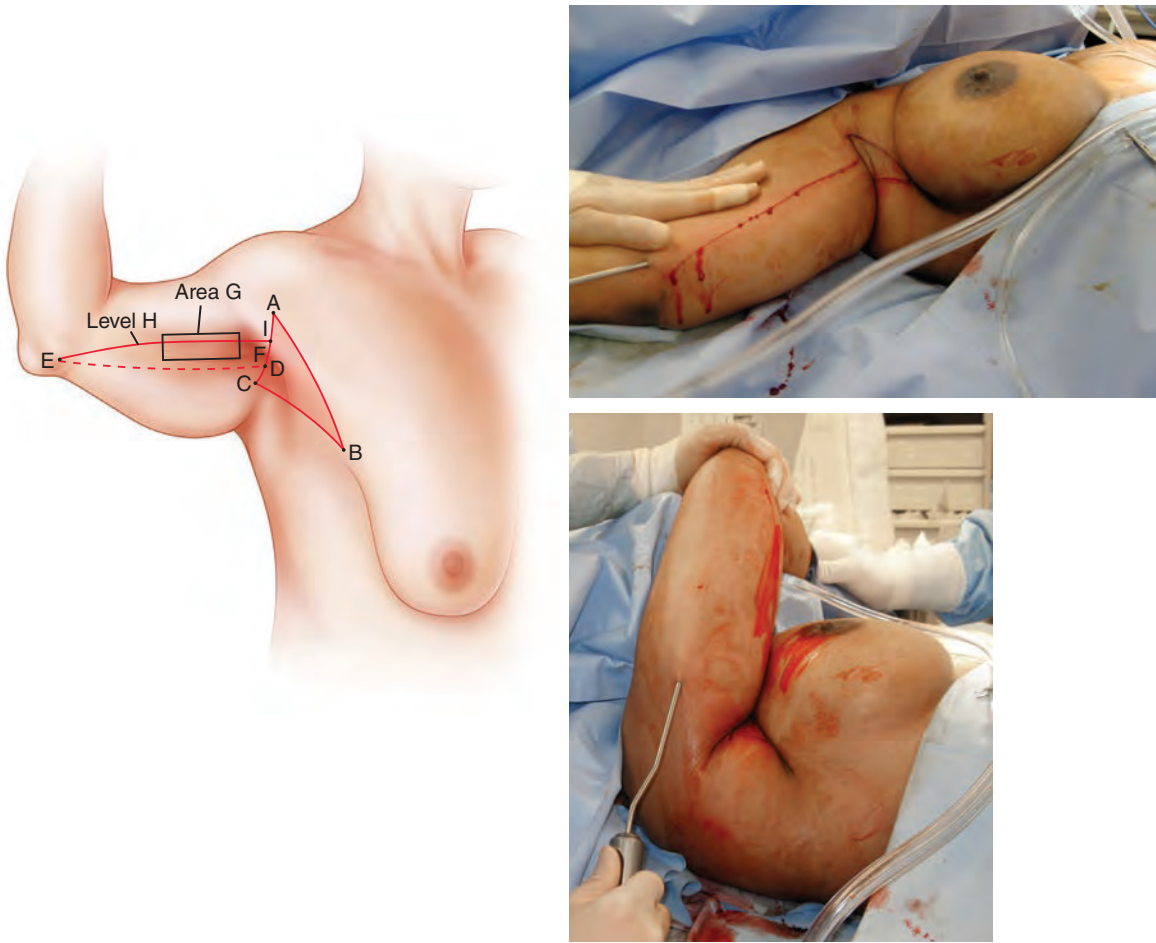
80-1 Brachioplasty



Draping for bilateral brachioplasty, performed with lateral thoracoplasty and mastopexy

Sterile drapes are placed on the operative table and arm boards. With the patient supine, a sequential compression device is placed on one leg and a blood pressure cuff on the other. An intravenous catheter is placed in the dorsal aspect of the hand or wrist. Intravenous antibiotics are given, typically a first-generation cephalosporin. A pulse oximeter sensor is placed on the ear. Following administration of general anesthesia, often with a laryngeal mask, the forearm, arm, axilla, flank, and chest are prepared with povidone-iodine solution (Betadine). A sterile towel is wrapped around each hand and proximal forearm and secured to itself and the patient with staples. An ether drape is stapled to the patient along the upper chest and over the midclavicular portion of the shoulders. Sterile drapes are placed over the patient's body from the lower chest and inferiorly.

The previously made markings along the axilla, points *A* to *B*, up to *C*, and back to *A* are scored with a knife blade. Similarly, the line from *E* through *H* and onto the lateral limb of the axillary ellipse, point *I*, is scored. Beginning with the right arm and using a No. 15 blade, the surgeon makes four stab wounds: along the medial forearm, just distal to the medial epicondyle, the proximal and midposterior arm, and the distal lateral arm. Through these stab wounds tumescent fluid (1 L of saline solution, 1 ml of 1:1,000 epinephrine, 50 ml of 1% lidocaine) is injected into the subcutaneous tissues of the medial and posterior arm. If fatty deposits are to be addressed along the anterior and lateral arm, fluid should be injected into these areas as well. Our preference is to inject at a 1:1 ratio, fluid injected equaling effluent removed. Excessive fluid injection may compromise control over the excision. While the tumescent fluid is setting, the ellipse at the axilla is excised. Only a small amount of subcutaneous fat is removed with the skin to avoid any deeper structures.

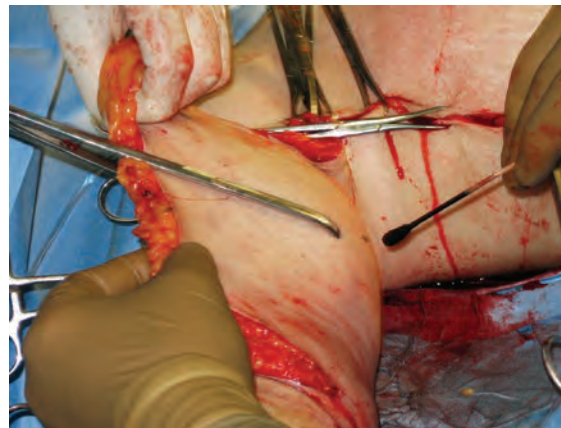


Liposuction is then performed with a 3 to 4 mm cannula, beginning through the stab wound along the proximal medial forearm. By this approach, the medial arm is suctioned with particular attention to the distal area, where the skin is more firmly adherent to the underlying fascia. The arm is typically resting on the arm board during this maneuver. Suction is then performed along the posterior and posterolateral arm through the stab wound along the distal lateral arm. The surgeon is standing and the forearm is elevated off the arm board by an assistant. Finally, the entire posterior arm is liposuctioned through the posterior stab wounds. The arm is rotated medially over the patient's chest. With the arm resting on the arm board, the surgeon incises the skin from points *E* to *I*. The subcutaneous tissues are divided to reach the honeycomb-appearing plane produced by the liposuction. In this plane, dissection is readily performed to the posterolateral aspect of the arm.



The appearance of the subcutaneous tissues after liposuction to the medial and posterior arm is shown. The plane of dissection is readily visible.

The supporting ligaments to the skin in the region of the elbow are thicker and slightly more difficult to divide. With the dissection complete, a towel clamp or an Adair clamp is used to approximate the lateral skin edge of the axillary ellipse, point *I*, to a point directly across the ellipse along the medial axillary skin edge. Towel clamps are then used to approximate the lateral skin edge at a point beginning below *E* to point *I*, already approximated. The correct point whether *C* or a point between *C* and *B*, is the point that creates the desired contour of the proximal arm but avoids excessive tension. Once the desired point is found, the skin edges of the axillary ellipse have been approximated. Attention is then directed toward the arm. Towel clips are placed along the upper divided skin edge, *E* to *I*.



Beginning in the region of greatest tissue excess of the arm, typically slightly proximal to the mid-arm, a Pitanguy long skin demarcator is secured to a towel clip. The surgeon and assistant then apply upward traction on the entire lower skin flap edge. Advancement of the demarcator posteriorly toward the lower flap will cause it to glide posteriorly for 1 cm or more before stopping. The lower flap is drawn into the jaws of the demarcator under moderate tension. Once mild resistance is reached, the lower flap is released by approximately 1 cm. This point is then marked.

The same technique is repeated along the arm three or four times to develop an outline of the flap to be excised. The dots are connected and the flap excised. Hemostasis is carefully restored. No drain is placed. Towel clamps are used to approximate the flap edges along the axilla and arm. At the axilla, 2-0 Vicryl interrupted sutures are used to approximate the superficial fascial system and deep dermis, approximately 0.5 cm from the flap edge. Incorporated in this approximation is a superficial bite of the deeper tissues to help eliminate dead space. A 3-0 Monocryl intracuticular suture is then placed. A similar closure with 2-0 Vicryl and 3-0 Monocryl is used along the arm; however, the deeper tissues are not incorporated in the closure. ABD pads are placed on the wounds of the axilla and arm, followed by a loosely applied elastic wrap to the arm. To support the dressings at the axilla, an upper pole breast binder is placed, or if breast surgery is being performed concomitantly, a bra is placed.

In our practice, the lateral thoracic region is often addressed in combination with a brachioplasty and mastopexy. The sequence of procedures in these cases is for the mastopexy to be performed first. From the lateral extent of the inframammary wound closure, the tailor-tacking technique is then used to assess the excess skin and soft tissue along the lateral thoracic region and to the dome of the axilla. Next the excess skin and a small amount of subcutaneous fat from the lateral thoracic region and axilla are removed. The arm portion of the brachioplasty procedure can then begin as described previously from the step in which liposuction is performed. The remainder of the procedure is the same, except for the final wound closure, which extends inferiorly from the axilla to the lateral thoracic region and terminates at the lateral extent of the mastopexy inframammary wound closure. If large areas of skin and soft tissue have been removed from the lateral thoracic region, the dermal sutures can be placed to incorporate a superficial bite of the tissues at the base of the wound, or a drain can be left in place for several days. These efforts may diminish the likelihood of a seroma or persistent fluid drainage from the axilla.

The proximal forearm, in addition to the arm, may be a concern for some patients, particularly women in their fifth decade and beyond. Management of the proximal forearm begins with the routine brachioplasty, as described previously, up to the point just before the final intracuticular layer of 3-0 Monocryl is placed. With the 2-0 Vicryl suture in place, the tailor-tacking technique is used to assess the excess skin and soft tissue along the proximal forearm beyond the medial epicondyle. The skin and a small amount of subcutaneous fat from the pattern created along the proximal medial forearm are removed. The final closure begins with 2-0 Vicryl in the forearm, followed by 3-0 Monocryl along the forearm, arm, and axilla.

Postoperative Care

Ambulation is encouraged as soon as possible after surgery. Brachioplasty is nearly always performed in an ambulatory setting, particularly if it is the only operation being performed. The patient is usually discharged several hours after the procedure. Dressings are removed 2 days later, and the patient is then allowed to shower.

Patients are encouraged to take narcotic analgesics as needed but to taper them as soon as possible. They are reminded to avoid elevating their arms above shoulder level. Routine follow-up visits are planned for 1 week, 6 weeks, 3 months, 6 months, and yearly thereafter. Images are usually taken at the 3-month follow-up.

Problems and Complications

Major complications are very few following brachioplasty. In our review of 350 brachioplasty cases (700 arms), skin dehiscence was the most frequent complication at 25%. None of the instances of dehiscence occurred acutely; that is, within the first 24 to 48 hours after the procedure. Rather, dehiscence began to become evident approximately 2 weeks after the procedure. Nearly all (95%) instances occurred at the intersection of the closure of the axillary dome and the arm.

As in many skin flaps that are triangular, the tip of the flap has a compromised blood supply. In the days after the procedure, the tip can become increasingly ischemic, taking on a dusky appearance, and at 2 weeks actual skin separation occurs. Most skin dehiscences (over 90%) were less than 2 cm in size.

Avoiding this complication is challenging, because some form of Z-plasty must be used for the closure to extend from the axilla to the arm to prevent scar contracture. Although advising the patient to limit extension of the arm may be helpful, it is unlikely to entirely prevent this problem. Dehiscences are treated with dressing changes. In some instances, hypergranulation tissue may arise in the area of skin dehiscence. Application of nitrate is very effective.

Seromas are the second most frequent problem (10%). Approximately 90% occur along the distal medial third of the arm, immediately beneath the scar. Most become evident at about 3 weeks postoperatively and range in diameter from 1 to 4 cm. Initially we manage them by needle aspiration; unfortunately, this technique has a very high recurrence rate.

Marsupialization, which consists of incising the skin over the seroma, draining the seroma, and suturing the seroma cavity to the skin, is 100% effective but results in a scar that may be wider than the adjoining scar and can prolong wound healing. Currently we prefer to drain the seroma through the scar and place a secured Penrose type of drain into the seroma cavity. This technique has also proved very effective. Patients receive antibiotics while the Penrose drain is in place.

Infections have had been very infrequent, as have bleeding and hematomas. Complaints of dysesthesia beyond 3 months have been few, and rare beyond 6 months. Skin necrosis has also been very infrequent despite liposuction being performed in virtually all cases.

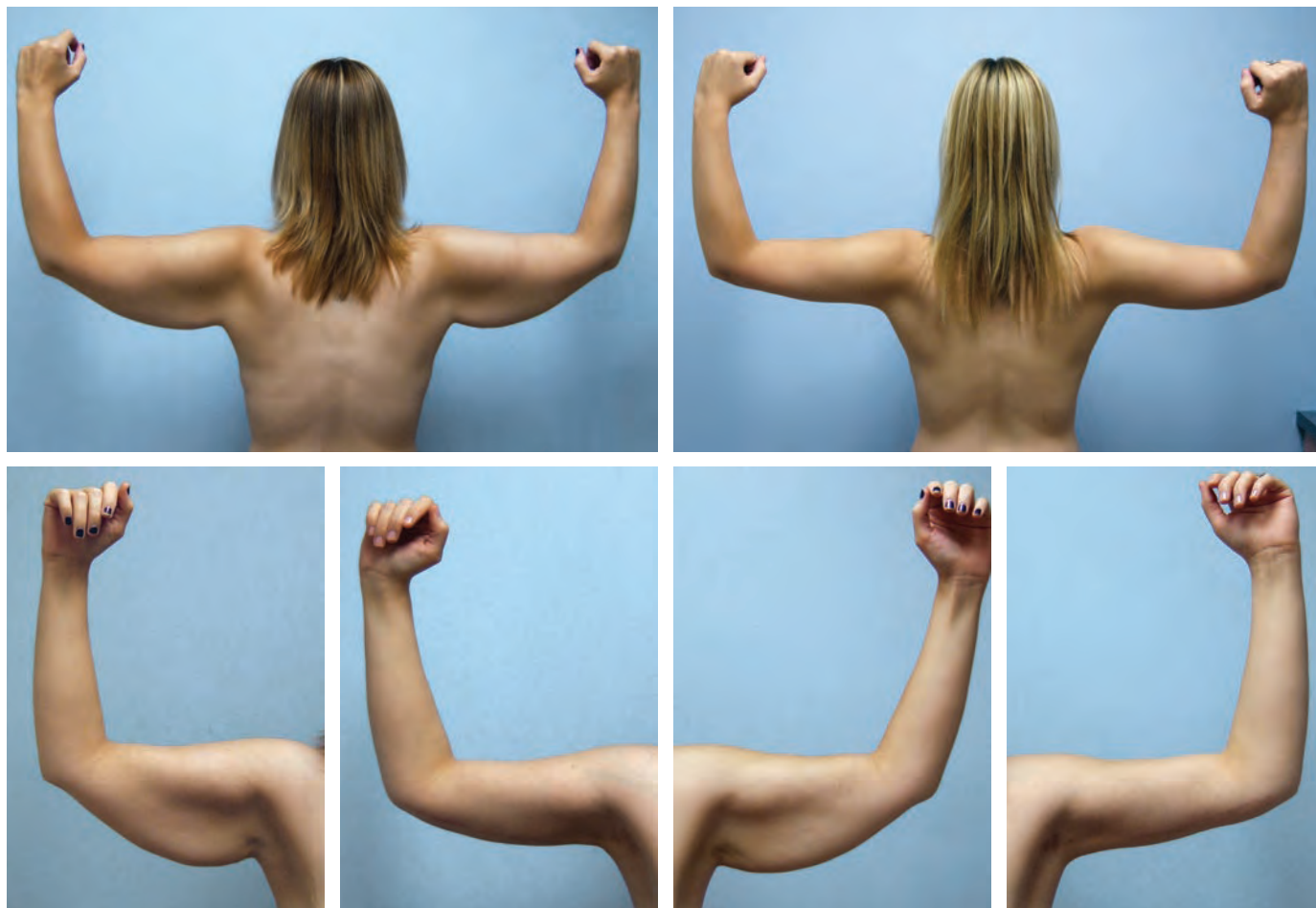
We have had only one documented instance of DVT in a patient who underwent brachioplasty. The patient presented with a palpable cord extending from the forearm to the arm. There have been no instances of pulmonary embolism.

Complication Rates Associated With Brachioplasty (N = 350 cases; 700 arms)

Complication	Percentage
Skin dehiscence	25.0
Seroma	10.0
Infection	2.6
Hematoma	0.6
Skin necrosis	0.6
Deep venous thrombosis	0.3
Pulmonary embolism	0.0

Results

The following cases have been selected to represent the broad range of postbariatric patients following brachioplasty.



This 25-year-old woman presented 4 years after bariatric surgery that resulted in a weight loss of 58 kg (128 pounds). Her current weight was 62 kg (137 pounds) with a BMI of 25. Her highest weight had been 120 kg (265 pounds) with a BMI of 48. She is seen 6 months after brachioplasty with concomitant liposuction and postero-medial scar placement. Note the improvement of the axilla, a critical component of an effective brachioplasty. Scars placed in this position are less noticeable than those along the bicipital sulcus.



This patient was a good candidate for brachioplasty. She was 31 years old and had undergone bariatric surgery 4 years earlier. As a result, she had lost 92 kg (203 pounds). Her current weight was 89 kg (195 pounds) with a BMI of 35. The highest weight and BMI she ever reached were 181 kg (398 pounds) and 71, respectively. She is seen 3 months after brachioplasty and concomitant liposuction, with scar placement along the posteromedial arm. Although the results are dramatic, the aesthetic level achieved is not the same as for the preceding ideal candidate. Note the constrictive band along the left arm that could not be eliminated.



This 70-year-old woman presented 4 years after bariatric surgery that had produced a weight loss of 52 kg (115 pounds). Her current weight was 61 kg (135 pounds) with a BMI of 25. Her highest weight had been 114 kg (250 pounds) with a BMI of 46. She is seen 6 months after brachioplasty and concomitant liposuction, with scar placement at the bicipital sulcus. Note that her deformity extends from the axilla and arm to the proximal forearm; this is typical of older women. In addition, her deformity is greater than might be expected from her degree of weight loss.



This 55-year-old man was initially seen when he requested brachioplasty 2 years after undergoing bariatric surgery through which he had lost 58 kg (128 pounds). His weight at the first visit was 109 kg (240 pounds) with a BMI of 35. His highest weight had been 177 kg (391 pounds) with a BMI of 58. He is seen 3 months after brachioplasty and concomitant liposuction, with scar placement along the bicipital sulcus. As is typical of men, his deformity was primarily limited to the axilla and proximal half of the arm. Although the erythema of his scar is quite typical for this postoperative period, this degree of scar visibility influenced our decision to place scars slightly more posterior along the medial aspect of the arm.

Concluding Thoughts

Increasing numbers of individuals are requesting arm contouring after massive weight loss. It is important that plastic surgeons have a safe, effective, and reliable technique to address upper extremity concerns. Careful preoperative evaluation with particular attention to weight history is the first step in creating the appropriate plan for each individual. The preoperative evaluation should include a clear understanding of patient expectations and their comfort level with scars. Examination of the patient should make note of the extent of the arm deformity, but also of surrounding structures such as the forearm, axilla and lateral thoracic region. Once a patient has been evaluated and a plan formulated, the brachioplasty procedure should proceed

in an organized, step-wise fashion. The technique described in this chapter has been performed hundreds of times on a wide array of postbariatric patients. The outcomes have been carefully evaluated and are associated with few significant complications and a high level of patient satisfaction. The goal of the technique is to restore normal contour to the arm and adjacent structures, with scars placed in the least noticeable locations. To achieve this in patients of varying BMIs, concomitant liposuction plays an essential role. Liposuction helps to create a safe plane for dissection and remove excess fat, making it possible to safely remove more excess soft tissue. Brachioplasty can be a consistently rewarding experience for both the plastic surgeon and postbariatric patient when careful attention is placed on preoperative evaluation and screening, scar placement, the treatment of the arm and adjoining structures, and the appropriate use of liposuction.

Clinical Caveats

Careful patient selection is critical for optimizing the outcome from brachioplasty surgery.

In postbariatric patients, the arm contour deformity must be evaluated as a part of the upper body and not as an isolated area.

Candidates for brachioplasty must have a clear understanding of scar visibility.

Upper extremity and upper body asymmetries, including the presence of constrictive bands, should be highlighted and discussed with patients before surgery.

Preoperative marking should be performed consistently, particularly with regard to patient position.

The surgical plan and sequence of steps should be determined before the procedure.

The excisional component of brachioplasty must be performed in a methodical and detailed fashion.

Liposuction should be considered for most postbariatric brachioplasty patients.

Annotated Bibliography

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A short-scar brachioplasty or minibrachioplasty technique is described that limits the scar to the axilla and proximal arm. Eight patients were treated with the technique. Brachioplasty techniques with scars limited to the proximal arm are likely to have a limited scope of utility in massive-weight-loss patients.

Gusenoff J, Coon D, Rubin JP. Brachioplasty and concomitant procedures after massive weight loss: a statistical analysis from a prospective registry. *Plast Reconstr Surg* 122:595-603, 2008.

The authors analyze data from a prospective registry of massive-weight-loss patients who underwent brachioplasty alone or with concomitant operations to identify statistically significant complications (a total of 101 cases). Outcome measures included operative time, time since the gastric bypass, need for revision, arm liposuction, and complications such as seroma, dehiscence, hematoma, infection, and nerve injury. Patients with a greater change in BMI had a higher likelihood of wound infection. Longer operative time was associated with increased rates of surgical complications at the operative site. There was a trend toward increased complications when arm liposuction was combined with brachioplasty.

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Lockwood T. Brachioplasty with superficial fascial system suspension. *Plast Reconstr Surg* 96:912-920, 1995.

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Pascal JP, Le Louarn C. Brachioplasty. *Aesthetic Plast Surg* 29:423-429; discussion 430, 2005.

A technique for brachioplasty is described in which the scar is placed along the posteromedial arm and concomitant liposuction is used to help preserve both deep and superficial lymphatics, reduce damage to blood vessels and nerves, reduce volume, and allow better tissue mobilization. The series included 21 patients.

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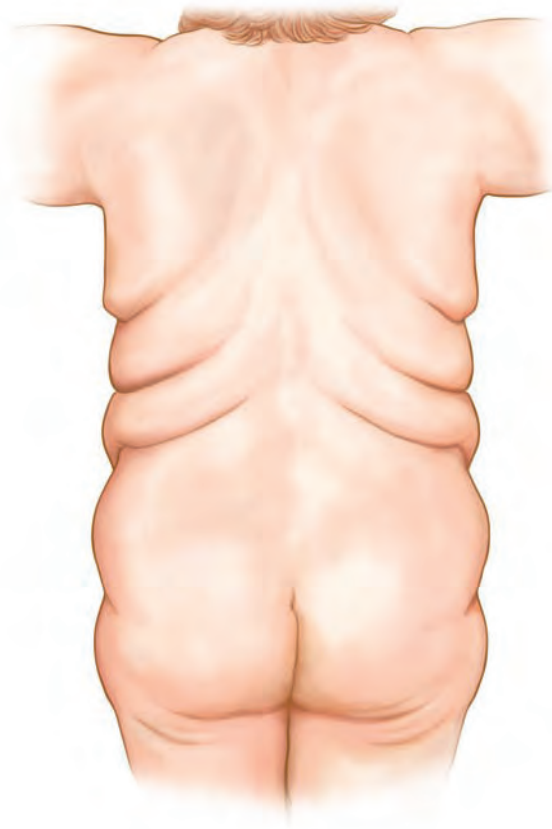
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CHAPTER 81



Back and Lateral Fold Contouring

DIRK F. RICHTER, ALEXANDER STOFF

With the steadily rising global rate of obesity—according to the World Health Organization, 300 million people worldwide are obese—there has been a substantial increase in the number of bariatric operations since the early 1960s. Because massive weight loss usually results in a significant and disfiguring excess of skin and soft tissue, there has been an increasing demand among patients for body-contouring procedures to complete the desired results. Many operative techniques have been developed and refined to a high standard, increasing the popularity and effectiveness of these procedures.

In the past, operations such as abdominoplasties and medial thigh and gluteal lifts were performed as multistage procedures for patients after massive weight loss. These have given way to modern, holistic concepts of treatment, such as circumferential lifting and full lower body lifts, the current benchmark procedures for postbariatric patients.

However, to date, treatment of the lateral and dorsal thoracic regions has not been as satisfactory, as indicated by surgical experience and the absence of reports of good results in the literature. The thick skin, fibrous soft tissue with lobulated fat, and poor retraction capability of this region have limited the success of treatment. Furthermore, scarring in the lateral and dorsal thoracic regions cannot be adequately hidden by underwear, especially in male patients; because of the thickness and quality of the skin, the scars in this region are usually significant and remain visible. In addition, scars are difficult to place in the natural, relaxed skin-tension lines. Because of these difficulties, minimally invasive, scar-reducing techniques such as liposuction are usually preferred, although the problem of poor skin retraction has remained insurmountable. Thus the results of liposuction-only treatments are disappointing, especially in patients after massive weight loss, primarily because of insufficient skin retraction.

To address these problems, we have developed a new method for treatment of the back, particularly the lateral and dorsal thorax, in massive-weight-loss patients. This technique combines surgical excision of skin redundancy with preliminary liposuction. The *upper lateral thoracic lift* (ULTL) is an alternative approach for eliminating skin excess in this region. It can be performed alone or as an integral part of a combined technique with upper body lift procedures.

Indications and Contraindications

The choice of technique must be individualized, based on the patient's preoperative characteristics. The importance of the individual's psychological attitude cannot be overstated, particularly in regard to his or her acceptance of the visible scars associ-

ated with this procedure. Fortunately, massive-weight-loss patients usually have a high tolerance for scar length and visibility.

In general, if there is skin and soft tissue excess in the form of local folds in the dorsal and lateral thorax, an excisional procedure will be necessary to correct the redundancy. Local liposuction can be worthwhile in cases of local soft tissue excess if there are no skin folds. The surgeon must assess the entire back preoperatively to determine the amount of skin elasticity present so that the areas of skin with the worst retraction potential can be distributed across a larger body surface, which will promote more effective skin retraction.

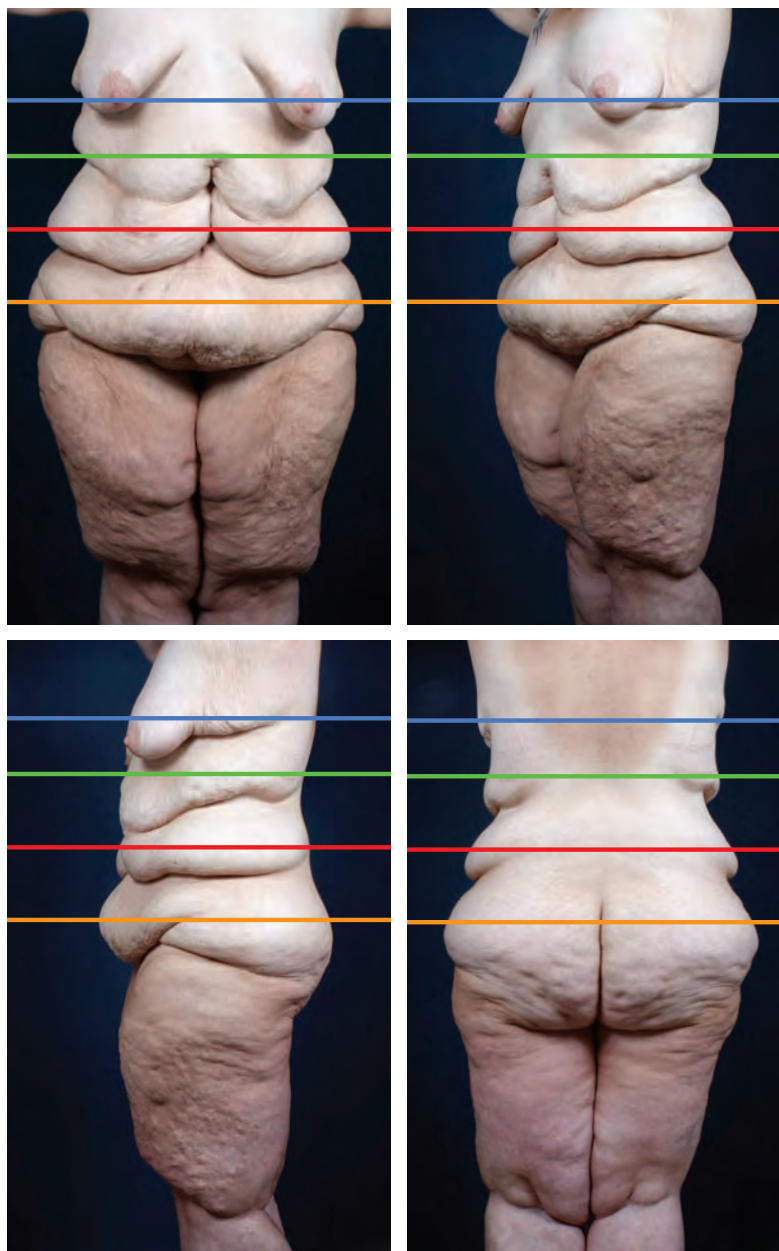
Patient Profiles



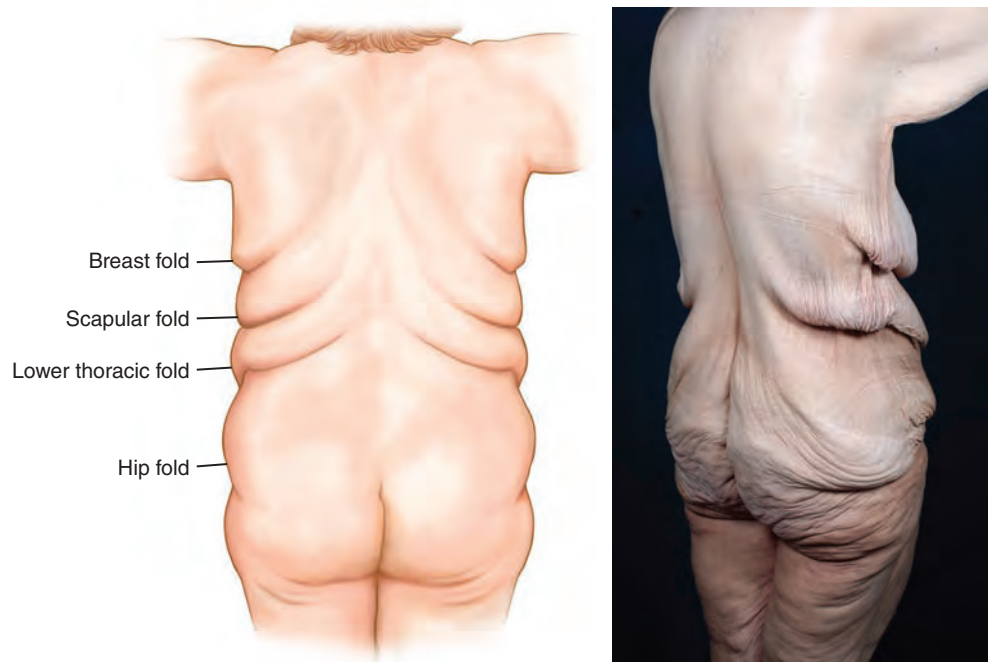
The ideal candidate for an excisional lifting operation is a psychologically prepared individual with significant skin and soft tissue excess with ptotic skin rolls and fold development. A BMI of 32 is the generally accepted upper limit for lifting operations to achieve good results with an acceptable complication rate. If patients are still too obese, their results will be poor and scarring unacceptable. Patients who tend to develop hypertrophic scars should not be considered for this operation, because the back is prone to noticeable scars and development of keloids.

Suitable candidates for liposuction have skin that is neither too thin nor too thick, with an obvious excess of subcutaneous fat. Using a technique that combines superficial and deep liposuction of the area, the surgeon can achieve good skin retraction; however, there is a risk of skin dimpling. If dimples occur, ultrasound-assisted liposuction may be used to ameliorate this problem (Jewell).

Pertinent Anatomy

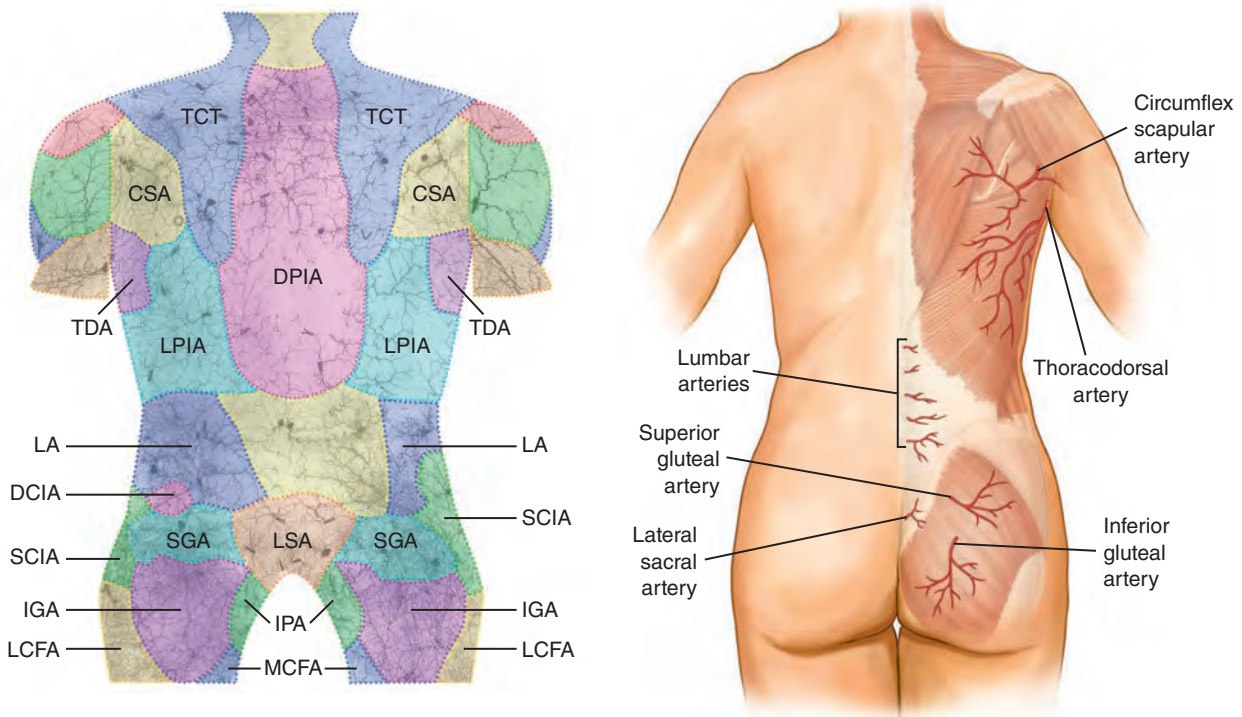


The entire back and lateral thoracic areas have a central conjoined zone over the vertebral column. When a person gains weight, this zone remains nearly unchanged; there are few fat cells there that can hypertrophy because of the connections between skin and fascia. More laterally, the tissue is thicker and heavier, and it gradually collapses back on itself, like a roman shade. Thus multiple rolls are formed, as previously described by Strauch and colleagues.



A classification for these back rolls includes an upper breast roll, followed by a lower scapular roll and a deeper lower chest/thoracic roll. An analogous classification is made for the iliac area hip rolls. The wrinkles can be seen individually as well as collectively.

In our patient population we have found strongly asymmetrical patterns, such as one roll on one side and four rolls on the other side. For this reason the surgeon has to evaluate each patient carefully for the presence of scoliosis, hip problems, or leg differences. It is thought that ligamentous structures of different strengths are responsible for the development of these asymmetrical rolls. A pathohistologic study that correlates the different types of collagen to the clinical outcome is currently under analysis.



Left: Cutaneous vascular territories are shown in different colors in this cadaver angiogram to facilitate identification: CSA, Circumflex scapular artery; DCIA, deep circumflex iliac artery; DPIA, dorsal branches of posterior intercostal arteries; IGA, inferior gluteal artery; IPA, internal pudental artery; LA, lumbar arteries; LCFA, lateral circumflex femoral artery; LPIA, lateral branches of posterior intercostal arteries; LSA, lateral sacral arteries; MCFA, medial circumflex femoral artery; SCIA, superficial circumflex iliac artery; SGA, superior gluteal artery; TCT, thyrocervical trunk; TDA, thoracodorsal artery.

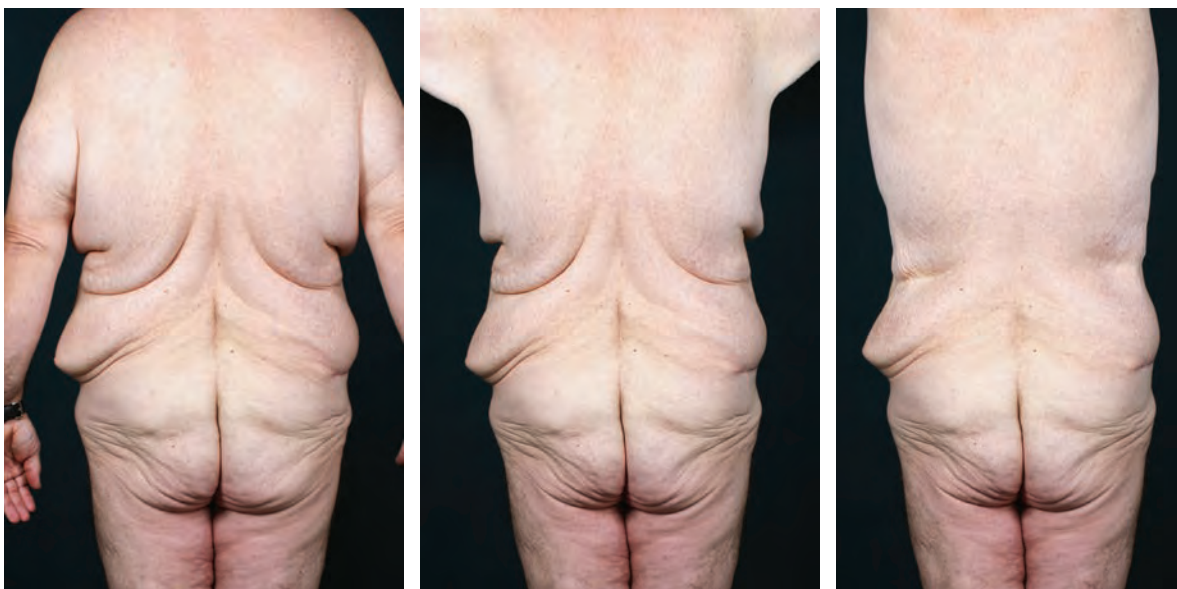
The back is perfused primarily by the perforating vessels of the latissimus dorsi. The area around the sacrum is supplied by numerous small arteries with no single main vessel, making the area a danger zone for development of decubitus ulcers and circulatory disturbance after a lifting procedure. New data must be evaluated with regard to lymphatic clearance, since surgical interventions in these areas (such as a latissimus dorsi flap, belt lipectomy, or extensive liposuction) present a high risk for seroma formation.

Preoperative Assessment

A detailed medical history is taken and the patient's BMI is determined during the initial consultation and physical examination. All local physical conditions must be assessed. It is important to ensure that the patient is psychologically prepared to accept the significant scars associated with these procedures. This is particularly criti-

cal for treatment of the upper folds of the back, because these often leave visible scars that are not easy to hide. Careful planning and explicit discussion with the patient are essential.

The quality and thickness of the skin folds are of particular interest and should be measured. The degree of mobility and the elasticity of the tethered areas provide helpful information for planning an effective operation.



The patient is evaluated with his or her arms maximally elevated and lowered. We recommend that a standard photographic series be obtained showing the full range of motion of the arms from 0 to 180 degrees to clarify and document the mobility of the skin folds and the overlying tissue.

The individual breast, scapular, and lower thoracic rolls should be measured with skin calipers. If liposuction-only treatment is indicated for a patient with one roll or even a certain degree of generalized obesity of the back or hip, it is essential to evaluate the thickness of the fat layer for preoperative planning. If liposuction is to be done, high-resolution ultrasonography may be helpful to define the thickness of the skin and fat layers to enhance planning.

We generally advise patients to refrain from taking any nonessential medications for 14 days before the operation, particularly those that could interfere with coagulation or lead to increased bleeding.

Preoperative Planning

Primarily we attempt to combine an upper arm lift with a breast lift and an integrated ULTL. This technique treats the upper part of the body as one unit. As a guide, we say that the two upper folds often can be treated by various surgical options or the lower body lift (LBL) alone (because this lift exerts such an influence on the entire back), whereas the two lower folds can only be effectively treated by using an LBL or a belt lipectomy.

When planning an LBL, it is important to remember the principle that *force equals counterforce*, so approximately one quarter of the soft tissue should be excised from the cranial side, with approximately three quarters removed from the caudal side.

However, we agree with the majority of surgeons that direct undermining of the back, especially in the sacral area, should be avoided. Aly excises the lower thoracic fold using a slightly higher incision line with the belt lipectomy. Thus approximately half of the lower thoracic fold can be resected, whereas the other half can be tightened by pulling downward.

Classification

The Pittsburgh Rating Scale has proved helpful for selecting the best operative approach. Overall, we agree with the general recommendations for treatment in this classification system; however, we have found a greater indication for the combined technique of liposuction and excisional procedures of the back.

The Pittsburgh Rating Scale*

Area	Scale	Preferred Procedure
Arms	0 Normal	None
	1 Adiposity with good skin tone	UAL and/or SAL
	2 Loose, hanging skin without severe adiposity	Brachioplasty
	3 Loose, hanging skin with severe adiposity	Brachioplasty $\pm$ UAL and/or SAL
Breasts	0 Normal	None
	1 Ptosis grade I/II or severe macromastia	Traditional mastopexy, reduction, or augmentation techniques
	2 Ptosis grade III or moderate volume loss or constricted breast	Traditional mastopexy $\pm$ augmentation
	3 Severe lateral roll and/or severe volume loss with loose skin	Parenchymal reshaping techniques with dermal suspension, consider autoaugmentation
Back	0 Normal	None
	1 Single fat roll or adiposity	UAL and/or SAL
	2 Multiple skin and fat rolls	Excisional lifting procedures
	3 Ptosis of rolls	Excisional lifting procedures
Abdomen	0 Normal	None
	1 Redundant skin with rhytids or moderate adiposity without overhang	Miniabdominoplasty, UAL and/or SAL
	2 Overhanging pannus	Full abdominoplasty
	3 Multiple rolls or epigastric fullness	Modified abdominoplasty techniques, including fleur-de-lis and/or upper body lift
Flank	0 Normal	None
	1 Adiposity	UAL and/or SAL
	2 Rolls	UAL and/or SAL
	3 Ptosis of rolls	Excisional lifting procedures
Buttocks	0 Normal	None
	1 Mild to moderate adiposity and/or mild to moderate cellulite	UAL and/or SAL
	2 Severe adiposity and/or severe cellulite	UAL and/or SAL $\pm$ excisional lifting procedure
	3 Skin folds	Excisional lifting procedure
Mons	0 Normal	None
	1 Excessive adiposity	UAL and/or SAL
	2 Ptosis	Monsplasty
	3 Significant overhang below symphysis	Monsplasty
Hips/lateral thighs	0 Normal	None
	1 Mild to moderate adiposity and/or mild to moderate cellulite	UAL and/or SAL
	2 Severe adiposity and/or severe cellulite	UAL and/or SAL $\pm$ excisional lifting procedure
	3 Skin folds	Excisional lifting procedure
Medial thighs	0 Normal	None
	1 Excessive adiposity	UAL and/or SAL $\pm$ excisional lifting procedure
	2 Severe adiposity and/or severe cellulite	UAL and/or SAL $\pm$ excisional lifting procedure
	3 Skin folds	Excisional lifting procedure
Lower thighs/knees	0 Normal	None
	1 Adiposity	UAL and/or SAL $\pm$ excisional lifting procedure
	2 Severe adiposity	UAL and/or SAL $\pm$ excisional lifting procedure
	3 Skin folds	Excisional lifting procedure

*Ten regions are assessed on a scale of 0 to 3. The presence of specific deformities determines the score. For each rating, the indicated surgical procedures are outlined. The procedures may be performed alone or in combination.

SAL, Suction-assisted lipectomy; UAL, ultrasound-assisted lipectomy.

PITTSBURGH RATING SCALE



0 (Normal)

1

2

3

It is important to start the planning with the LBL operation as the core part of the plan, because this operation exerts such a significant influence on the entire back. Sometimes no additional steps are needed after an LBL or a belt lipectomy has been performed.

For precise preoperative planning of any body-contouring operation, we suggest using the anatomic description by Strauch and colleagues (seen on p. 2856).

Treatment of the Upper Two Folds

We rarely see an isolated upper breast fold; therefore our method of choice is the ULTL, which we usually combine with a breast lift and an upper arm lift. The ULTL is also our method of choice when two folds are present, such as an upper breast fold and a lower scapular fold. If the old folds are more distinct or the fat excess is greater, we generally start with liposuction in a single operation.

For a patient with Pittsburgh grade 3 folds that are heavy and reach the spine, direct excision either in an oblique direction (referring to the relaxed tension lines) or in a horizontal direction may be indicated. Horizontal excisions, crossing these relaxed tension lines, usually result in unfavorable scars, although hiding them under the bra straps is easier than for vertical incisions.

Treatment of the Lower Two Folds



Good results can be obtained with an LBL and a belt lipectomy for treating the lower two folds. Even without direct treatment of the annoying lower thoracic rolls in patients with moderate folds, the folds can be reduced by the mechanism of *draw and counterdraw* (stretching one side to reduce the other side). Additional mobilization with liposuction is often necessary in patients with distinct hip rolls; this results in a supplementary lifting effect of this region.

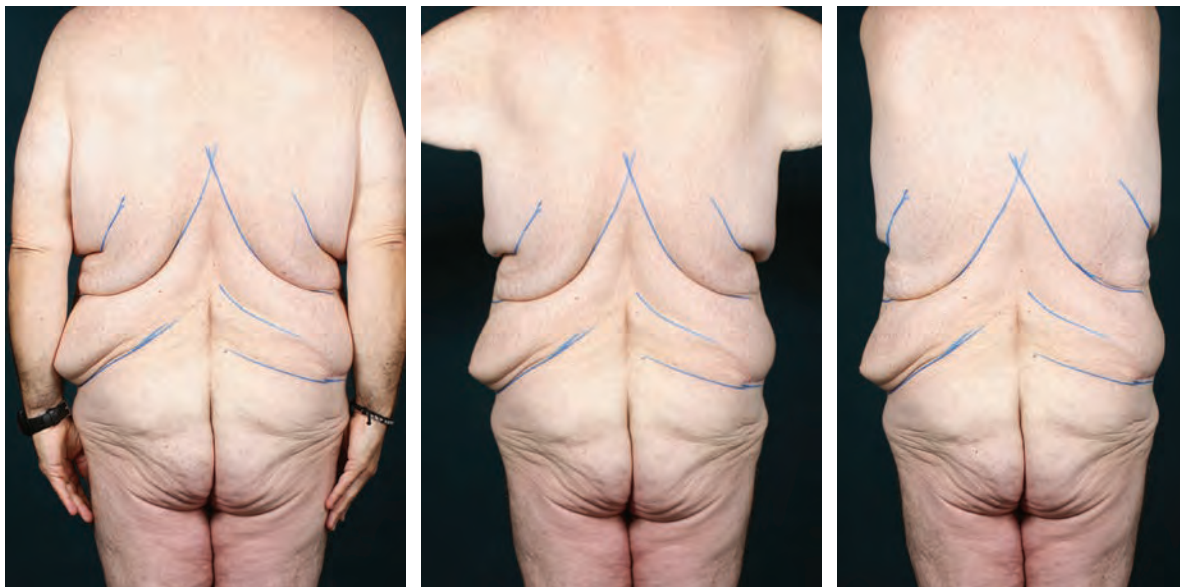
OPERATIVE APPROACH: UPPER TWO FOLDS

Liposuction Alone



We do not usually use liposuction-only for contouring the back folds but for treating back rolls of massive-weight-loss patients, because of the poor shrinkage capabilities of the thick skin of the back and because of the subjacent fibrous tissue, as seen in these two patients.

Markings



Back rolls should be carefully marked before the operation with the patient both standing and then lying down, because once the patient is positioned prone on the operation table, the rolls essentially disappear, thus making it nearly impossible to determine the areas of soft tissue excess.

Technique

We always use tumescent infiltration and superwet technique. Infiltration of the entire back is essential to achieve a consistent result. Then we massage the area to distribute the fluid among the fatty tissue. For liposuction we use 3 to 4 mm cannulas and a low suction pressure (0.3 bar). We start at the top and use a crisscross technique to avoid dimples and to achieve better skin retraction. The surgeon should not suction in the rolls alone but should cross their folds. Careful pinching provides essential information about the thickness of the tissue. Liposuction is stopped at the hip rolls, where we perform some superficial refinements with a 2 mm cannula. The procedure is complete when the tissue thickness is consistent all over. The patient wears a compression garment for 2 to 4 weeks.

Indirect Excisional Procedures

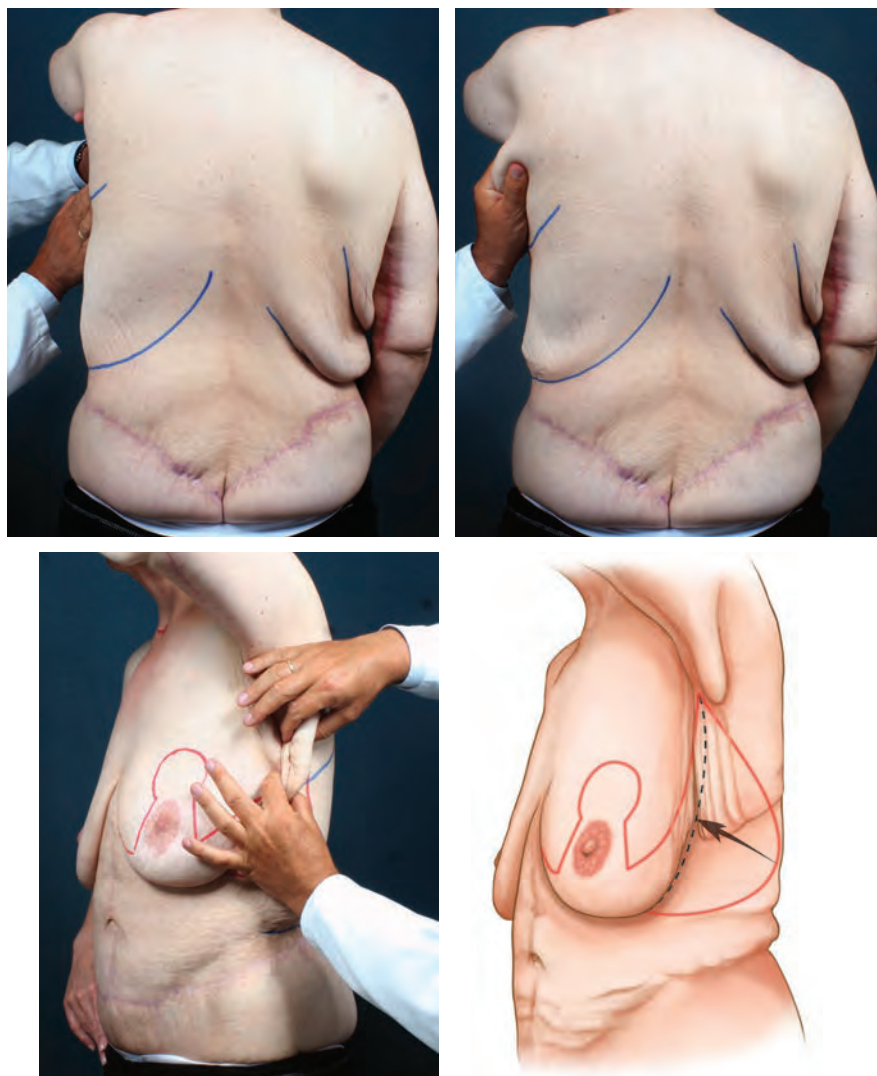
If there is an indication (after the LBL) for indirectly treating the two upper folds (the upper breast and lower scapular folds), we use an approach from the lateral thoracic region with a local excision for indirect lateral and dorsal thoracic rejuvenation.

Upper Lateral Thoracic Lift

Assessment and Markings



81-1 Upper lateral
thoracic lift

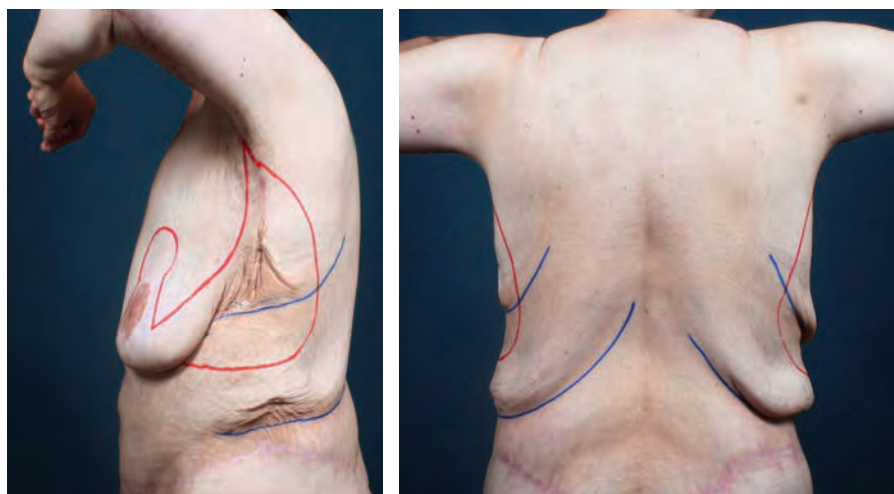


Our preferred method for moderate upper folds with more than 2 to 3 cm of overlapping skin is the ULTL (for Pittsburgh 3). To better assess whether this technique is appropriate for meeting the patient's expectations, it is helpful to grab the tissue in the lower axillary region and give it a good pull to see how much of the upper back folds will disappear or remain. In most cases, this lateral pull test will provide the surgeon and patient with a clear idea of what can be achieved.

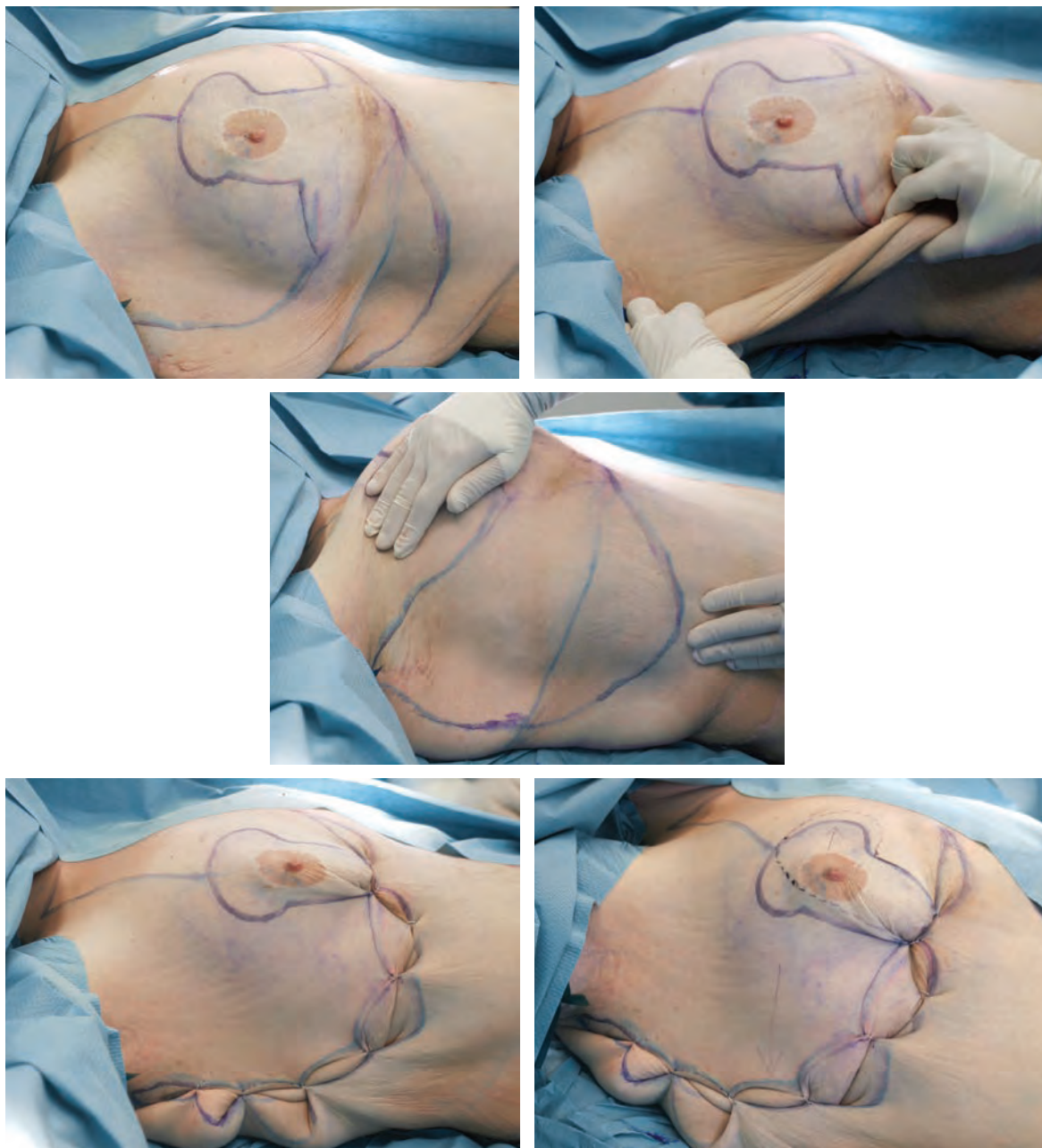
The ULTL is usually carried out in combination with a breast lift and upper arm lift. Typically a moderate extension of the incision that sweeps toward the back becomes necessary if an additional scapular fold exists. This means it is possible to achieve transposition and rotation of the soft tissue upward and outward so that the scar will be located in a medial or posterior axillary line.

For such an indirect excisional procedure without concomitant liposuction of the back, we position the patient supine with the upper arms at a 90-degree angle. This affords good access to the posterior resection line; however, in special cases we may place the patient in a lateral position, which results in considerable additional operating time.

With the ULTL, the breast fold is directly excised, and the laterocaudal tissue is removed through the lower incision. Balancing of the scapular fold can be achieved at the same time.

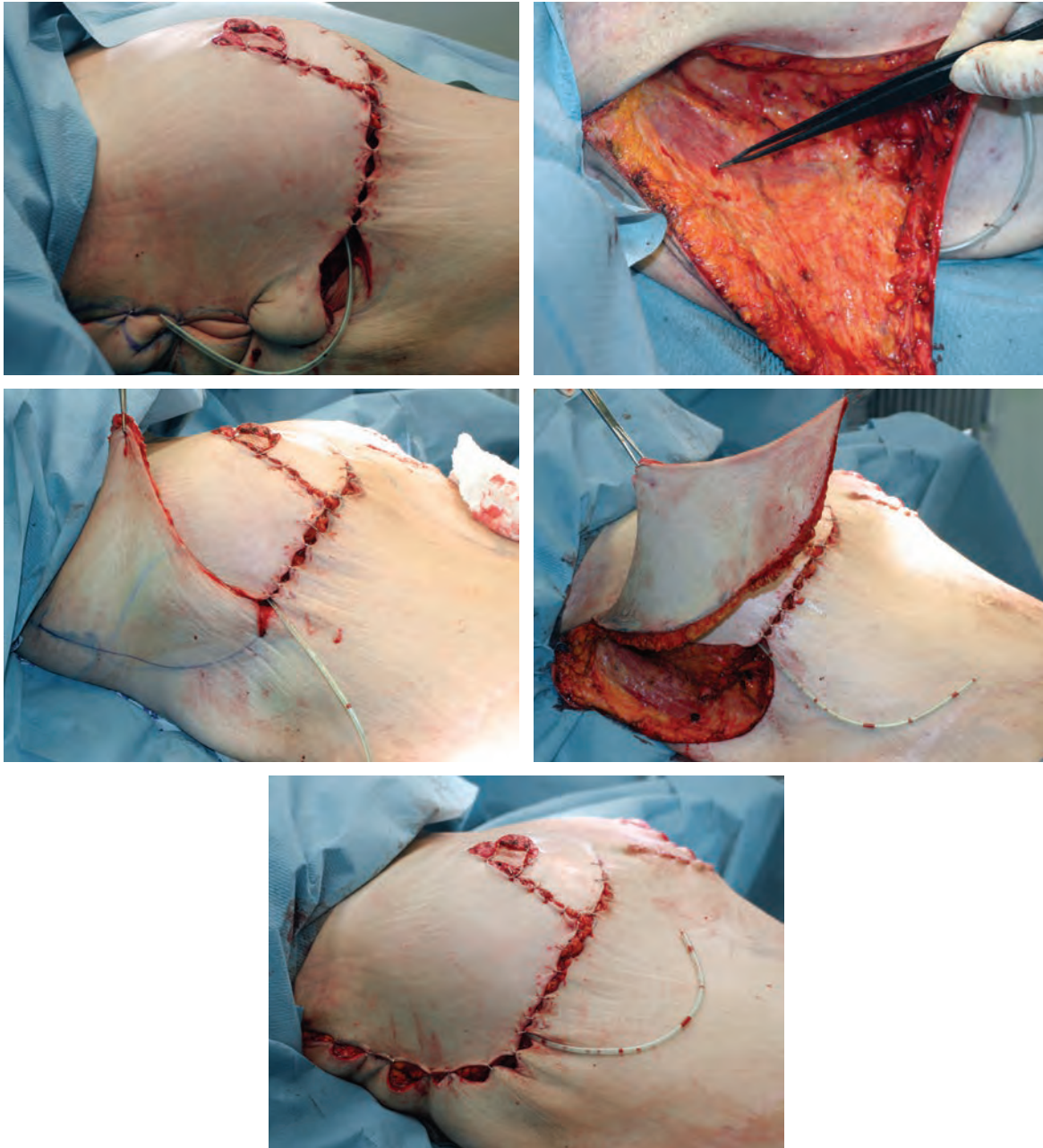


The ULTL can be carried out as a single maneuver just to address the back rolls, or, as is done in many of our cases, it can be used after an upper arm lift and breast lift to connect the lateral scar from the mastopexy procedure with the axillary end of the arm lift scar.



After carefully pinching and watching how much lateralization of the breast occurs with the patient supine, we begin the incision at the curved ventral line. Because there is no clear definition of Scarpa's fascia at this level, we do not go too deep and leave a small amount of fat on top of the deep fascia. This helps to protect underlying nerves, such as the lateral thoracic nerve and lower intercostobrachial branches.

Once the incision has been made and preparation has been completed to the dorsal resection line, we carefully pull the ventral wound edges dorsally, estimating whether the breast shows a tendency to move laterally. If there is too much lateralization, we suture the deep layer of the ventral wound edges down to the deep muscle fascia to provide a good anchor, usually with 2-0 Monocryl.



Then we pull the dorsal flap over the ventral wound edge and complete the resection. Before closing the wound with the dorsal tissue surplus, we pleat the tissue and tailor-tack it with towel clamps or staples.

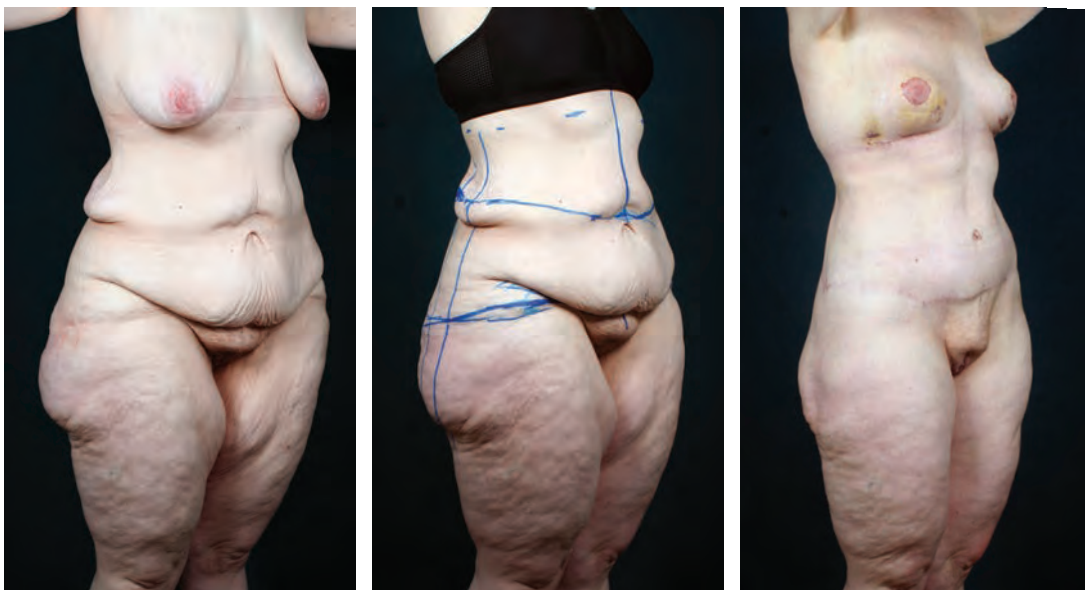
Combination Technique

In the vast majority of cases we treat our patients using a combination of liposuction and a lateral thoracic lift (CLTL). With this combination we can reduce the considerable tendency of the tissues to develop a seroma from direct undermining, and with liposuction we obtain additional movement of the otherwise poorly mobile fascial strands. However, because of the simultaneous liposuction and the greater degree of mobilization of the tissues, the upper incision line should be placed higher than for a standard body lift incision. The same applies to the mobilization of the two upper folds toward the axilla. Later shrinking effects appear to have no clinical relevance to the location or position of the scars.

Upper Folds

If a combination technique is planned, we place the patient prone initially so that we can treat the entire back first. This yields two benefits: the adipose tissue is reduced to an acceptable thickness, and we gain some additional release of the adherent tissue. That leads to more mobility upward and laterally toward the axilla. Then we turn the patient onto the back for the lifting procedure, as described previously.

Lower Folds



Although hip folds are sufficiently resectable with an LBL, the lower thoracic folds are more difficult to address. The upper incision line can be raised to catch at least half of the fold; however, the scar will be visible above the patient's underwear.

Attempts to address the lower thoracic fold by direct undermining through an LBL will lead to a massive seroma collection and severe wound-healing problems as a result of cutting the lower perforator vessels of the latissimus dorsi. We recommend not undermining the area above the LBL incision.

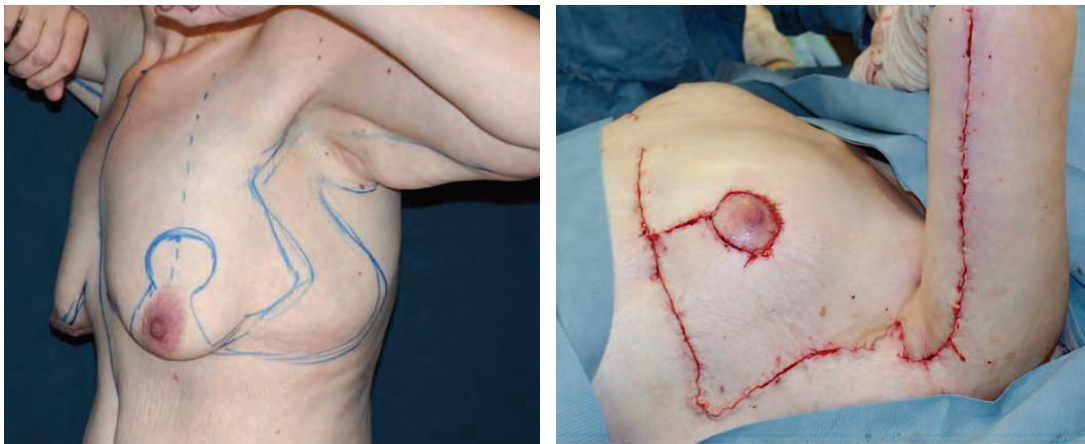


To eliminate the lower thoracic fold, we usually place the LBL incision higher than usual and perform a thorough liposuction above. This deflates the lower thoracic and hip rolls and enables us to move the tissues downward so that the scar will lie within the area covered by underwear. During liposuction we address the rolls in a crisscross manner to disrupt the connective bands and adhesions to the deep fascia.

Upper Lateral Thoracic Lift in Combination With Upper Arm and Breast Lift

In most of our cases we combine the ULTL with an upper arm lift and a breast lift to treat the whole unit. We start with the arm, usually with a double ellipse technique, as described by Aly. At the axillary end of the incision, we open up for the ULTL as described and close it completely. We then address the breast with the patient in an upright position, usually with the Rubin technique, to preserve volume and prevent bottoming out.

This sequence ensures that the areola is not placed too laterally and that we are able to compensate for the lateral pull being created with the ULTL.

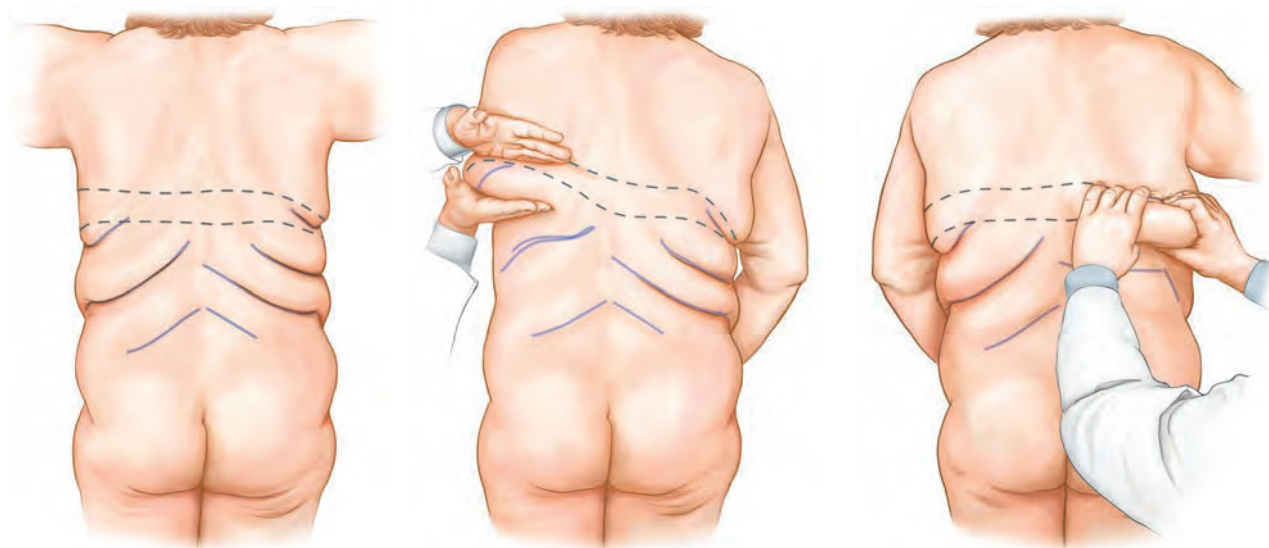


We usually break the scar with a Z-plasty at the level of the axilla to prevent the scar from contracting primarily. If necessary, this can be staged to be performed later.

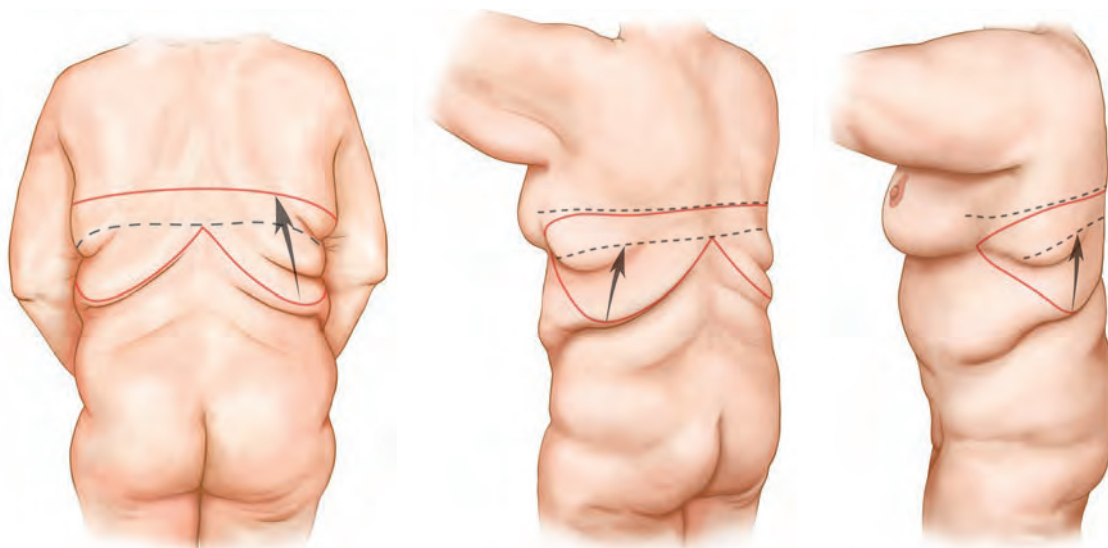
DIRECT EXCISIONAL PROCEDURES

Bra Lift

If the lateral pull test does not correct the entire deformity on the back, a direct excision with a horizontal or curved elliptical incision should be considered. While the surgeon is pinching and adjusting the amount to be resected, he or she pays attention to the thickness of the flap between the fingertips. We recommend proceeding as described by Aly, employing the double ellipse technique for the arms and thighs and using liposuction to thin out the flap that will be resected; otherwise, it may not be possible to close the wound, because the dermis of the back is thick and rigid.



With the patient's arms elevated, the bra markings are made, and the folds are marked (note the unequal number of folds bilaterally). The tissue excess is estimated and pinched.



The markings for the upper incision line and lower estimation line are shown. If the deformity is located more laterally, we extend the lower incision line like a W-curve.

The patient is placed in a prone position with the arms abducted 90 degrees. Infiltration and liposuction of the marked areas are performed. Thorough, careful liposuction in all layers preserves the lymphatic vessels in the deep layers. An incision is made from the top and continued downward, leaving a little fat on top of the deep fascia. The lateral extent of the Scarpa's fascia roll usually correlates with a separate deep fat structure that needs to be resected. It is advisable to reconstruct the fascia afterward to avoid dimpling.

We continue with the incision downward to the estimated lower resection line and do not go below this to prevent any dead space. We then do a final check of the lower resection line and proceed with careful resection and closure. Usually we insert two drains and apply compression garments, which the patient wears for 2 to 4 weeks.



The scar may be positioned within the bra line or within the relaxed tension lines of the back.

Upper Body Lift

To treat the whole upper body circumferentially as one unit, we use the upper body lift, which includes the following:

1. Breast lift
2. Arm lift
3. Upper lateral thoracic lift
4. Back lift (upper breast and lower scapular folds via bra lift)

The procedure is indicated primarily for massive-weight-loss patients with severe circumferential deflation. The procedure employs a combination of the four lifting procedures described previously.

Full Lateral Thoracic Lift

A full lateral thoracic lift (FLTL) with vertical excisions in the midaxillary line may be indicated in very select cases after a circumferential procedure in which there is still a skin and soft tissue surplus in the hips and/or upper abdomen as well as up-

per back folds. Careful pinching will demonstrate the potential result on the front and back with a vertical incision. In some cases it is advisable to break the scar line with a Z-plasty.

Postoperative Care

As for any other patient after a significant loss of weight, a standard antithrombotic treatment regimen with antithrombotic stockings and chemoprophylaxis is initiated. Prophylactic antibiotic therapy has not been necessary in our experience, and we avoid it to prevent the development of antibiotic resistance. We initiate patient ambulation on the day of surgery. We prefer that the patient be placed in a supine position in bed, even if a direct incision was done on the back; moving the patient is much easier when the patient is supine.

The patient wears a special compression corset for 4 weeks after liposuction of the back, with or without any lifting operation. After treatment of the lower folds only by an LBL, we do not order a special compression corset for the first 1 or 2 weeks, because we have concluded that compression of this circumferentially resected area may result in further reduction in perfusion (possibly causing delayed wound healing).

For at least 3 months silicone sheets are applied to the operated areas to improve maturation of the scars.

Problems and Complications

As in other body-contouring procedures, seromas frequently form in the back and hips. Even after radical liposuction, sporadic aspiration may be required, since cavities may develop in the septated fatty tissue and will fill with serous fluid.

Because of the risk of seroma, if a direct excision is performed, we suggest leaving a certain amount of fat beneath the underlying fascia to reduce flap shearing on the fascia. We further recommend the use of an ultrasonic scalpel to avoid heat while cutting and to seal the lymph channels. Wound drains are essential, as well as the compression garment previously mentioned. Wound dehiscence usually occurs in combination with seroma. Seromas are a minor complication if adequate preparation and closure have been done and there is no dead space. The axilla has a slightly higher risk of complications, such as wound-healing problems, because mobility in that region is high, and hygiene is poorer.

Subcutaneous depressions may result from liposuction that is overaggressive and too superficial. These are very hard to correct. They may be avoided by using a correct liposuction technique with a fine cannula and limited suction pressure.

Minor wound dehiscences and wound-healing problems are not uncommon after LBL procedures. Shearing forces especially put tension on the scars and should be avoided. The key to good scar formation is a well-defined preparation and suturing technique, careful tissue handling, and suture material that is patient compatible.

Outcomes

Upper body–contouring procedures have gained wide popularity among massive-weight-loss patients and are today performed as part of multistage body reconstruction after weight loss, whether the reduction has been from a nutritional regimen or a bariatric procedure. Technical improvements enable plastic surgeons to sufficiently treat the upper truncal contour to achieve patients' goals and expectations.

Depending on the patient's preoperative BMI, indications for direct excisional procedures of the dorsal thoracic region are rarely seen in patients with mild to moderate weight loss, and occasionally are appropriate in patients after massive weight loss. Although satisfactory results can be achieved with this approach, unfavorable scar placement and scar quality restrict the implementation of this procedure.

A more common and favorable procedure for improving the contour of the dorsal thoracic region is the ULTL. With this procedure the surgeon can eliminate appropriate amounts of tissue in various anatomic units. Optimal scar placement is possible, and the procedure can be performed alone or as an integral part of a combined contouring procedure of the upper arm, the lateral and dorsal thoracic wall, and the female or male breast. In women it is usually combined with an inverted-T pattern breast reshaping, elongating the submammary incision to the axillary crease. In men after massive weight loss we perform the direct excisional procedure for breast reshaping, optionally with a free nipple graft, as popularized by Aly, or as a pedicle transfer, as described by Rubin and colleagues. The submammary scar is ideally placed at the inferior boundary of the pectoralis major muscle and is well hidden at the lateral thoracic wall to the axillary crease.

Scar formation in upper body contouring is well accepted by patients, although results differ widely in quality and appearance as a result of the atonic skin quality with poor elasticity after significant damage to extracellular matrix components that can occur from bariatric surgery. In this regard, patients should be told that revisional surgery might be necessary, because the rate for secondary corrections in this patient group is relatively high as a result of skin and tissue relaxation.

Results



This 24-year-old man had reached a BMI of 62 at a weight of 210 kg (462 pounds). He then lost 130 kg (286 pounds) through diet and vigorous sports activities. He maintained a stable weight for 2 years and presented with a preoperative circumferential vertical excess of skin and soft tissue at the lower and upper truncal regions. His main complaint was the local fat depots in the hip region, which were extremely resistant to reduction despite his weight-loss efforts. In addition to excision of the gluteal skin excess, he asked that the lower scapular folds be eliminated bilaterally and requested breast and arm lifts. The patient is shown 3 months after a circumferential lower truncal dermatolipectomy, followed by an FLTL combined with breast reconstruction using a free nipple-areolar graft, and arm lifts. His vertical tissue excess and lower scapular folds were reduced sufficiently.



This 39-year-old woman had her greatest BMI of 64 at a weight of 176 kg (388 pounds); she lost 91 kg (200 pounds) after a gastric bypass procedure, and her weight stabilized at 86 kg (190 pounds). When initially seen, she had a circumferential vertical and horizontal excess of skin and soft tissue at the lower and upper truncal regions. Although a preoperative BMI of 31 and the documentary appearance might seem to indicate the need for further weight reduction, the patient felt absolutely comfortable with her weight, which she considered to be her ideal body weight.

The patient is shown 9 months after a circumferential lower truncal dermatolipectomy, 6 months after breast reconstruction in the technique described by Rubin, and 3 months after a direct horizontal excision in the dorsal thoracic region. The horizontal excision eliminated the preexisting lower scapular folds, including an incomplete upper breast fold on the right thoracic wall. Postoperative scar formation was impaired by scar dehiscence on the left dorsal thorax. Fortunately, the scar line was well hidden in the bra line.



This 43-year-old woman had lost 45 kg (100 pounds) 19 years earlier and had undergone breast reshaping and an abdominoplasty 17 years earlier. She had her greatest BMI at a weight of 183 kg (404 pounds), lost 113 kg (250 pounds) following a gastric bypass procedure; her weight stabilized at 68 kg (150 pounds). She presented with an extraordinary circumferential vertical and horizontal excess of skin and soft tissue at the lower and upper truncal regions, with multiple skin folds in the abdominal regions as well as dominant lower scapular folds, and less defined upper breast and hip folds. After reconstruction of the lower trunk by circumferential lower truncal dermatolipectomy and an inner thighplasty, the upper trunk was reconstructed initially with an upper arm lift and in the final step with a ULTL, in combination with breast reshaping with round silicone implants placed subpectorally.

She is shown 3 months after the final stage demonstrating an outstanding overall contour; she was very pleased with the results. The less than optimal scar quality in the axilla may require minor scar revision, which would be scheduled at the earliest 12 months postoperatively.



This 24-year-old man lost 82 kg (180 pounds) through diet and exercise. His BMI was 31 before a first-stage circumferential lower truncal dermatolipectomy; further weight loss was resistant to any soft tissue reduction in the area of the lower trunk. He was able to stabilize his weight at 78 kg (172 pounds). The first-stage procedure produced remarkable improvement of the lower trunk; significant recontouring in the gluteal region resulted in high patient satisfaction. The entire upper trunk was improved through a total upper body lift, including contouring procedures in the upper arm, lateral thoracic wall, and breast. The breast was reconstructed with a free nipple graft, setting the scar into the inframammary fold to emphasize the male breast shape, as described by Aly; the scar continues into the axillary region.

The patient is shown 6 months after the circumferential lower truncal dermatolipectomy and 3 months after the upper body lift. The upper trunk is greatly improved, as are the breasts, arms, and lateral and dorsal thoracic wall. The upper breast and lower scapular folds were eliminated by means of an indirect excisional combined lateral thoracic lift. Reconstruction of the inner thigh region is planned as a final step.

Clinical Caveats

The entire posterior, lateral, and anterior trunk should be considered as independent aesthetic units. Recognizing this, planning for treatment of the upper trunk should include an analysis of every single unit to achieve optimal results in a minimum of stages.

Lower body-contouring procedures such as circumferential lower truncal dermatoilipectomies should be performed initially, followed by upper body procedures.

Upper body procedures can be performed in single steps or as combined techniques to reduce operative and recovery time and produce superior results.

The correct choice of technique is the key to producing patient satisfaction. Generally speaking, massive-weight-loss patients are much more tolerant of longer scars than they are of a procedure that results in insufficient skin and soft tissue reduction.

Liposuction in massive-weight-loss surgery is commonly performed as an adjunct technique for contour refinements or may be performed preceding various excisional procedures.

Upper lateral thoracic lifts enable elimination of redundant skin and soft tissue in the lateral and dorsal thoracic regions by placing a well-hidden scar in the lateral thoracic region. This procedure can be performed alone or as an integral part of an upper body lift.

To prevent scar contractions in combined techniques, a Z-plasty can be included at the axillary crease level.

Horizontal back excisions that cross the relaxed tension lines usually result in unfavorable scars, although hiding horizontal scars under the bra straps is easier than with vertical incisions.

The postoperative recovery after upper body-contouring procedures can be compared with that for lower body-contouring procedures, although initially after upper trunk procedures, a patient's mobility in activities of daily living is impaired to a greater degree.

Key elements in optimizing the outcome of surgery is careful patient selection, optimal choice of procedure, careful preparation and dissection, gentle tissue handling, awareness of physiological changes, and the optimal choice of closure technique.

Continued

Clinical Caveats—cont'd

The closure technique, especially the choice of suture material, can greatly affect scar outcome. Any patient incompatibility to suture material should be determined beforehand, since it can result in delayed wound healing and impaired scar quality and appearance. Nevertheless, secondary scar or wound revisions should be undertaken as appropriate.

Complications can be reduced by cautious procedure planning and precise markings, which will reduce operative time and lead to minimal tissue handling and damage.

Complications that occur frequently in lower body-contouring procedures, such as seromas and minor wound separations, are less often associated with upper body-contouring procedures.

In general, patients with a lower BMI before surgery have fewer complications and a superior result.

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Strauch B, Herman C, Rohde C, et al. Mid-body contouring in the post-bariatric surgery patient. *Plast Reconstr Surg* 117:2200-2211, 2006.

Dr. Strauch and colleagues have developed unique variations of the circumferential and near-circumferential abdominoplasty operations at the height of the junction of lower and upper trunk. A cohesive operative sequence that includes optimized patient preparation and positioning, tailoring of flaps for improved contour with avoidance of unnecessary midline scars, a strong superficial fascial system closure, and coordination with the entire operating room team has been developed and is presented. Sufficient elimination of mild to moderate lower lateral and back folds is presented.

Strauch B, Rohde C, Patel MK, et al. Back contouring in weight loss patients. *Plast Reconstr Surg* 120:1692-1696, 2007.

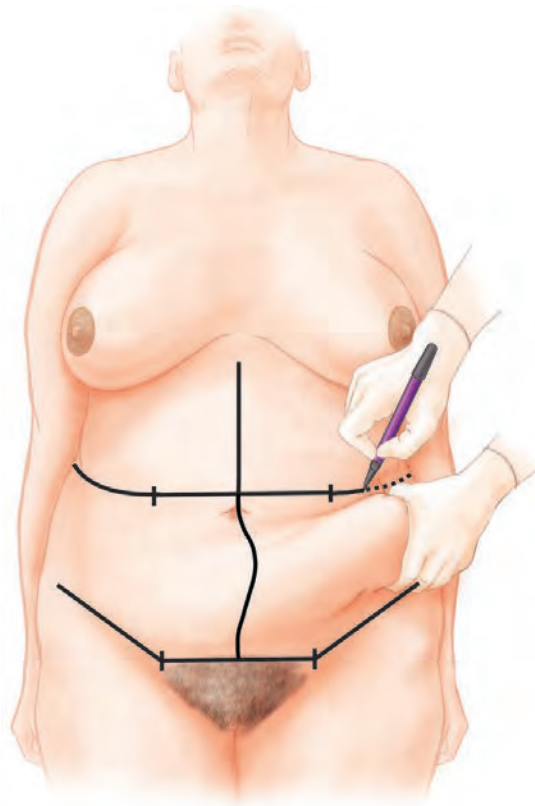
The authors have developed a classification system and surgical treatment for excess back tissue that eliminates the local folds.

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CHAPTER 82



Body Lift: *Belt Lipectomy*

AL S. ALY, ALBERT E. CRAM

Techniques for altering body contour have evolved significantly over the past century. Initially only dermatolipectomy techniques were used, but in the 1980s, when liposuction was introduced, it facilitated the ability of plastic surgeons to refine body contour with minimal scarring. Early on there was enthusiasm that liposuction might replace dermatolipectomy procedures completely. Although liposuction is still, and probably will always be, the most commonly performed body-contouring technique, it has limitations, especially in the area of skin retraction. In patients who have skin that will not conform to underlying structures after liposuction, dermatolipectomy is still required to effect the desired body contour.

Early in the twentieth century, truncal contouring was limited to excision of the pendulous pannus. Subsequently, abdominoplasty, in its various forms, was introduced for the treatment of abdominal wall laxity and skin excess. Currently, abdominoplasty is best used in patients with truncal deformity limited to the anterior abdomen. For patients who have a more generalized deformity of the trunk, abdominoplasty is inadequate. In fact, incomplete or partial treatment of patients with circumferential excess may lead to worsening of lateral and posterior contours. Thus, to treat the trunk as a unit, circumferential management is required. If the circumferential excess is mild to moderate, combining abdominoplasty with liposuction may achieve the desired contour. However, as the lateral and posterior excesses increase, there is a greater and greater need to extend the excisional component of the procedure around the trunk, eventually leading to the need for circumferential resection.

There are many names in the literature for circumferential dermatolipectomy/torso-plasty: *circumferential* or *extended panniculectomy*, *central body lift*, and *lower body lift*. We prefer the term *belt lipectomy*, because conceptually all of these procedures involve a combination of “lifting up” and “pulling down” of different aspects of the truncal anatomy. The word *lift* is somewhat inaccurate in this context. In this chapter, body lifting will be discussed in a wide variety of patient populations and will be referred to as belt lipectomy.

Evolution of Technique

The first surgeon to coin the term belt lipectomy was González-Ulloa in 1961. He used the technique on massive-weight-loss patients and described multiple turns in the operating room. Baroudi subsequently described many body-contouring excisional procedures, including circumferential truncal resections. Dardour and Vilain briefly described their belt lipectomy technique on patients with massive weight losses; it placed the final scar at midabdomen and may have added rectus fascia plication. Hunstad treated his obese patients by circumferential dermatolipectomy, extensive truncal liposuction, and subscarpal direct fat excision of the abdominal flap.

A number of other investigators subsequently contributed to our understanding of circumferential truncal contouring. Perhaps the most significant contribution to modern body contouring was made by Lockwood when he introduced the use of the superficial fascial system as an anchoring layer during closure of massive excisional procedures. This type of closure has led to better scars and a greater ability to excise more abnormal tissues during dermatolipectomy without the fear of dehiscence. He introduced a number of lower body-lift procedures that have paved the way for others in the pursuit of excellence in body-lifting surgery. Most recently, we critically evaluated a large series of belt lipectomy patients in a review article in which we delineated guidelines for patient selection, introduced a classification scheme for patients undergoing belt lipectomy, defined the truncal deformities encountered in our patient population, evaluated the effects of surgery on different groups of patients, and quantitatively reported on our complications.

Principles of Belt Lipectomy

Belt lipectomy is a combination of the following components:

- Abdominoplasty
- Lateral thigh lift
- Buttocks lift
- Liposuction of various areas

However, a belt lipectomy is not simply combining these procedures. The complexity of combining these procedures, and the wide variety of body types that can benefit from body lifting, make belt lipectomy a difficult procedure to master, with a significant learning curve. Although the procedure has some basic features that are common to most patients, the details of the technique are adjusted to each patient's present needs. For example, the technique used in a massive-weight-loss patient who is still obese is different in detail from the technique used on a patient in the normal weight range.

Belt lipectomy is an extensive procedure. It requires multiple turns of the patient in the operating room, results in a very large area of surgical injury, and leaves a long circumferential scar. Although it is possible for a single experienced surgeon to perform a belt lipectomy alone, it is often necessary to use an experienced assistant to reduce potentially long operative times.

Complications are not uncommon with this type of surgery, and both the surgeon and the patient must be willing and able to deal with setbacks. The postoperative recovery can be long, in some cases up to 6 weeks, which can cause strain for the patient and surgeon alike. Patients require both physical and psychological support for a relatively long recovery period.

The trunk is a body unit, with the thorax constituting the superior subunit, and tissues from the lower aspect of the thorax to the pelvic rim constituting the inferior subunit. The *unit principle* described by Millard dictates that when one is reconstructing defects, it is best to reconstruct the whole unit and place the final scars along natural junctions or between anatomic units. Burget and Menick, in discussing reconstruction of the nose, emphasized the importance of creating proper contour matching of the natural topographic nasal anatomy within each reconstructed subunit. Belt lipectomy surgery is an extrapolation of these important principles, applied to the trunk. The surgeon's goal is to create proper contour of the inferior subunit of the trunk and to place the resultant scar in natural junctions.

Another major advantage of circumferential dermatolipectomy procedures, despite their being extensive and associated with significant morbidity, is the high patient satisfaction rate. Studies conducted on patients who have undergone belt lipectomy demonstrate an improvement in the overall truncal contour in a wide variety of patients, as rated by both the surgeon and the patient.

Indications and Contraindications

Indications

There are many patients who can benefit from a belt lipectomy. Their presentations, goals, and outcomes vary considerably. They are grouped here into clinically relevant categories.

Massive-Weight-Loss Patients

Advances in bariatric surgery and the recognition of obesity as a leading health risk factor in the United States, have led to an increase in the number of patients requesting body contouring after massive weight loss. Although the medical benefits of weight loss, such as reduction or elimination of diabetes and high blood pressure, are by themselves worth the time and effort, the resultant body contour in most patients is less than ideal. Often these patients are surprised and dismayed by their appearance. If they are able to undergo body-contouring surgery, it can be the final step in their life transformation. Post-massive-weight-loss body contouring is the new frontier in plastic surgery, and it will become one of its major subspecialties in the near future.



The plastic surgeon will see a wide range of body contours and sizes in massive-weight-loss patients. These individuals also have differences in the thickness of subcutaneous fat, skin-fat envelope redundancy, and in their fat deposition patterns.

Multiple factors have been found to contribute to the diversity encountered with massive-weight-loss patients. The first and most important is their BMI at presentation. BMI relates the patient's weight to their height and is the most commonly used obesity index. It is calculated as shown in the box on p. 2890.

Calculating Body Mass Index

$$\frac{\text{Weight in kilograms}}{(\text{Height in meters})^2}$$

or

$$\frac{\text{Weight in pounds}}{(\text{Height in inches})^2} \times 703$$

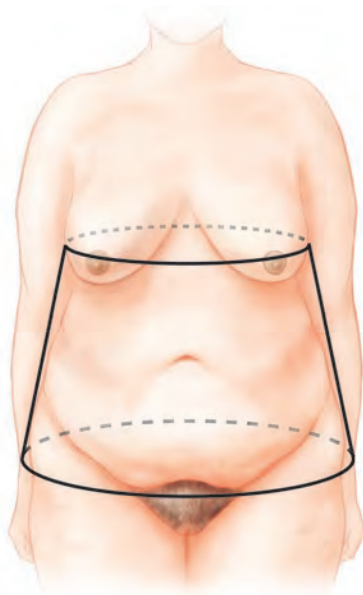
The upper limit of normal is 25; 26 to 29 is considered overweight; 30 to 35 is considered obese; and greater than 35 is considered morbidly obese.

The actual weight-loss process, whether from bariatric surgery or changes in lifestyle, will stabilize or plateau at different levels in different individuals. The level of this plateau is not easily altered. Thus BMIs at presentation will range on a continuum from individuals who are still significantly obese to those who are near their ideal weight. A second factor contributing to the diversity in presentation is the quality of the skin fat envelope, which includes its thickness, elasticity, and, what is most important, what we have coined as the *translation of pull*.



The translation of pull is determined by pinching tissues in the proposed area of resection, simulating the effects of the surgical resection on the tissues above and below. This patient demonstrates a significant translation of pull, which can be seen by the patient and surgeon before surgery. The third major factor affecting the diversity of massive-weight-loss patients is their genetically controlled fat deposition pattern, which dictates the amount and location of fat during weight gain and loss.

Although quite variable in presentation, massive-weight-loss patients share a common factor: almost all will have an inverted-cone appearance to their inferior trunk—narrower at the ribcage and wider at the pelvic rim. Anteriorly, they have varying degrees of pendulous panniculi and may have one, two, or, occasionally, three rolls. It is not clear why these extra rolls develop, but there are probably fibrous connections between the skin and underlying muscle fascia that are similar to the inframammary crease anatomically. Almost all massive-weight-loss patients will present with some degree of abdominal wall laxity. Many also have hernias of varying sizes and locations, especially patients who have had open bariatric surgery procedures. The mons pubis frequently has ptosis, lipodystrophy, and varying degrees of vertical and horizontal excess. The opening of the vulva in women and the takeoff of the penis in men will face downward to varying degrees, rather than the normal anterior vector.



Laterally, massive-weight-loss patients will lack definition of the waist because of excess tissue hanging from the narrower ribcage to the relatively wider pelvis, which tends to camouflage the underlying anatomy. Many patients have fairly large and distinct hip rolls. The lower back is often indistinct from the superior aspect of the buttocks. Some patients have lower back rolls; others do not. The buttocks in many patients are overprojected and simply blend superiorly with the hip excess, giving the buttocks a vertically long appearance. In other patients, the buttocks may have no excess in posterior projection but often still lack definition. The superior extent of the central buttocks crease in some is fairly low, and it may be combined with a loss of soft tissue cover over the coccyx. The infrabuttock crease varies greatly in presentation, depending on the BMI. When patients are still in the obese range, the infrabuttocks creases are usually very abnormal in appearance and are horizontal rather than semicircular. In patients who have reached BMIs near their ideal body weight, often the infrabuttocks creases will show redundancy.

The goals for an individual patient may vary within the massive-weight-loss group, but in general, there is a desire to return the patient's truncal contour to the normal range for the general population. More specifically, goals in the abdominal area include elimination of hanging tissue and restoring a flat contour. If the mons pubis is ptotic, it should be lifted to a more superior position to produce an anterior-facing vulva in women and an anterior penile takeoff point in men. An hourglass figure, with narrowing at the waist, should be reconstituted, although to a lesser degree in a male patient. Posteriorly, lower back rolls should be reduced or eliminated. A clear delineation between the lower back and buttocks should be created. The desired improvement in the buttocks proper is highly dependent on the initial presentation. If the buttocks are overprojected, they should be reduced. If they are already underprojected, they should be better defined but not reduced in projection. The central buttocks crease in some patients requires elevation to a more superior position. If possible, the infrabuttocks crease should be altered to approximate a normal semicircular appearance.

A subgroup of massive-weight-loss patients includes individuals who have undergone anterior truncal resections but are still unhappy with persistent lateral dog-ears, a lack of definition in the waist, and lack of improvement in posterior truncal contour. The number of patients presenting in this manner is increasing as massive-weight-loss patients are either convinced to, or choose to, undergo resections limited to the anterior trunk. The goals of this subgroup of patients are similar to those of massive-weight-loss patients who have not undergone these resections. Depending on the extent of their initial procedure, these patients may need a full belt lipectomy, a modified belt lipectomy, or a partial belt lipectomy limited to the lateral and posterior resections.

Non-Massive-Weight-Loss Patients

Patients Who Are 20 to 30 Pounds Overweight

Non-massive-weight-loss patients usually request either liposuction or an abdominoplasty but are 9 to 14 kg (20 to 30 pounds) over their ideal body weight. They have usually tried to lose the weight over many years but have been unable to, despite genuine attempts. They may be young with good skin elasticity, or older with significant skin laxity. Typical truncal contour deformities include abdominal wall laxity, skin and fat excess, and lateral and back excess. Many will have lower back rolls and buttocks ptosis. They may or may not have lateral and medial thigh lipodystrophy. If these patients undergo simple abdominoplasty, significant lateral dog-ears may be created, and their lateral and posterior contours will not be improved. If liposuction is combined with abdominoplasty, adequate improvement may be achieved. However, this combination of procedures will not result in lifting of the lateral thighs

and buttocks or a more defined waist, especially if the typical abdominoplasty incisions are not extended around to the back. The goals for this group of patients include a flat abdominal contour, waist and hip definition, elimination or reduction of lower back rolls, raising and definition of the buttocks, and reduction in lateral thigh excess and ptosis. These patients start out with bodies that are within the norm for the overall population, and they desire a greater shift toward ideal when compared with many massive-weight-loss patients.

Normal-Body-Weight Patients

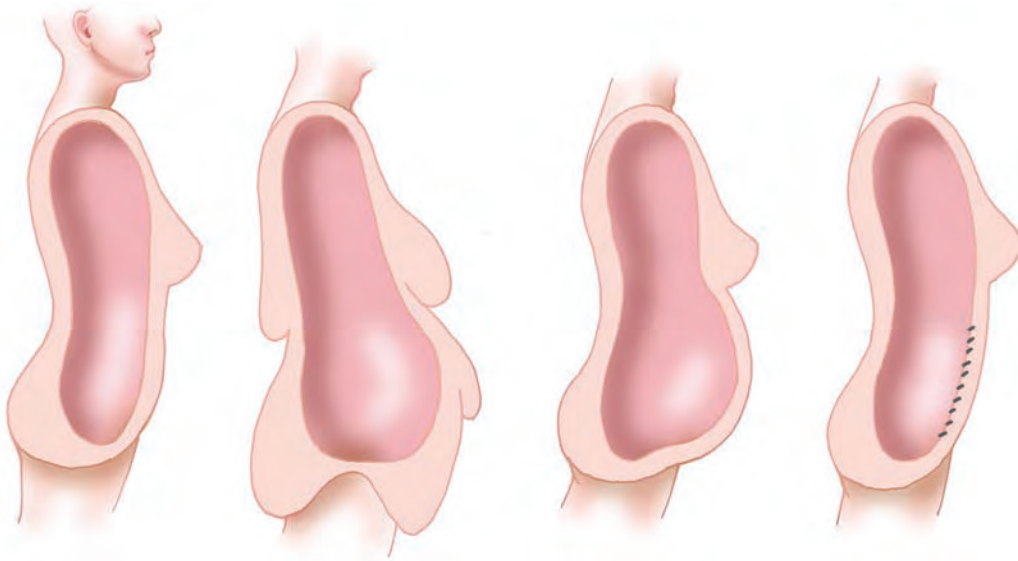
Patients of normal body weight present with abdominal wall laxity and/or skin excess. They also usually have different degrees of isolated fat deposits in the lateral thighs and hip regions. Most patients who present in this manner can benefit from abdominoplasty, with liposuction of the areas involved with lipodystrophy. The reasons for considering belt lipectomy in this group include a desire for significant anterior and lateral thigh elevation, buttocks elevation, and a remarkable improvement in lower truncal contour.

Contraindications

As with any elective surgery, belt lipectomy should not be performed in patients with significant medical or psychiatric problems. The possible fluid shifts and alterations of intravascular volume during a belt lipectomy can stress a less than optimally functioning heart. Almost all patients who undergo a belt lipectomy will need a significant amount of abdominal wall tightening by various forms of rectus fascia plication. As the abdominal wall is tightened, the intraabdominal contents are pushed up onto the diaphragm and in turn onto the lungs, leading to some restriction of pulmonary capacity. In patients who have significant lung disease, pulmonary compromise may occur. Thus patients with significant chronic obstructive pulmonary disease (COPD) or restrictive lung disease are not good candidates for belt lipectomy. With the inherent compromise of blood supply of undermined abdominal tissues during the procedure, conditions associated with decreased vascularity, such as smoking, are to be avoided in most instances. We have recently performed belt lipectomy on well-selected diabetic patients; however, it is not clear at this point whether this will become routine.

Patients who have lymphedema of their anterior abdominal pannus are not good candidates for belt lipectomy, since they will almost universally redevelop lymphedema and a hanging pannus. It is best to avoid such extensive surgery in the face of almost certain failure, and such patients should be counseled accordingly.

Patients with excessive intraabdominal content are not good candidates for belt lipectomy. The illustrations below demonstrate why this is true.

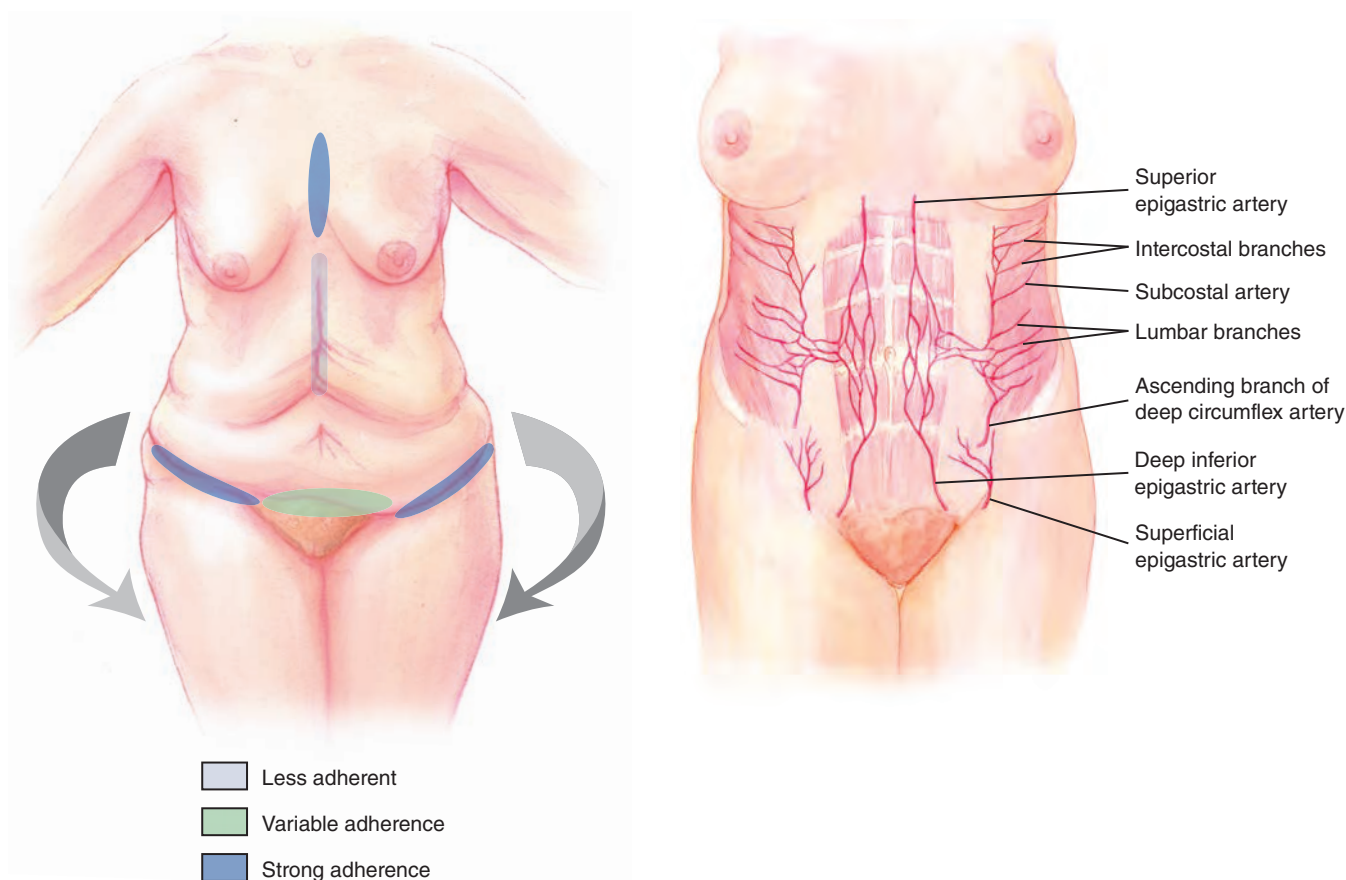


Conceptually, the inferior trunk can be thought of as two balloons, one inside of the other. The outer balloon is the skin and the inner balloon is the abdominal wall musculature, within which the intraabdominal contents are contained. Fat is contained between the two balloons and inside the abdominal cavity.

If both balloons are overinflated by weight gain and subsequently deflated by weight loss (*second from left*), then reducing the outer balloon without being able to flatten the inner balloon will lead to a persistently convex contour (*third from left*). The appearance of a patient with excessive intraabdominal content after a belt lipectomy is similar to a patient who undergoes a simple panniculectomy. Since a panniculectomy is a simpler and less risky procedure, obese patients who have excessive intraabdominal content are advised to lose weight or undergo a traditional panniculectomy. Thus a basic requirement for patients undergoing belt lipectomy is that their intraabdominal contents allow abdominal wall flattening by rectus fascia plication.

Hormonal manipulation of body fat content is an emerging field in the medical management of obesity. In general, growth hormone deficiency is associated with an increase in both subcutaneous and intraabdominal fat, with a preferential increase in intraabdominal fat. Growth hormone replacement will lead to an overall decrease in body fat content, with a relatively greater loss of intraabdominal fat. Testosterone is also known to decrease the overall body fat content, with selective activity at the intraabdominal level. Thus in the future it may be possible to use these hormones to decrease intraabdominal fat in patients who tend to retain it after massive weight loss to allow better abdominal wall tightening during body-contouring procedures.

Pertinent Anatomy



The soft tissues over the inguinal region and at the junction between the hip and lateral thigh fat deposits are anchored by zones of adherence consisting of fascial attachments that restrict both elevation and descent of the tissues surrounding this region. The inguinal region zones of adherence, along with a variable-strength suprapubic zone of adherence, create a lower abdominal area of restriction that is responsible for why a hanging pannus hangs. It is also these horizontal zones of adherence that are essential to understanding how to control scar position in the marking process. There is a weak midline abdominal zone of adherence that is usually inconsequential to excisional body-contouring procedures.

The blood supply of the abdominal flap after its elevation off the underlying muscular fascia is reduced to the lateral intercostal, subcostal, and lumbar vessels, as shown. Although this is similarly encountered in a traditional abdominoplasty, the blood supply in a belt lipectomy maybe jeopardized to a greater extent when some techniques are used in particular patients because of the need for more extensive lateral dissection of the abdominal flap.



Massive-weight-loss patients also have various zones of adherence in the superior truncal subunit of the thorax.

Preoperative Assessment

History and Physical Examination

A complete history is taken and a thorough physical examination is conducted on all patients being considered for belt lipectomy. The patient's weight history, exercise routine, and nutritional habits are documented. Patients whose weight is fluctuating when they are initially seen should not be operated on until they reach a stable weight. Patients who are in the midst of heroic efforts to lose weight, such as starvation diets or overly taxing exercise regimens, should not be considered candidates, because most patients are not able to sustain such efforts over a lifetime. Patients with significant medical problems, uncontrolled psychiatric difficulties, and smokers are not good candidates and should be counseled accordingly.

As stated, postoperative recovery from a belt lipectomy is long, and complications are not uncommon. Even for patients with adequate psychological reserves to handle such stress, psychiatric difficulties can arise. Many massive-weight-loss patients present with a concurrent psychiatric illness and are at risk for acute flare-ups during recovery. A preoperative psychiatric clearance should be considered in these patients.

The patient's BMI should be determined. Although the BMI is not always accurate, especially in an athletic male with a relatively large muscle mass, it is helpful for predicting results and potential complications. The patient's overall body contour is examined circumferentially, with close attention to the inferior truncal subunit, thighs, thorax (superior truncal subunit) and upper arms.

The surgeon must determine the extent of abdominal wall laxity and whether the amount of intraabdominal content is excessive. In patients within the normal weight range, this is determined by abdominal wall palpation and the classic "diver's test," in which the patient bends forward from the waist, revealing any abdominal wall laxity. This is more difficult to determine in patients with higher BMIs but can be established by placing the patient in the supine position and observing the abdominal wall contour. If the abdomen is scaphoid, it is likely that the intraabdominal contents are not excessive, which should allow rectus fascia plication to tighten and flatten the abdominal wall. Conversely, if the abdomen in the supine position is convex and protrudes above the ribcage, intraabdominal content is excessive and belt lipectomy should not be considered as an option. The surgeon should search thoroughly for hernias, because it is not unusual for patients to have incisional, ventral, or periumbilical hernias. The patient's fat distribution pattern and skin quality should be examined. Subcutaneous fat thickness and skin mobility over the underlying muscular anatomy are noted. Generally, thinner subcutaneous fat layers increase the likelihood that the skin will be fairly mobile when resection is attempted. For patients who have had bariatric surgery, the following laboratory tests should be obtained: complete blood cell count, blood urea nitrogen, creatinine, electrolytes, glucose, urinalysis, liver function, iron, calcium, albumin, prealbumin, total protein, and thiamine. Chest radiographs and electrocardiograms are obtained if indicated.

Patient Education

Because of the magnitude of belt lipectomy surgery, patients should be counseled extensively in the preoperative period. This will help the patient and the surgical team develop rapport, which is invaluable in the relatively long postoperative recovery period. Both the patient and plastic surgeon should clearly understand the presenting deformities and the patient's realistic goals. An overview of the surgery, the typical postoperative course, and the possible risks and complications should be thoroughly discussed. This is especially important because patient cooperation is essential in preventing complications in the early postoperative period. For many patients, especially massive-weight-loss patients, body-contouring surgery is the culmination of a life transformation, and it may be the toughest hurdle from a physical, psychological, and financial standpoint for them. Thus it should be presented to them as a "major life event."

Preoperative Planning

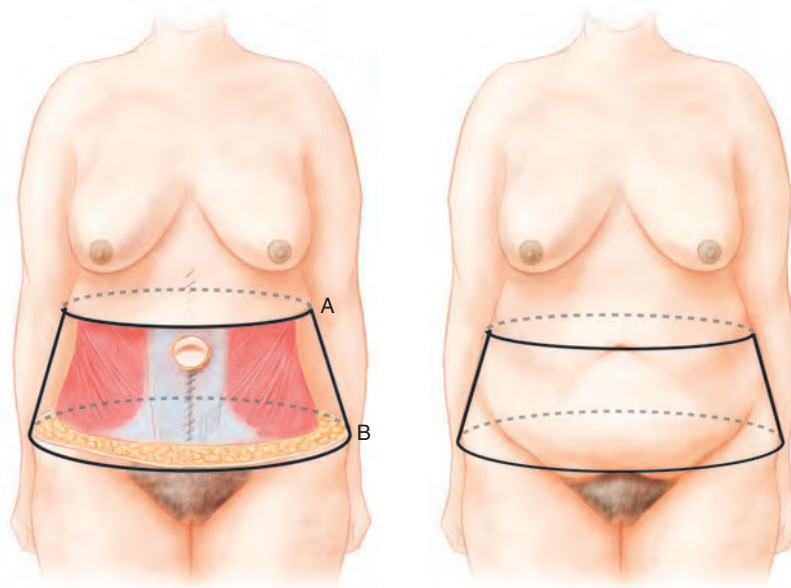
Markings

The markings are usually done 1 or 2 days before surgery. These are photographed; the surgeon evaluates the photos and may make changes based on the findings. As with the whole field of body lifting, the markings have evolved and will continue to evolve to produce the best results and to adjust to new and unique problems. The markings are different for every patient, and the sequence described here is intended to be a starting point from which to diverge and adjust to attain the best result.

A number of concepts should be stressed in performing the markings:

The money is in the belly. The abdominal contour attained after surgery should be as good as possible given a particular patient's anatomy. It should be of higher priority than the posterior contour in treating most patients because it is the area of greatest deformity, especially in the massive-weight-loss patient, and it is also the most visible area to the patient.

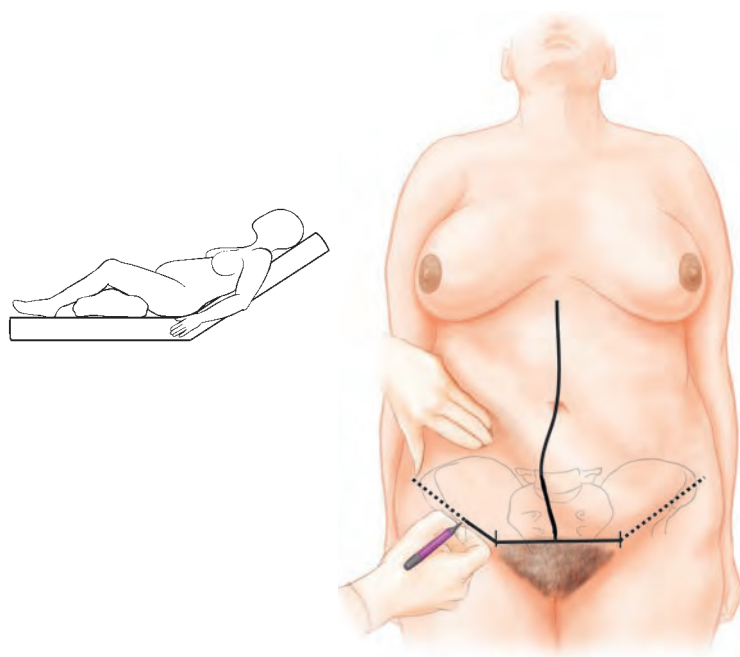
The lateral resection should be maximized. The patient's lateral contour is also very important and should be stressed because it is highly visible and easily judged by the patient. Although in some patients the waist region does not need significant improvement, in most patients it is essential that this area be contoured as aesthetically as possible.



The markings delineate the superior and inferior extents of a circular excision in an inverted-cone shape. If the circumference of the superior proposed line of excision (A) is compared with the circumference of the inferior proposed line of excision (B), A is always shorter. Occasionally the distances are equal,

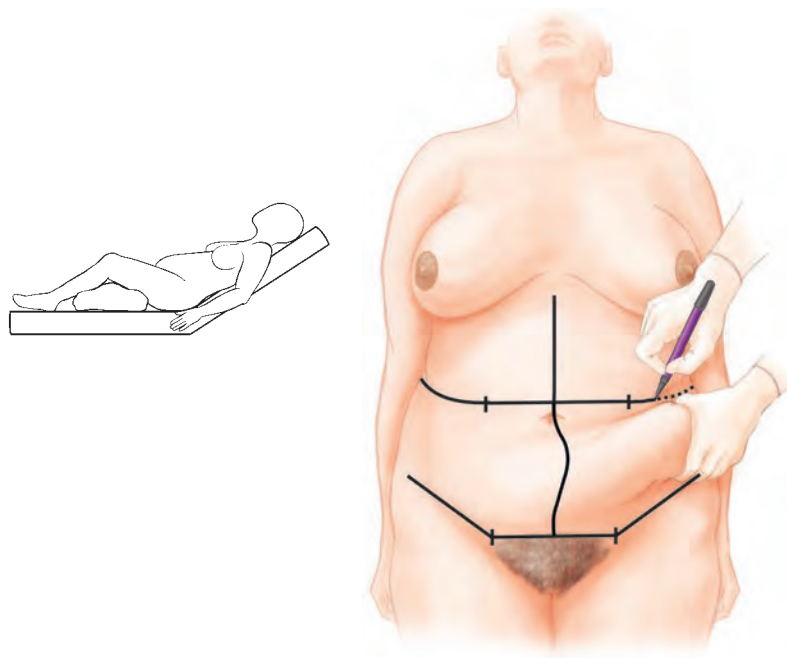
but *B* is almost never shorter than *A*. This is important, because it explains the fact that in almost all patients there is no need to decrease upper truncal horizontal excess, as would be attempted with a fleur-de-lis pattern.

The markings should be considered as guides to the resection. The actual resections should be adjusted to intraoperative tension.



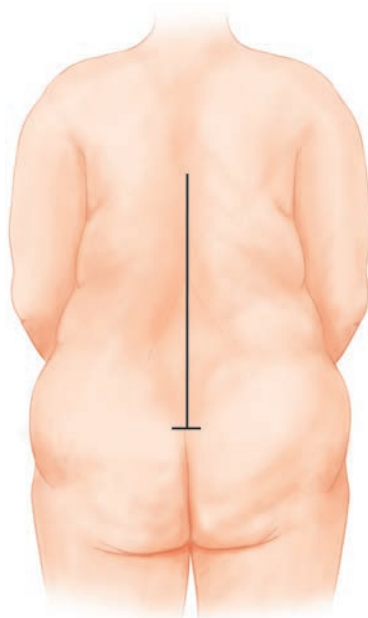
The patient's anterior midline is marked. In non-massive-weight-loss patients, the horizontal mons pubis mark is made similar to the marking for traditional abdominoplasty, usually at the natural suprapubic crease. A massive-weight-loss patient is placed in the supine position, the mons pubis is pulled up into a pleasing appearance, and the pubic bone is palpated. At a point 1 to 2 cm above the bone, the horizontal mark is made from one lateral edge of the mons to the other. In some patients this may lead to eliminating as much as 15 cm of hair-bearing skin.

With the patient in the supine position and slightly bent at the waist, a line is drawn from the lateral aspect of the mons pubis and directed toward the anterior superior iliac spine (ASIS). The mark is made after the abdominal tissues are manually elevated superomedially to estimate the amount that the inguinal tissues will lift. The zone of adherence in the inguinal region limits the extent of this lift. This maneuver simulates tissue dynamics at closure and allows the surgeon to predict final scar position to a great degree. The pull of the manual elevation of the flap simulates the superomedial pull of the resected abdominal flap. The inguinal zone of adherence acts to limit that elevation. We prefer a "French bikini" angulation of this mark, with the line drawn aiming slightly above the ASIS. If the surgeon prefers a flatter-angled scar, the same superomedial elevation of the abdominal tissues is performed, and the scar is drawn where the surgeon wants it.

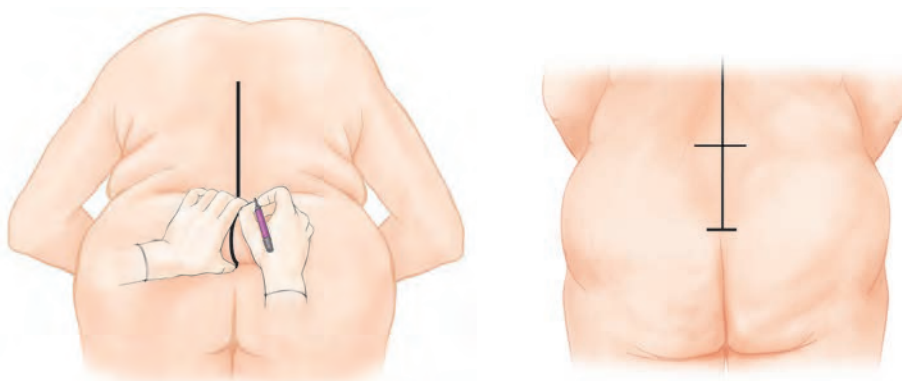


The proposed superior extent of the anterior resection is marked. Centrally, the mark is made similar to that for a traditional abdominoplasty and should not be tempered by the subsequent back resection, because the anterior resection is stressed over the back resection. In non-massive-weight-loss patients it is usually just above the umbilicus, whereas in massive-weight-loss patients the mark may be considerably higher. Because of the circumferential nature of belt lipectomy, the lateral abdominal excisions are marked without concern for possible dog-ears, as in the case of abdominoplasty markings. The markings are made with the aid of the pinch technique and should be as aggressive as they need to be to create a flat lateral contour. Laterally, the superior proposed mark should be made fairly flat, because angulating this aspect of the mark may lead to compromise of some of the remaining abdominal flap intercostal, subcostal, and lumbar vessels. In turn, this can cause central flap necrosis.

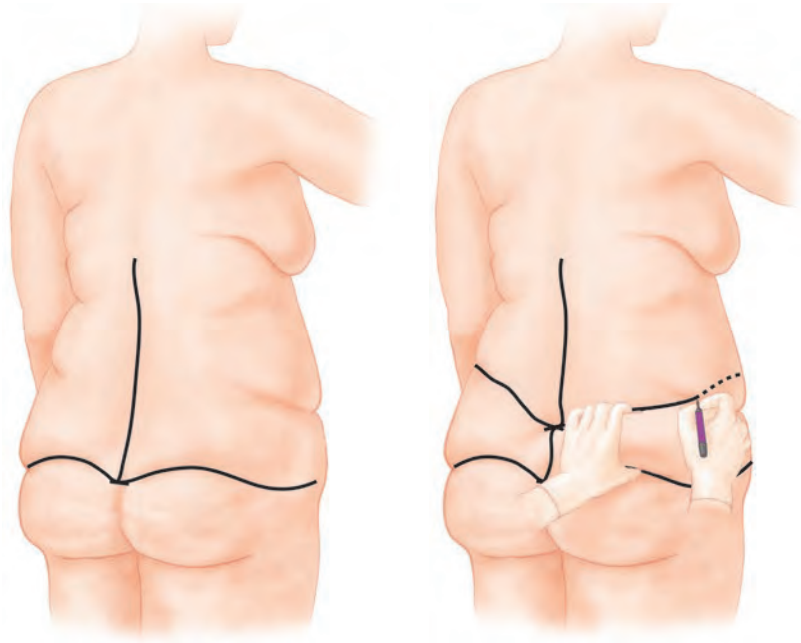
Anteriorly, the inferior marks control scar position.



With the patient standing, the back midline is marked. A decision has to be made as to the vertical level of the posterior resection. In many patients this is a fairly easy decision, because the area of posterior excess is fairly well delineated by the natural anatomy. In others it is not evident, and the surgeon has to decide on the level based on the desired goal. Some patients have excessive buttock protrusion, and their resection level should include the superior aspect of the buttocks proper to allow for an appropriate reduction. Other patients have normal or less-than-normal buttock projection, and the level of resection in these patients should be more superior to avoid decreasing the projection farther. Part of this decision is also based on the surgeon's aesthetic sense and the patient's desires. Once the level of resection is decided on, the inferior midline mark is made.



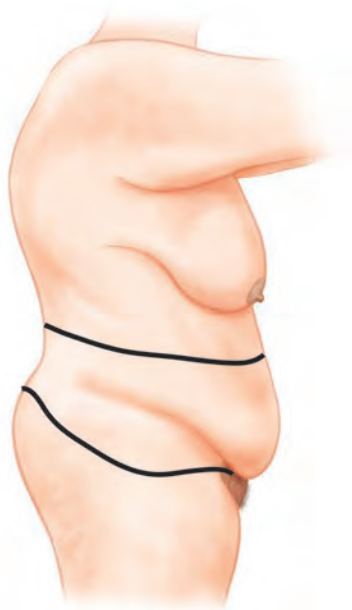
The superior extent of the midline back excision is marked with the patient flexed at the waist to approximate the bent position in which the patient will be at the completion of the anterior resection. *This is a very important step in preventing wound dehiscence.*



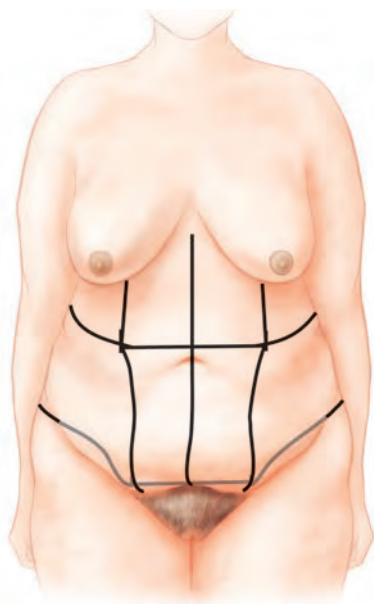
The inferior aspect of the back excision is then marked from the midline toward the lateral aspect of the trunk. Centrally, a shallow widow's peak is created at the midline, and bilateral lazy S's are drawn. In most patients the areas that need the greatest elevation posterolaterally are the lateral buttocks and lateral thigh regions. Resecting more laterally in these regions will create a better lateral contour and will improve the shape of the infrabuttocks crease in most patients.

The superior extent of the back excision is marked using the pinch technique. Generally, this mark is placed fairly close to where the actual final scar will end up, since back tissues are restricted in their movement because of their stronger zones of adherence, whereas buttocks tissues are quite mobile. Thus tissues from the buttocks and lateral thighs are lifted to the position of the superior incision in this region rather than the lower back tissues descending to the inferior tissues.

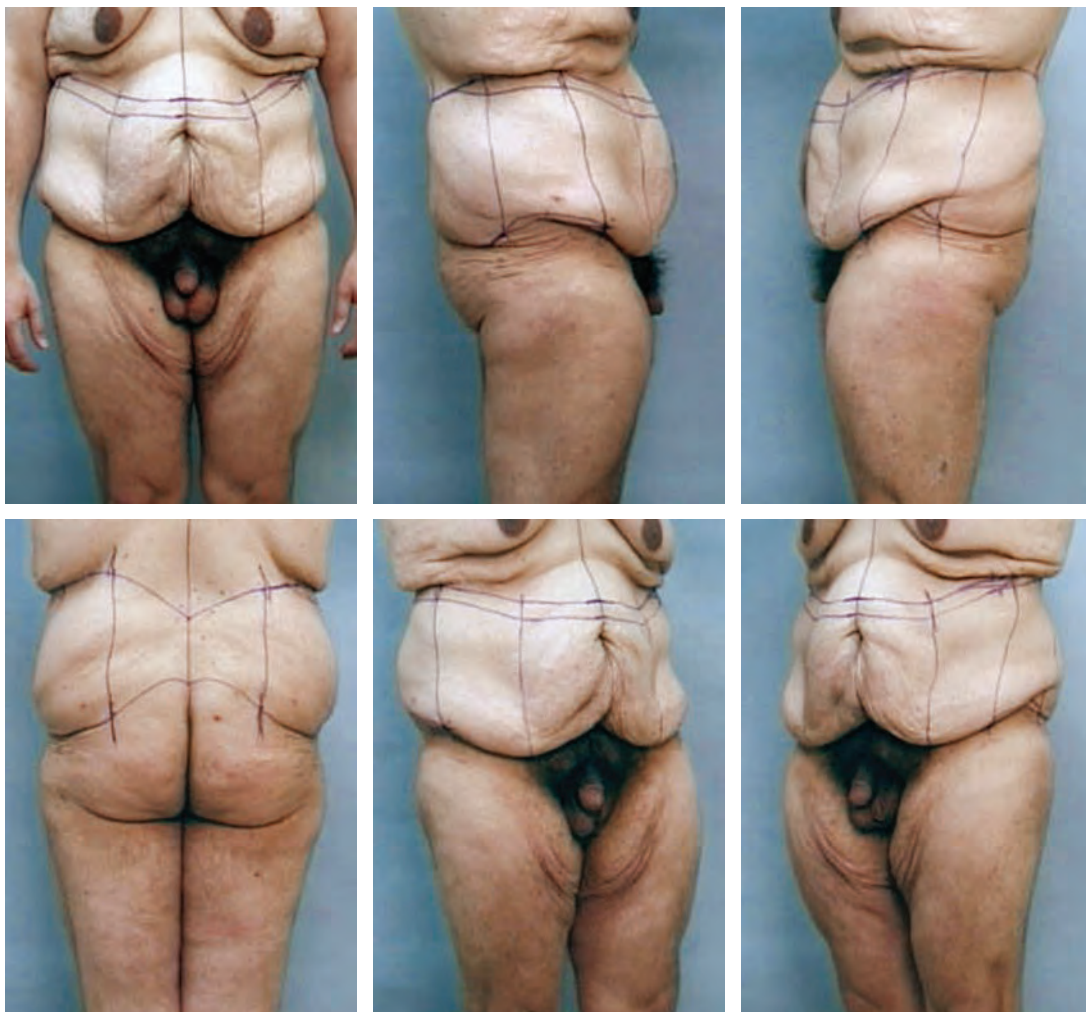
Posteriorly, the superior marks control final scar position.



At this point in the marking process, both the anterior and the posterior marks are in place. There may be a transition from the anterior to the posterior marks. Superiorly, connecting the anterior and posterior marks is usually not difficult, because they typically line up well. Inferiorly, in some patients the anterior mark may be significantly higher than the posterior mark. A compromise then needs to be made between these marks. The anterior marks are lowered and the posterior marks are raised. Often this transition will fit in the natural creases, especially in massive-weight-loss patients. The patient is then placed through the operative positions, supine and both lateral decubitus positions, and the marks are checked for symmetry and whether they are reasonably placed.



A series of vertical marks is made to facilitate alignment at closure, because many patients who undergo a belt lipectomy have tissues that become significantly distorted in the operative positions. In patients with an extremely ptotic and redundant mons pubis, normal contour should not be expected nor promised. A compromise should be accepted rather than risking overresection, which can potentially lead to permanent lymphedema of the mons pubis. After complete healing from belt lipectomy, a separate mons puboplasty can be considered and discussed with the patient.



With typical markings, the vertical marks are helpful in aligning tissue during closure. Often two sets of lines are drawn as possible superior extents of resection, and the appropriate line is used at surgery based on the tension encountered.



Markings continue underneath the hanging pannus. If the patient needs lateral and anterior thigh liposuction, those areas are marked.

Operative Technique

Because of the circumferential nature of belt lipectomy, it is not possible to perform the total resection using a single body position in the operating room. Both the number of body positions employed and the sequence in which they are used can be varied and will differ from surgeon to surgeon. Based on the need to stress the anterior resection over the posterior resection and to maximize the lateral resection, the sequence of supine-lateral/decubitus-lateral/decubitus has been found to optimize the results and will be described here.

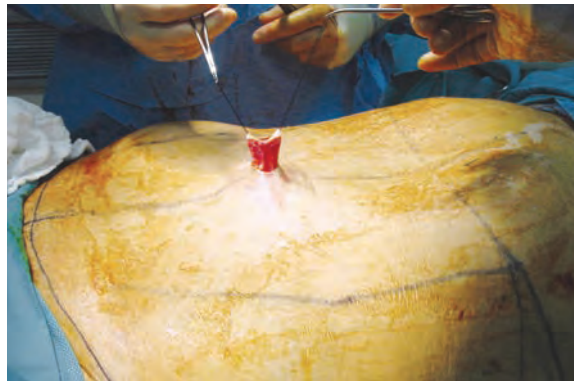
Preoperatively the patient has an epidural catheter placed for postoperative pain management. We have found that epidural analgesia considerably reduces the risk of deep venous thrombosis/pulmonary embolism; thus chemoprophylaxis is not used. If the surgeon chooses not to use an epidural—which most will not—they should consider the use of chemoprophylaxis, although it is not easy to determine the best regimen to use.

Sequential compression stockings are put on the patient in the holding room. The patient is then taken to the operating room and placed in the supine position on the operating table with an underlying beanbag. Symmetry is checked before induction of general anesthesia. Once general anesthesia is induced, the arms are placed at a 90-degree angle and padded, and an indwelling urinary bladder catheter is placed. An 18-gauge needle dipped in methylene blue is used to tattoo the vertical marks above and below the extents of possible resection. The methylene blue tattoos will last for a few weeks and are very helpful for tissue orientation at closure.

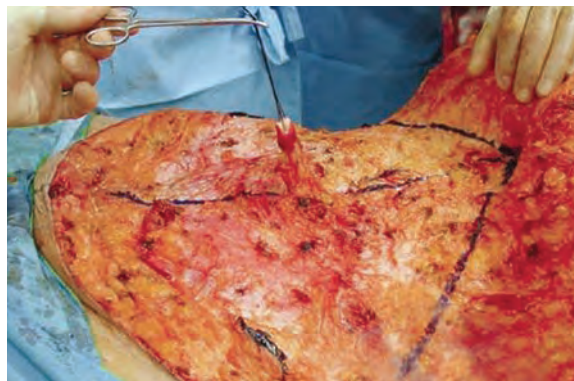


Because the anterior resection has to end where the patient's body makes contact with the operating table, a temporary dog-ear is marked in the shape of a V. This area is temporarily closed with staples at the end of the anterior resection. The patient is then prepared and draped.





Two 2-0 silk sutures are placed through the skin of the superior and inferior umbilicus as traction sutures. If the umbilical stalk needs to be shortened, the sutures can be placed deeper within the umbilicus. A circumbilical incision is then made and dissected down to the level of the rectus fascia with some fat left on the stalk.



The anterior abdominal inferior mark is then incised and carried down to the level of the Scarpa's fascia. The abdominal flap is elevated superiorly, at or just below Scarpa's fascia up to the umbilicus. In patients with a thin pannus, the dissection is carried up to the costal margins and xyphoid, indicated above by the methylene blue chevron-shaped marks. In patients with a thick pannus, the supraumbilical dissection is limited to the medial edges of the rectus muscle fascia and the flap is liposuctioned directly to thin it.

Patients with scars from an open cholecystectomy are at risk of tissue necrosis inferior to the scar if that tissue is elevated off the underlying muscle fascia and advanced as the inferior aspect of the abdominal flap. In these patients, the proposed superior mark is incised first. A limited central supraumbilical dissection is performed, just

enough to allow advancement of the flap to the proposed inferior marks. The blood supply of the tissue inferior to the cholecystectomy scar is then examined. If it appears viable, the inferior flap is elevated down to the level of the inferior marks and is then tailored to the superior mark. If the tissues appear to be vascularly compromised, all of the tissue below the cholecystectomy scar is resected and the inferior flap is elevated and tailored to the level of the resection at the cholecystectomy scar. In this case the final scar is going to be much higher onto the abdomen, and the mons pubis will most likely not be addressed adequately, requiring a secondary excisional procedure.

Abdominal wall plication is performed with a nonpermanent, running, long-lasting, barbed suture. If any hernias are encountered, they are treated before the plication is done. In a small number of patients the umbilical stalk is part of the hernia sac and may need to be sacrificed.

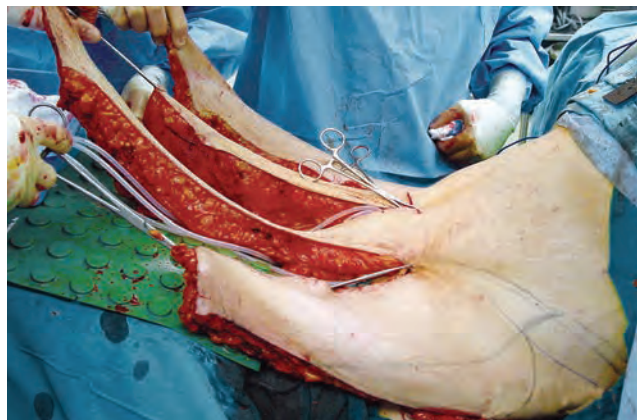


The infraumbilical plication is usually performed before the supraumbilical plication, because this is the area of greatest laxity in most patients, especially women.

During plication, peak respiratory pressures should be checked. Most patients' respiratory pressures will rise mildly with the plications, but if they are significantly elevated, restriction of pulmonary function could develop. This can be avoided by making certain that the patient does not have excessive intraabdominal contents during the preoperative examination.



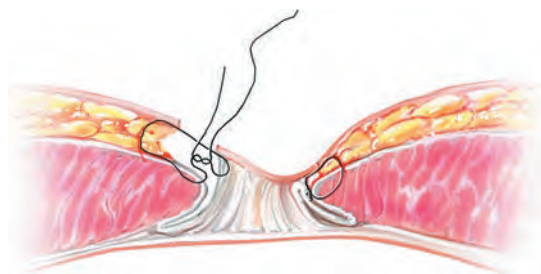
The patient is then flexed at the waist and the abdominal flap is redraped inferiorly and tailored to the inferior incision. As the flap is redraped, it is also conveniently split in the inferior midline. Splitting the flap facilitates the initial flap elevation in a patient with a large hanging pannus.



Ferguson clamps are used during tailoring of the abdominal flap. Extensive amounts of anterior abdominal excess will often need to be resected in massive-weight-loss patients. Laterally, in the area of the previously marked V, the temporary dog-ear is stapled.

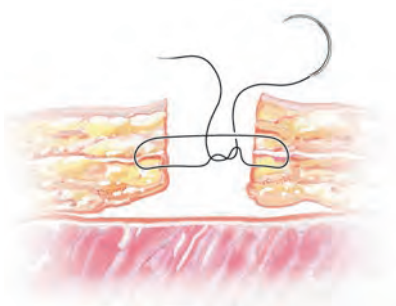
In patients who have midline vertical supraumbilical scars, occasionally the scar is tethered and may prevent advancement of the inferior flap during the tailoring procedure. In these patients the surgeon makes a series of horizontal nicks in the vertical scar to release the scar and allow appropriate advancement. We prefer not to resect the scar during a belt lipectomy, because it increases the risk of vascular compromise of the distal aspect of the abdominal flap at the T intersection.

A closed suction drain is placed and brought out through a lateral stab incision. If the patient requires liposuction of the anterior and medial thighs, this is performed either through the open abdominal wound or through appropriate stab incisions. The proper location of the umbilicus is then determined with the abdominal flap temporarily tacked in place with Ferguson clamps. A vertical 1.5 to 2 cm incision is made in the midline at the chosen location. The fat deep to the incision is bluntly dissected apart to allow a path for the umbilicus.



Three nonpermanent sutures (we prefer 3-0 Monocryl) are placed at the 3, 6, and 9 o'clock positions at a subcuticular level on both the abdominal flap and the umbilicus, as well as through the surrounding rectus fascia to help invaginate the umbilicus when the sutures are tied. The remainder of the umbilicus is sutured to the abdominal flap with simple interrupted, nonpermanent, subcuticular sutures.

Before abdominal closure, a series of interrupted quilting sutures are placed from the abdominal flap to the rectus fascia, to help close dead space. We think that this reduces the risk of seroma formation.



The abdominal wound is then closed in multiple layers, the first and most important layer being the reapproximation of superficial fascia, or Scarpa's fascia. One of the authors (A.S.A.) prefers to use Quill 1 PDO nonpermanent, long-lasting, running barbed suture to reapproximate Scarpa's fascia, whereas the other author (A.E.C.) prefers 0 PDS nonpermanent, long-lasting, interrupted sutures. We have found no difference in scarring between these different closures. The next layer of closure is accomplished with nonpermanent subcuticular staples. The final layer is closed with a running subcuticular 2-0 Monocryl temporary suture. Finally, tissue glue is applied to the skin to complete the closure.

The patient is then turned over to one of the lateral decubitus positions, which allows maximal resection of the lateral trunk and more direct access to the lateral thighs for liposuction. To accomplish the turn efficiently and safely, five or six people should be involved. One person is assigned the responsibility of making certain the patient is flexed at the waist to prevent dehiscence. Multiple pillows are placed between the knees to flex the hip as much as possible. All pressure points are padded, an axillary roll is placed, and the beanbag is molded and hardened to hold the patient in the desired position. In this position, resection from the created lateral dog-ear to the midline of the back is performed. If lateral thigh liposuction is needed, it is also performed while the patient is in this position.

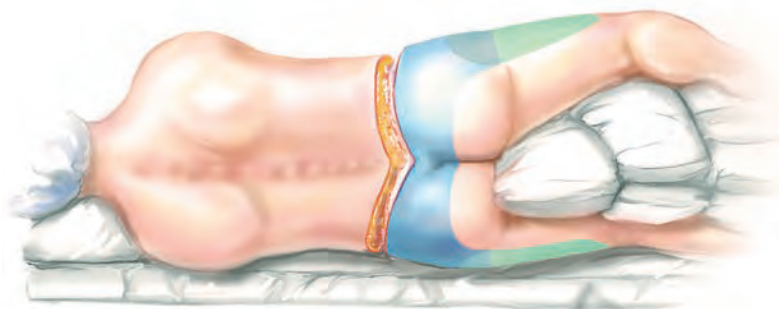
The lateral and back marks are reinforced and the vertical marks are tattooed in this position.



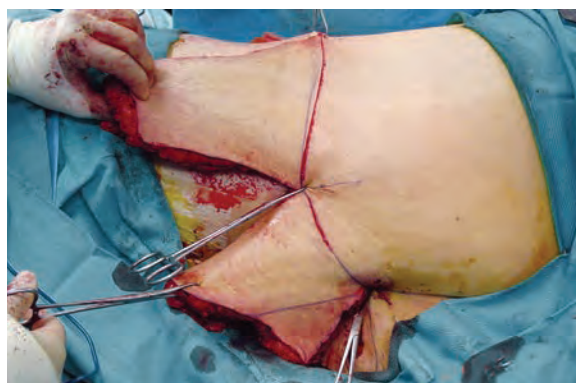
Just past the midline of the back, a temporary V-shaped dog-ear is again marked to allow for the subsequent turn.

The patient is prepared and draped again in this position. The lateral thigh is suctioned if necessary. Unlike the anterior resection, the superior mark is incised first during the back resection. The reason for this is twofold. First, most patients have more inferior than superior laxity in the lateral trunk, so it is best to dissect inferiorly rather than superiorly to lift the ptotic buttocks and lateral thighs. Second, the back has tendency to develop seromas, and less dissection in this area is desirable. The level at which the inferior flap is elevated is based on the patient's anatomy. If the patient has overprojected buttocks, as is the case in most high-BMI patients, the dissection is performed at a level just above the muscle fascia, leaving a small amount of fat on the fascia.

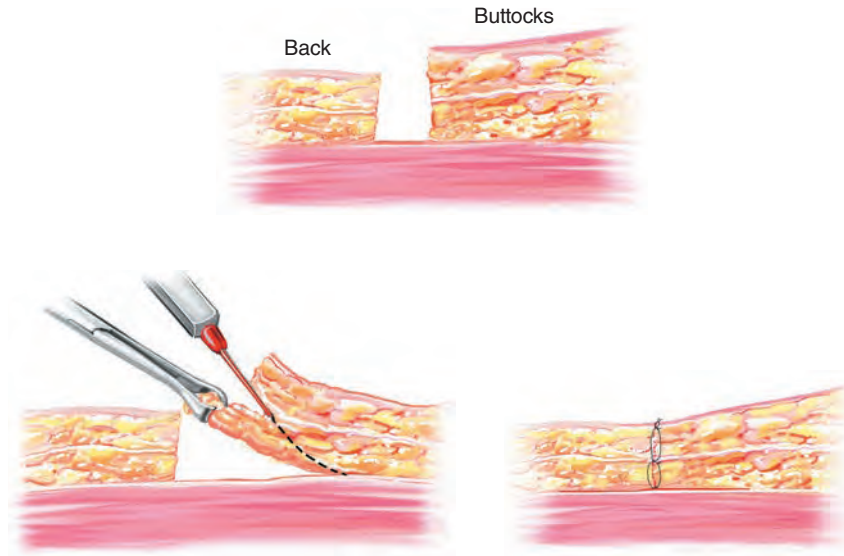
If the patient has underprojected buttocks, the elevation is performed at the level of the superficial fascia so that as much fat tissue as possible is left behind. In either case, the flap is elevated at least to the level of the proposed inferior line of excision. The dissection can be carried down as low as needed to get the desired amount of tissue resected; not infrequently, this can be down to the level of the midbuttocks.



This illustration demonstrates the extent of direct elevation (*blue*) and possible indirect, or discontinuous, lateral thigh elevation (*green*), usually performed with a large, unconnected liposuction cannula.



The inferior flap is then redraped superiorly and, with the aid of Ferguson clamps, tailored accordingly. The vertical marks, placed every 10 cm or so, are extremely helpful in aligning tissue at this juncture.



In patients with excessive buttocks protrusion, there is a discrepancy in thickness between the lower back and the buttocks. Tailoring of the inferiorly based flap should be more aggressive in the fat deep to the superficial fascia to equalize the thickness of the subcutaneous fat of the two edges brought together. This is an important step in helping create a smooth transition between the buttocks and the back, which many of these patients lack. If there are still small discrepancies after closure, liposuction can be performed to create a smooth contour from the waist through the hip and down onto the lateral thighs and buttocks.

One closed suction drain is placed in the back through a stab incision made laterally. The closure of the back is similar to the anterior closure. Just past the midline, the temporary dog-ear is closed with staples to allow for the final turn.

The patient is turned to the other lateral decubitus position, and the other side of the resection is completed in a similar manner. Occasionally, the second side does not allow for as much resection of tissue as the first side; thus the surgeon should not assume that the same amount can be removed.

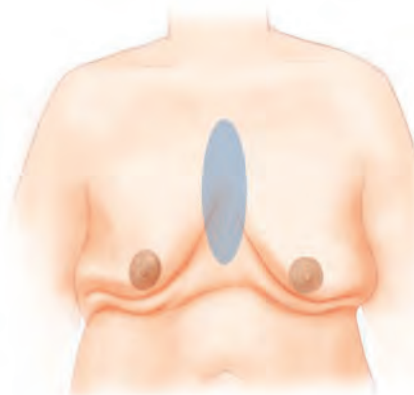
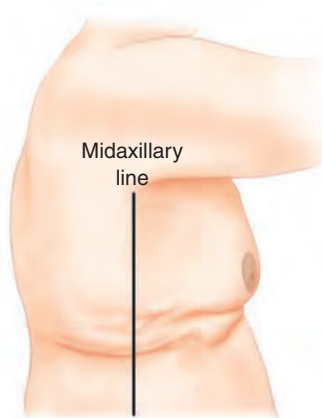
After the second side is completed, the patient is placed in the supine position on the operating table, with the waist flexed to the appropriate position. This turn, as all other turns, requires five or six people to accomplish safely, with one person making certain that the waist is flexed appropriately. There is the danger of causing abdominal flap necrosis with circumferential compression; thus compression garments are not routinely used.

After extubation, the patient is placed on a flexed hospital bed under the guidance of the surgeon to prevent dehiscence.

Adjunctive Procedures and New Concepts

Upper Body Lift

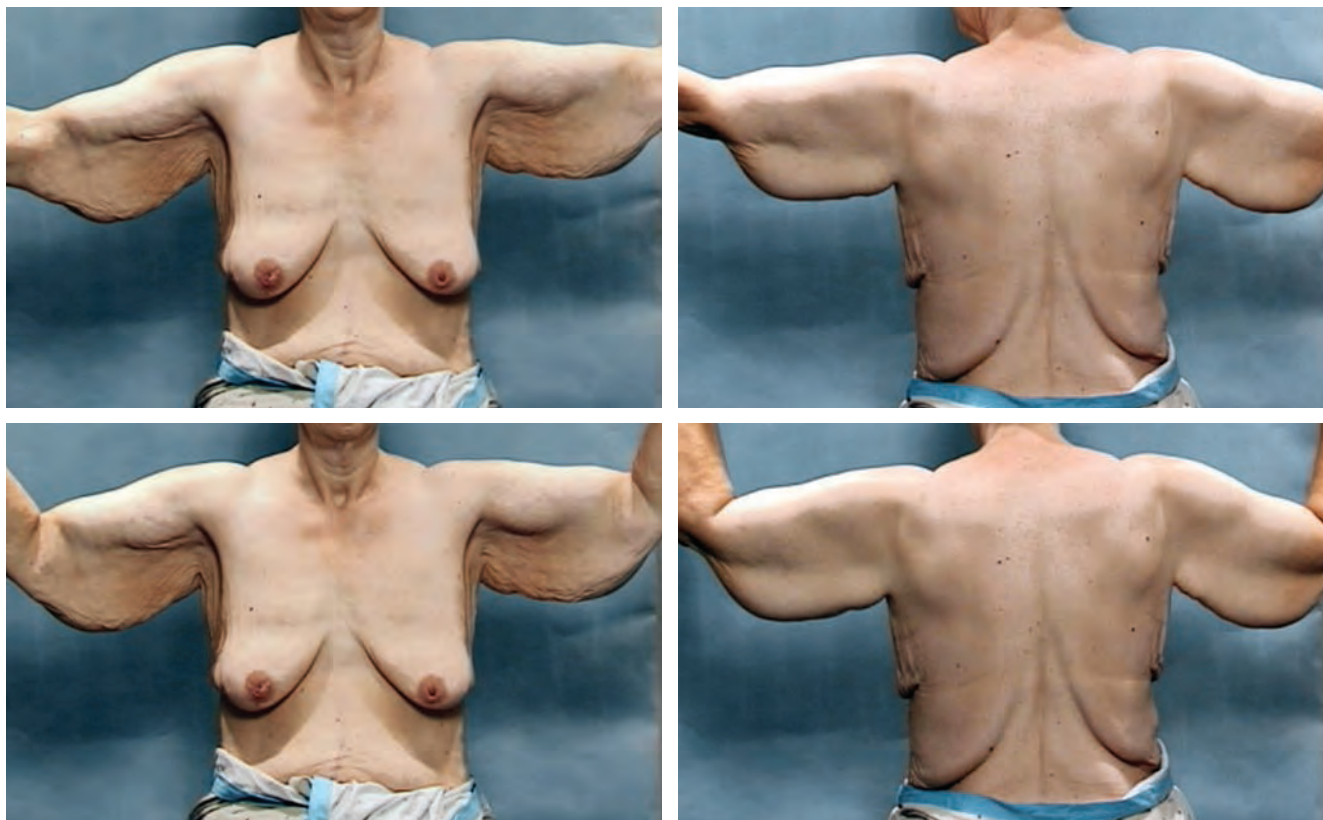
Belt lipectomy addresses problems of the inferior subunit of the trunk, from the ribcage to the pelvic rim. For non-massive-weight-loss patients, the procedure addresses their problems well, since their deformities are usually limited to the inferior subunit. Massive-weight-loss patients, on the other hand, often have problems involving the superior subunit of the trunk, or the thorax.



When thoracic soft tissues are inflated by obesity and then deflated by weight loss, they will hang lower than their original position, onto the underlying skeleton, with the exception of the zones of adherence located at the anterior and posterior midlines. The soft tissues overlying the midlines thus are tethered, while the rest of the thoracic tissues are free to hang down as a curtain drapes down from two tethering pleats.



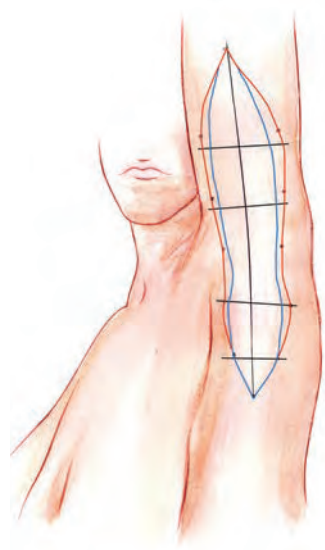
The region of greatest descent is located at the midaxillary line, because that is the greatest distance from the zones of adherence. Anteriorly the breast will demonstrate varying degrees of ptosis. The nipple-areola complexes will often appear medially displaced, but this is an optical illusion, because the lateral inframammary crease is free to descend, while the midline zone of adherence tethers the medial inframammary crease. The transition from the lateral breast onto the lateral chest wall usually is in the form of a roll that is an extension of the lateral breast and may extend onto the back as an upper back roll. In some patients a second roll is also present. The upper back roll occurs in various sizes and will travel in a superior direction toward the midline posterior zone of adherence. Overall, the thorax has both vertical and horizontal excess as a result of the deflation of weight loss.



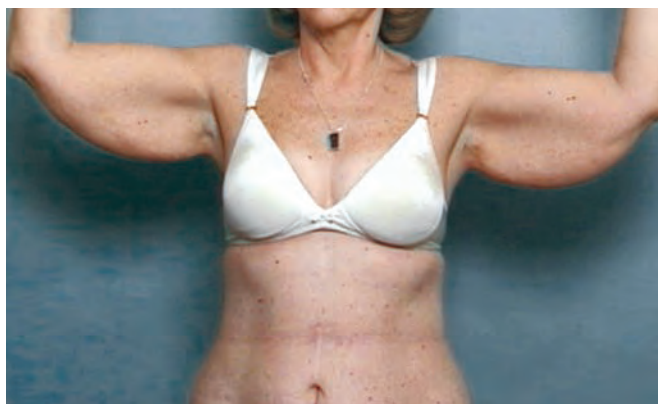
In massive-weight-loss patients, the upper arm excess often spills onto the lateral chest wall. This is important, because most brachioplasty techniques do not address the lateral chest wall excess, which is part of the horizontal thoracic excess created by massive weight loss.

The constellation of upper truncal deformities in massive-weight-loss patients has not received much attention, because the abdominal pannus tends to be the overwhelming problem that massive-weight-loss patients complain about—and what insurance companies are willing to pay for. However, as these patients become more familiar to plastic surgery as a whole, there will be greater emphasis on all their areas of deformity, including the thoracic region.

The individual massive-weight-loss patient may or may not have any or all of the thoracic deformities described here. The deformities depend on the amount of weight gained and lost and on the patient's genetically controlled fat deposition pattern. Each of these deformities can be treated separately, or together in a single procedure.

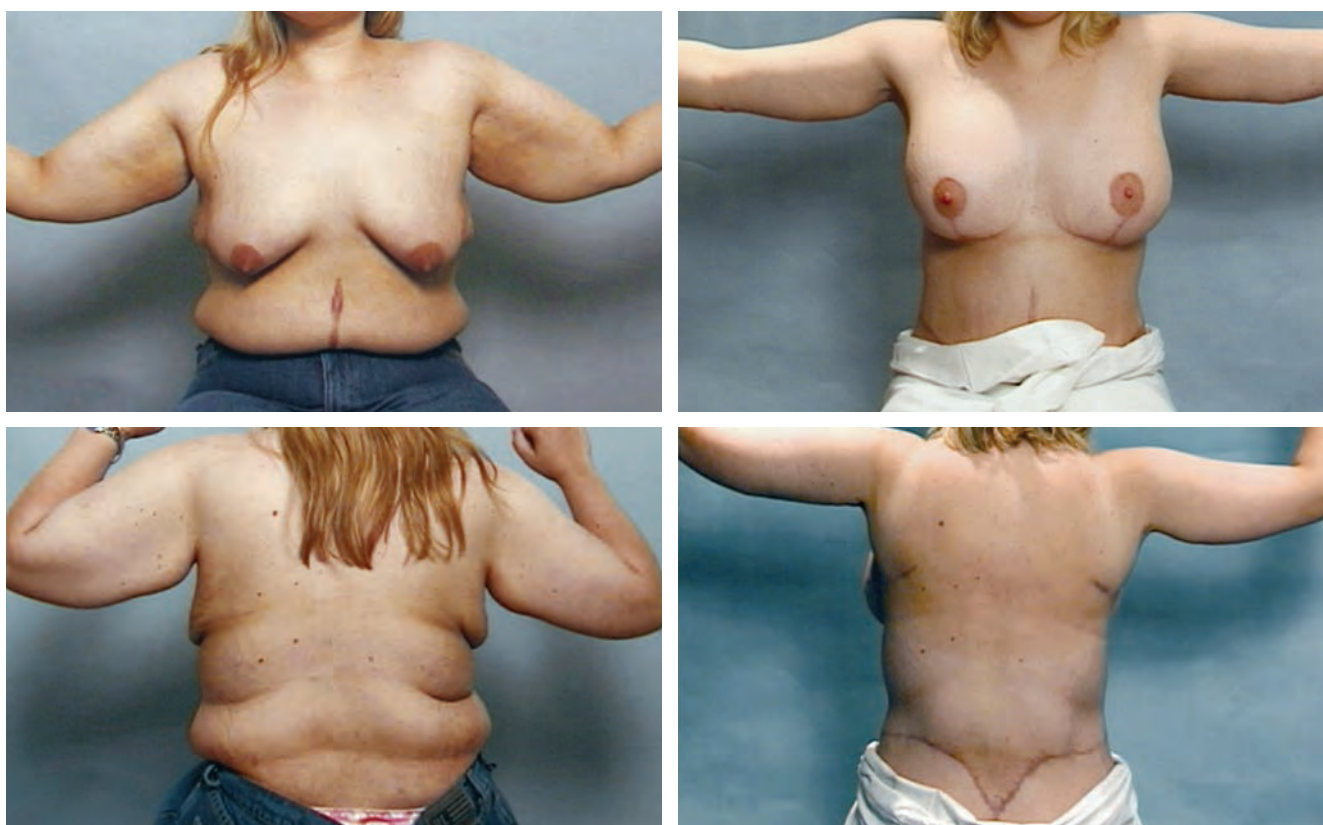


Massive-weight-loss patients have upper arm excess that is in continuity with the thoracic tissue's horizontal excess is marked preoperatively for a brachioplasty technique that crosses the axilla, onto the lateral thoracic wall. Previously we would perform a Z-plasty in the axilla to avoid the potential for scar contracture, but we have abandoned its use as part of the primary procedure, using it only in a secondary procedure if a contracture occurs.

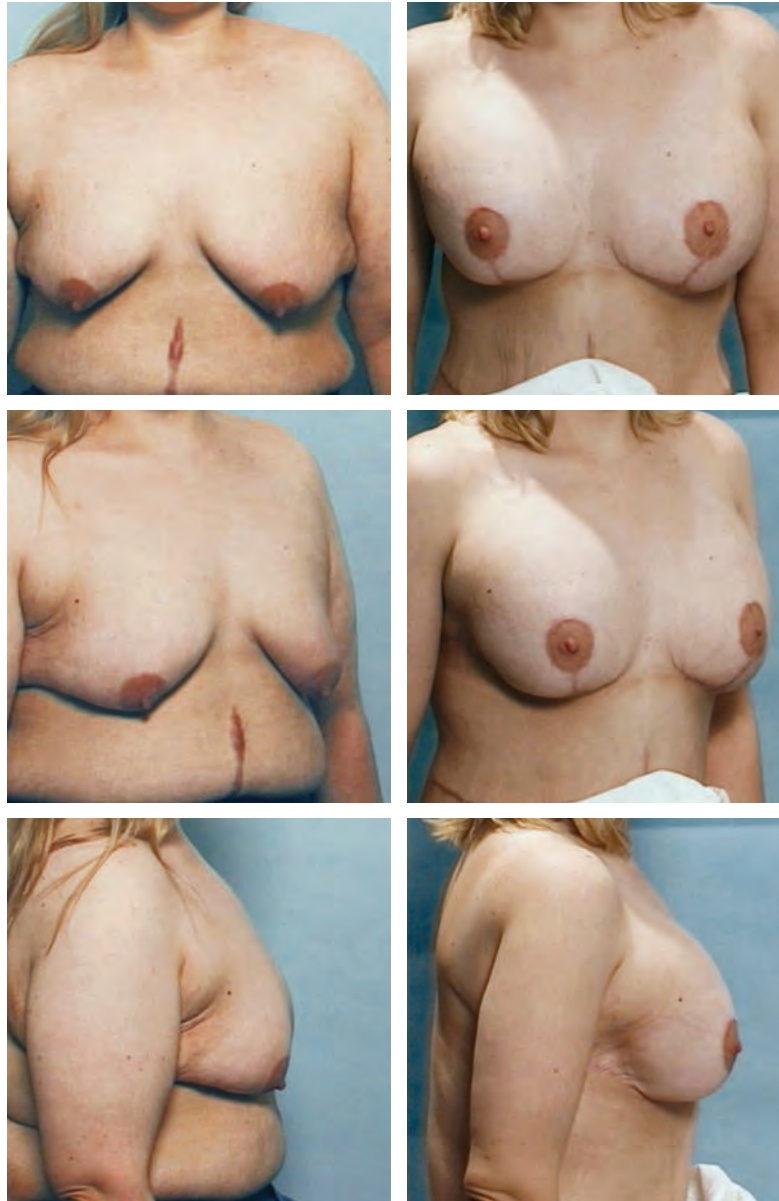


An advantage for patients who undergo brachioplasty with this technique is the excellent contour achieved, as can be seen in these two patients. This level of improvement is usually not attainable in massive-weight-loss patients if techniques limited to the axilla are employed.

The lateral thoracic rolls, or lateral breast rolls, that extend onto the back to differing degrees as upper back rolls, are usually not eliminated by belt lipectomy. Thus if the patient desires elimination of these rolls, a direct dermatolipectomy will be required (see Chapter 83). This resection eliminates the rolls and lifts the lateral thoracic tissues into their proper anatomic position, which includes lifting the lateral inframammary crease to its correct location and creating its normal upward sweep. It also shortens the vertical excess created by the weight loss. Subsequently, lifting or reducing breast tissue can be performed based on a correctly positioned inframammary crease.



This massive-weight-loss patient underwent a *complete upper body lift* that combined brachioplasty, lateral breast/upper back roll excision, and breast surgery. Pre-operatively the patient had upper arm excess that crossed the axilla and involved the lateral thoracic wall, prominent lateral breast rolls, and descent of the lateral inframammary crease.



The upper body lift shortened both the horizontal and vertical excess of the thorax and allowed the augmentation-mastopexy to be performed based on the corrected position of the lateral inframammary crease.

Another important anatomic area that is especially difficult to treat in massive-weight-loss patients is the thigh region. The thighs in some patients have minimal or no abnormality, even after fairly large amounts of weight gained and lost. These patients simply never deposit fat in their lower extremity because of their genetically programmed fat deposition pattern and do not require treatment. In others, large amounts of fat are deposited in their lower extremities and lost along with the rest of their body fat as they reduce their weight. Depending on the amount of excess re-

maintaining, either a medial thigh lift or a medial thigh lift combined with a vertical-component dermatolipectomy is necessary. Another less fortunate group will gain weight in the lower extremities with their weight gain, but they are genetically programmed to retain that fat, even after significant losses in the remainder of the body. This group requires a combination of a reduction of fat content in the entire thigh region and a subsequent dermatolipectomy. To accomplish this safely, the thighs require fairly aggressive circumferential liposuction to create a deflation similar to the one created by the massive weight loss in the truncal region. To tighten and lift the thighs, 3 to 6 months after liposuction, direct excision of both horizontal and vertical excess is necessary.

Postoperative Care

Immediately after belt lipectomy surgery, wound dehiscence is of greatest concern because of the circumferential nature of the closure. A carefully followed regimen of prevention is instituted beginning in the operating room. At the end of surgery the patient is transferred to a flexed hospital bed by the operating surgeons. The patient's body position is maintained in the flexed position during the transfer. Unlike an abdominoplasty, in a belt lipectomy the patient cannot be overflexed to relieve tension on the anterior wound, because that may lead to undue tension on the posterior wound. Conversely, the patient cannot be flattened at the waist, because this would lead to undue tension on the abdominal closure. A large sign is placed on the hospital bed indicating to the nursing staff that the patient is not to be moved, even in minor ways, until he or she is completely awake and alert. Postoperatively, the patient is the only person who can actually sense tension on the different aspects of the wound, so he or she is extensively instructed on this point preoperatively. When the patient is awake and alert on the day of surgery, ambulation is initiated with assistance, and the patient is expected to guide others regarding positioning during ambulation to prevent dehiscence.

If the patient has an epidural catheter, the anesthesia team adjusts its infusion to relieve pain but not affect motor function so that the patient is able to ambulate. The epidural infusion is continued through the morning of the second postoperative day. The urinary bladder catheter is left in place for at least 4 hours after the epidural infusion is discontinued. The patient's diet is advanced to a regular diet soon after surgery. Once pain control is stabilized on oral medications, the patient is ready for discharge, with instructions about drain management. The average hospital stay for a belt lipectomy patient is 2 to 3 days. If the patient does not have a good support team at home, the surgeon should insist on a longer stay.

The patient is instructed to maintain the flexed position for 1 week. At the end of the week the patient is instructed to practice slow straightening exercises. Most patients will be able to stand up fairly straight by 10 to 14 days after surgery. Drain management for any surgical procedure is widely variable and depends on the surgeon's philosophy and experience. Belt lipectomy is no exception, but drain management is particularly important because of the relatively high incidence of seromas, especially in massive-weight-loss patients who have high BMIs. We do not think that any particular protocol of drain management will actually decrease the rate of seroma formation, but a reasonable approach is to start removing drains that reach the criterion of less than 40 ml of drainage per 24 hours, starting the third day after surgery. In most cases the anterior drains will reach this criterion within the first 7 to 10 days. The posterior drains will usually be the slowest to reach this criterion, and in some patients they will not have reached it at 14 days. In this instance, a sclerosing agent is injected through the drain every 2 to 3 days in an attempt to decrease the size of the pocket. We prefer to use doxycycline as the sclerosing agent. Once the drainage drops to approximately 80 ml per day, the drain is removed and the possible seroma is dealt with through serial aspirations. Early in the postoperative period the use of compression garments should be individualized to the patient, because circumferential compression in this group of patients can potentially cause skin necrosis of the lower abdominal flap. We use compression garments after concerns about flap vascularity have passed, usually 4 to 5 days after surgery. Patients are instructed to keep the garment on as much as they can tolerate for up to 6 months.

Patients can usually return to normal, nonvigorous activity after 4 to 6 weeks. They are advised to slowly increase their activity level, depending on how they feel, with really strenuous exercise discouraged for at least 3 months. Swelling superior to the scar, especially anteriorly, will be significant and apparent for at least 3 months. Overall truncal contour will start to stabilize in appearance at about 1 year but can continue to improve for years, especially if the patient loses more weight.

Complications

We evaluated 70 consecutive belt lipectomy patients; 85% were women and 15% were men. Fifty-six percent had at least one complication, 21% had more than one complication, 44% had no complications at all, and no deaths occurred in the series. Complications occurred in 55% of women and 56% of men. When complications were stratified according to BMI, it was noted that the rate of complications increased as the BMI increased. Seromas were the most frequent complication, occurring in 30% of patients, with an increase in frequency as the BMI rose. The fairly large number of seromas can be attributed to the very large area of dissection, with most of these fluid collections occurring in the back (back dissections are associated with seromas in general). Small wound separations occurred in 20% of the patients,

with a few fascial dehiscences requiring surgical intervention. Dehiscences were caused by mechanical stress on the wounds, which mostly occurred within the first 24 hours after surgery.

Preventing patients from moving until they are completely awake and instructing them to guide their own ambulation are very helpful in reducing this problem. The other cause of dehiscence is large seromas that cause breakdown at the wound edge to allow drainage. Detection and frequent aspiration of seromas will help reduce that risk. Infections occurred in 4.3% of the patients and were almost always associated with seromas. They were controlled through appropriate seroma drainage and antibiotic therapy. Pulmonary emboli occurred in 2.9% of the patients. To prevent this serious complication, all patients were required to wear sequential compression garments intraoperatively and while in their hospital bed. They were also ambulated as soon as possible after surgery.

Despite such efforts, these problems can still occur, and any suggestive symptoms should be investigated. Since this study was conducted, we have used postoperative epidural analgesia, and the rate of DVT/PE has dropped to zero.

Lower midline abdominal flap skin or fat necrosis occurred in 4.3% of the patients. In two patients, the lateral abdominal flap was tailored at an acute angle to match an acute angulation of the inferior line of resection that traversed from the lateral mons pubis to the ASIS. This was done to create a high French bikini line-shaped scar. This is believed to have led to a reduction of the number of lateral perforators reaching the inferior midline of the abdominal flap. Thus it is wise to avoid extreme angulation of the lateral abdominal flap. Another cause of abdominal flap necrosis was encountered in two patients who had a midline supraumbilical scar that had to be resected to allow advancement of the abdominal flap at closure. When the abdominal flap is incised in the midline, there is a reduction of the blood supply at the level of the subdermal plexus to the inferior medial edge of the skin on each side. If this is combined with aggressive resection of the abdominal flap in the vertical direction, leading to significant tension at closure, vascular compromise may occur. Thus, as previously mentioned, we have abandoned the practice of resecting tethered midline scars and replaced that with serial stab incisions to release the flap.

Outcomes

In properly selected patients who undergo belt lipectomy, significant improvements in their inferior truncal contour can be achieved. The outcomes of surgery can be categorized into two main groups: massive-weight-loss patients and non-massive-weight-loss patients. Each group can be further divided into subgroups that can help the surgeon better predict the possible outcome for a particular patient. The classi-

fication of patients discussed here, which is based on weight at presentation, is helpful in predicting outcome. However, it is not the only telling factor, because the patient's fat distribution pattern and the absolute decrease in BMI from the greatest to the lowest weight are also important.

Massive-Weight-Loss Patients

This group of patients is defined as any patient whose weight at one time was in the obese range (a BMI of 30 or above) and subsequently lost a significant amount of weight. Although generally that amount is often felt to be at least 45 kg (100 pounds), patients who are small in stature can lose less weight and still qualify as massive-weight-loss patients. The results that can be expected from this group of patients are divided into clinically relevant subgroups according to the weight at which they stabilized before surgery. As a general trend, the lower a patient's BMI at presentation, the closer to normal his or her body contour will be after surgery.

Still Significantly Obese With a BMI of 35 or More

The subgroup of patients who still have a BMI above 35 will achieve significant improvement in their inferior truncal contour through belt lipectomy, but generally they do not attain what is considered normal for the overall population. They often have other body areas, especially the thighs, where a significant amount of fat is still retained, preventing an appearance of normality. They have a very significant increased risk of complications, seromas being the most common problem. Often they will require treatment of other areas of the body to reach the norm for the population.

Near Ideal Body Weight With a BMI of 28 or Less

The closer a patient is to ideal weight at presentation, the better the final contour after belt lipectomy. Commonly the subcutaneous fat layer encountered in this subgroup of patients allows the overlying skin to move freely over the underlying muscular framework. This permits the surgeon to resect larger amounts of excess skin and to transmit the effects of the pull on tissues located far from the areas of the resection. This subgroup of patients generally achieves a remarkable improvement that will place them in the normal range of body contour; some even attain ideal body contour. Their complication rate is relatively low, especially when compared with the still-obese subgroup of patients previously discussed.

Intermediate Weight Level With a BMI of 29 to 34

Patients in this intermediate subgroup generally attain results that are intermediate between the two subgroups discussed previously and would be considered on a continuum between them. They will attain a significant improvement in their inferior truncal contour and would generally be considered to have body contours within

the norm for the overall population. Their results are similar to the group that is 20 to 30 pounds overweight discussed below. Their complication rate is intermediate between the two subgroups mentioned previously.

Massive-Weight-Loss Patients Who Have Undergone Anterior Resection

This subgroup is composed of massive-weight-loss patients who have had dermato-lipectomy procedures limited to the anterior abdomen. They are grouped separately because they have distinct complaints; this group is growing in increasing in numbers. Typical patients in this group are initially seen with the complaint that before their previous surgery they were told that they needed only an abdominoplasty or panniculectomy. After that surgery was performed, these patients are often disappointed with the increased lateral prominence caused by the limited anterior resection's dog-ears and the lack of improvement of the waist, hips, back, and buttocks. Depending on the patient's contour at presentation, a partial, modified, or full belt lipectomy will be appropriate. The results can be predicted based on the BMI categories described previously.

Non–Massive-Weight-Loss Patients

Patients 20 to 30 Pounds Overweight With a BMI of 26 to 29

This subgroup comprises patients who are 9 to 14 kg (20 to 30 pounds) overweight, have not been able to lose the weight despite real attempts, and have never been appreciably heavier. A significant improvement in their inferior truncal contour is generally attained with surgery. They start out with contours that are within the norm for the general population and will attain significant improvement toward an attractive contour with belt lipectomy. Results in this subgroup are similar to those of the intermediate subgroup in the massive-weight-loss group discussed earlier. Their complication rate is also similar.

Normal-Body-Weight Patients

Patients who are at or near their ideal body weight may have abdominal wall laxity and/or skin excess amenable to abdominoplasty; they also usually have different degrees of isolated fat deposits amenable to liposuction. However, they will specifically desire remarkable elevation and definition of their buttocks contour, and some patients will request more waist definition. The postoperative abdominal and lateral truncal contour in this subgroup of patients usually demonstrates the typical effects attained by abdominoplasty, in addition to remarkable improvement in buttocks contour that would not be attainable by liposuction alone. These patients present within the norm of the general population and should have a remarkable improvement in their inferior truncal contour after belt lipectomy.

Results

The following patient examples demonstrate the results attainable in the patient categories that have been discussed. These cases show variations of technique and deformities and help to delineate the limitations of belt lipectomy.



This 33-year-old woman reached her highest weight at a BMI of 45. She lost 45 kg (100 pounds) after bariatric surgery and presented with stabilized weight at a BMI of 29. She is shown before and after undergoing a belt lipectomy. Her postoperative photographs demonstrate an excellent improvement in her inferior truncal contour with elimination of the pannus, flattening of the belly, elevation of her mons pubis, creation of waist definition, and elevation and definition of the buttocks. Although her lower back rolls were eliminated, the upper truncal deformities were minimally affected and more outlined after belt lipectomy. The same can be observed in her thigh region. Thus both the superior truncal subunit and the thighs will need further surgical intervention.



This 52-year-old woman's BMI at her greatest weight was 49. She subsequently underwent a gastric bypass procedure and lost 36 kg (80 pounds) before stabilizing at a BMI of 37. She is shown before and after undergoing a belt lipectomy. She presented with a preoperative circumferential inferior truncal excess of skin and fat, mons pubis ptosis, abdominal wall laxity, and a fairly unique pattern of hip lipodystrophy. The pattern of posterior resection used in this patient was adjusted inferiorly to address the prominent hip roll. After a belt lipectomy, her abdomen is flat, the mons pubis is partially elevated, and the extra hip roll is eliminated. Because her presenting BMI was still in the morbidly obese range, her improvements, although significant and very much appreciated by the patient, are tempered by the fact that she still has an overall body contour that would not be considered within the norm for the whole population. Her fat deposition pattern dictates that her lower extremity has persistent lipodystrophy after significant weight loss, which contributes to the less than ideal body contour. Patients in her weight range often have a thick subcutaneous fat layer that reduces the mobility of the skin-fat envelope over the underlying muscle fascia. This prevents improvement of anatomic contour located at a distance from the actual dermatolipectomy resection, such as the infrabuttocks creases.

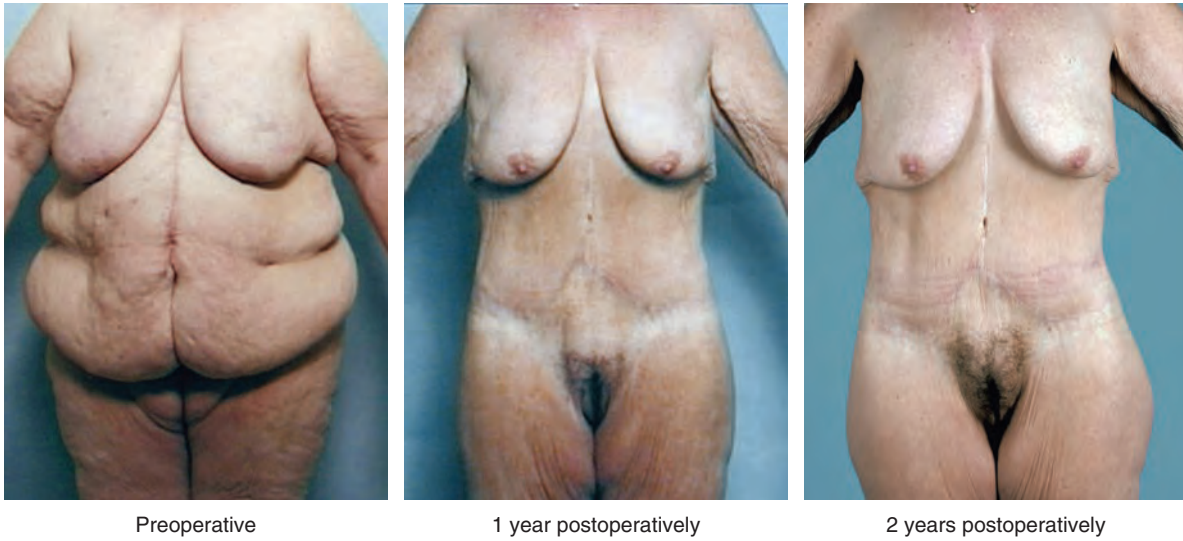


This 31-year-old woman who had triplets and then another child reached her highest weight at a BMI of 41. She subsequently lost 26 kg (60 pounds) as a result of lifestyle changes, reaching a BMI of 30. She is shown before and 14 months after surgery. She presented with significant abdominal wall laxity, a single roll pannus, mons pubis ptosis, and a lack of waist definition. Her buttocks appeared long vertically and lacked definition but were not overprojected. The surgical technique we employed had a more superiorly positioned posterior excision, because she did not need a reduction of her posterior buttocks projection. Placement of the scar in the posterior vertical position chosen allowed the surgeon to create the desired depression in contour at the junction of the back with the buttocks. This was accomplished by thinning the inferior advanced flap. If the scar had been placed lower, onto the buttocks proper, this maneuver would not have been possible, because it would have created a depression in the superior buttocks area.

Postoperatively, the patient has a flattened abdominal contour and an elevated mons pubis, and an attractive waistline has been created. Her buttocks are better defined and appear shorter in the vertical dimension. Note that this patient does not need surgery to the upper truncal subunit or the lower extremity, which correlates with her range of BMI.



This 38-year-old woman had reached a BMI of 42 before losing 45 kg (100 pounds) through diet and exercise. At presentation, her BMI was 25 for a total drop of 17 in BMI. She is shown before and 1 year after surgery. Postoperative photographs reveal elimination of her hanging skin, flattening of the abdomen, elevation of the mons pubis, increased soft tissue cover over the coccyx, increased buttocks definition, and improvement in the redundancy below the infrabuttocks creases. Because she had a relatively significant drop in her BMI, she presented with a small amount of subcutaneous fat. This allowed the surgeon to “translate the pull” to greater distances from the line of resection, especially compared with patients who have a much thicker subcutaneous fat layer. Thus the significant improvement of the infrabuttocks creases and the moderate improvement of the anterior thighs can be attributed to her thin subcutaneous fat layer. Patients in this range of BMI will often attain a near-ideal body contour after surgery.



This 44-year-old woman originally reached a BMI of 72. She lost more than 91 kg (200 pounds) after gastric bypass surgery and stabilized at a BMI of 33. She is shown before and after undergoing a subsequent belt lipectomy. The procedure was adapted to her open cholecystectomy scar, which required a reverse approach to the abdominal resection. Thus her abdominal superior incision was made first during the anterior resection, at the level of the cholecystectomy scar, and the inferior flap was adjusted to the superior flap. This resulted in a more superiorly positioned anterior abdominal scar.

Excellent contour was achieved through the surgery, but she continued to lose weight, reaching a BMI of 25 at the time the postoperative photographs were taken 1 year after surgery. However, she did not feel well at that weight and intentionally gained weight to reach a BMI of 26.6. It is unusual for a stabilized weight-loss patient to lose the remarkable amount of weight this patient did. Her BMI of 33 at presentation would ordinarily predict less improvement than she actually has attained. The better-than-expected improvement is the result of the very large drop in BMI, which led to greater elasticity and redundancy of the skin-fat envelope and thus provided the surgeon a greater ability to resect the excess.

Overall, she has a remarkable improvement in her circumferential inferior truncal contour. Her pannus was eliminated and a flat abdominal contour achieved, her mons pubis was elevated, her waist was defined, and her lower back rolls were eliminated. Her buttocks contour at a BMI of 25 was too deflated and improved with her weight gain to a BMI of 26.6, but her lateral thighs increased in prominence because of her genetically controlled fat deposition pattern. The upper truncal subunit contour was unaffected by the belt lipectomy; she will need an upper body lift to attain maximal improvement in those areas.



Preoperative

1 year postoperatively

2 years postoperatively



This 46-year-old patient is shown before and 2½ years after belt lipectomy. At presentation, she was 18 kg (40 pounds) overweight with a BMI of 31.2. She was not able to lose the weight despite multiple serious attempts over a number of years. Her complaints were concentrated on the lower truncal subunit and included abdominal wall laxity, excess abdominal skin and fat, lack of waist definition, lipodystrophy of the hips and lower back region, and ill-defined buttocks that appeared long in the vertical dimension. She was offered a traditional abdominoplasty and liposuction but was warned that her lateral excess might not be eliminated. She refused that approach and underwent a belt lipectomy. Postoperative photographs demonstrate a flat abdomen, a well-defined waist, elimination of the lower back rolls, and well-defined buttocks that appear shorter in the vertical dimension. This patient is fairly representative of patients who are 14 to 23 kg (30 to 50 pounds) overweight.



Preoperative

1 year postoperatively

4 years postoperatively

This 44-year-old woman presented with a BMI of 23. She requested improvement in abdominal contour, elimination of her right lower quadrant scarring, and reduction of her hip and lateral thigh lipodystrophy. She was offered an abdominoplasty and liposuction to the hips and lateral thighs, but elected to undergo a belt lipectomy because of her specific desire to lift and improve her buttocks contour. She is shown before surgery, 1 year after surgery, and 4 years after surgery.

After 1 year there is improved abdominal contour and an outstanding improvement in buttocks contour. Four years after surgery, she is shown after a 9 kg (20-pound) weight gain despite a continued good exercise regimen. Although she has retained benefits from the surgery, it is apparent that a rise in BMI from 23 to 27 has led to a return of some of her original fat deposition pattern.

Clinical Caveats

Patients with excessive intraabdominal content are not good candidates for belt lipectomy.

The goal of belt lipectomy surgery is to create proper contour of the inferior subunit of the trunk and to place the resultant scar in natural junctions.

There are many types of patients who can benefit from belt lipectomy, the most prevalent being massive-weight-loss patients.

Multiple factors contribute to the widely variable presentation of massive-weight-loss patients, including the BMI at presentation, the difference between the highest and lowest BMI, and the genetically controlled fat deposition pattern.

The anterior abdominal contouring aspect of belt lipectomy should be emphasized over the back resection. The lateral resection should be maximized to create the best possible lateral contour.

Belt lipectomy should be thought of as a circular excision of the lower trunk, in the shape of a “boxing championship belt,” wide anteriorly and narrow posteriorly.

Since dehiscence is of major concern in the postoperative period, the extent of the midline back excision is marked with the patient flexed at the waist to approximate the flexed position that the patient will be in after the anterior resection.

Upper arm excess in massive-weight-loss patients crosses the axilla onto the lateral chest wall and to treat that deformity, the brachioplasty technique used needs to cross the axilla.

In a massive-weight-loss patient the thorax, or the superior truncal subunit, will often have deformities that may require a combination of procedures called an *upper body lift* to normalize the appearance of that subunit.

The postoperative recovery from belt lipectomy, especially in a massive-weight-loss patient, is a long and difficult process and should not be taken lightly by the patient or the surgeon.

As a general rule, especially in massive-weight-loss patients, the lower the patient's BMI before surgery, the better the results and the lower the complication rate.

Seromas and small wound separations are the most common complications associated with belt lipectomy surgery.

Overall, complications are not uncommon with belt lipectomy surgery; the higher the patient's BMI before surgery, the higher their risk for complications.

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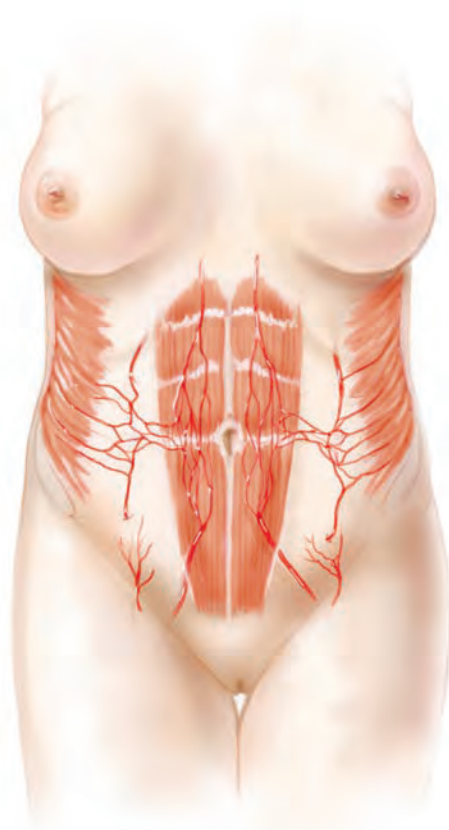
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CHAPTER 83



Abdominoplasty

GILBERT P. GRADINGER,
LORNE K. ROSENFELD, FARZAD R. NAHAI

Abdominoplasty is performed to correct soft tissue abnormalities of the anterior trunk, from the lower border of the ribcage to the inguinal and pubic areas. Body contour problems involving the fat and skin of the lateral and posterior truncal regions are treated with liposuction and extended dermolipectomy.

Plastic surgeons who perform abdominoplasty have recognized that variations in abdominal contour require modifications in surgical procedure. Newer techniques require shorter incisions and eliminate umbilical circumscription. In the past, patients who sought contour reduction had only one choice—abdominoplasty. Today superior aesthetic results can be achieved in many patients with liposuction alone. Liposuction combined with abdominoplasty has enhanced our ability to achieve better results. Small fat deposits, which cannot be treated with abdominoplasty, are ideal for liposuction, which is associated with insignificant scarring, minimal inconvenience, and negligible morbidity. On the other hand, treatment of a massive-weight-loss patient mandates more aggressive and advanced techniques to repair this multifaceted deformity.

Plastic surgeons now have a much wider range of choices for operative correction of the many abdominal deformities, including the following:

- Liposuction alone
- Complete abdominoplasty with or without umbilical translocation
- Lower abdominoplasty
- High lateral tension abdominoplasty
- Fleur-de-lis abdominoplasty
- Reverse abdominoplasty

Surgery may involve one option, a variation on an option, or a combination of options.

Indications and Contraindications

The typical abdominoplasty patient is a woman (although increasingly men are also seeking treatment) who has had one or more full-term pregnancies and a subsequent loss of youthful abdominal contour. Most of these women have tried exercise and dieting but have been unable to regain their prior shape. Obesity may or may not be

a factor. Usually an excess of fat is present. The skin of the abdomen is stretched from pregnancy weight gain and subsequent weight loss. Dermal breakdown, as evidenced by stretch marks, is often present. The quality of the lower abdominal skin often determines the relative roles of surgical lipectomy versus liposuction. The status of the underlying fascia and abdominal wall muscles also dictates which surgical approach is indicated.

The patient criteria to be considered must be exhaustive if the surgeon is to avoid major complications and patient dissatisfaction. The elements of a successful abdominoplasty include the following:

Weight: Stable for more than 6 months and not grossly overweight (BMI less than 30)

Medical condition: No major medical issues such as labile hypertension, diabetes, or coronary artery disease

Psychological state: Well motivated and realistic (for example, postpregnancy or gastric bypass patients)

Habits: Regular exercise, reasonable diet, and no smoking or excess alcohol consumption

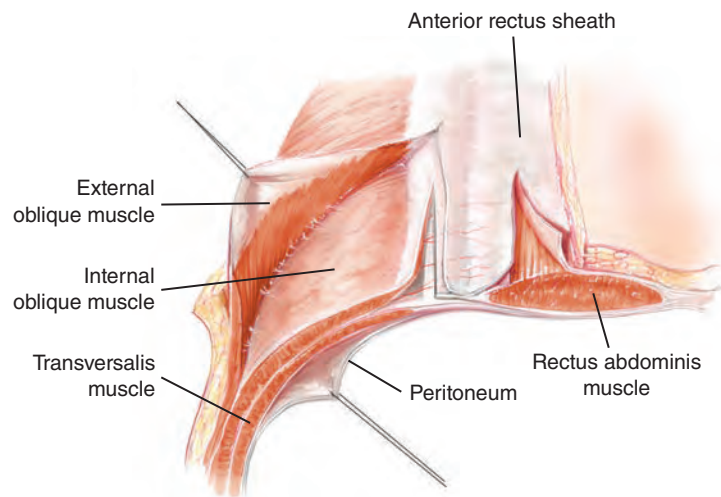
Anatomy: Absence of multiple abdominal scars and no extreme abdominal protrusion (secondary to intraabdominal fat accumulation)

Pertinent Anatomy

FARZAD R. NAHAI

When considering aesthetic procedures of the abdomen, the surgeon must be thoroughly familiar with the anatomy of the abdominal wall. A clear understanding of the blood supply and soft tissue layers is critical when planning incisions, determining the amount of tissue to be resected, and deciding whether concomitant liposuction or lipectomy is indicated. It is also important when managing the umbilicus and calculating the degree of flap elevation, especially in patients who have had prior abdominal procedures. The specific anatomy most relevant to the understanding and application of these complementary techniques includes the zones of adherence, the superficial fascial system, and the blood supply remaining after each approach.

Soft Tissue Layers of the Abdominal Wall

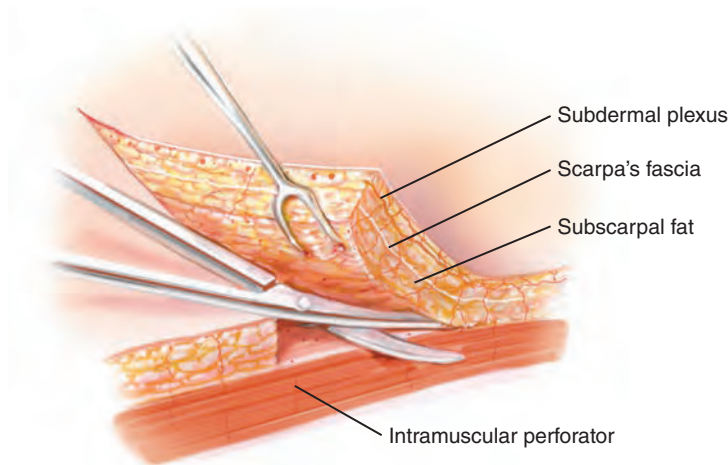


The abdominal wall is composed of six distinct soft tissue layers: skin, subcutaneous fat, subscarpal fat, anterior rectus sheath, muscle, and a posterior rectus fascia. It spans the area between the costal margin, midaxillary line, iliac crest, and symphysis pubis—a sort of elongated hexagon. The layers of the abdominal wall are consistent in their relationship to each other; the variability occurs with regard to the quality of the tissues and amount of fat present.

Skin

The skin of the abdomen receives its blood supply from multiple muscle and fascial perforating vessels that feed a subdermal vascular plexus. Depending on multiple patient characteristics (such as age, BMI, and number of full-term pregnancies), the skin of the abdomen can have differing degrees of elasticity. Often, the skin of the patient being considered for abdominoplasty is stretched, demonstrating poor elasticity and multiple striae. These striae are surface evidence of attenuated or absent underlying dermis. The location and extent of striae should be considered when planning skin incisions, because at the time of closure these areas of poor or absent dermis are more difficult to close and are at risk for separation. The surgeon should attempt to place skin incisions on the abdomen in such a way that the resultant scars will be covered by the patient's choice of undergarments.

Fat

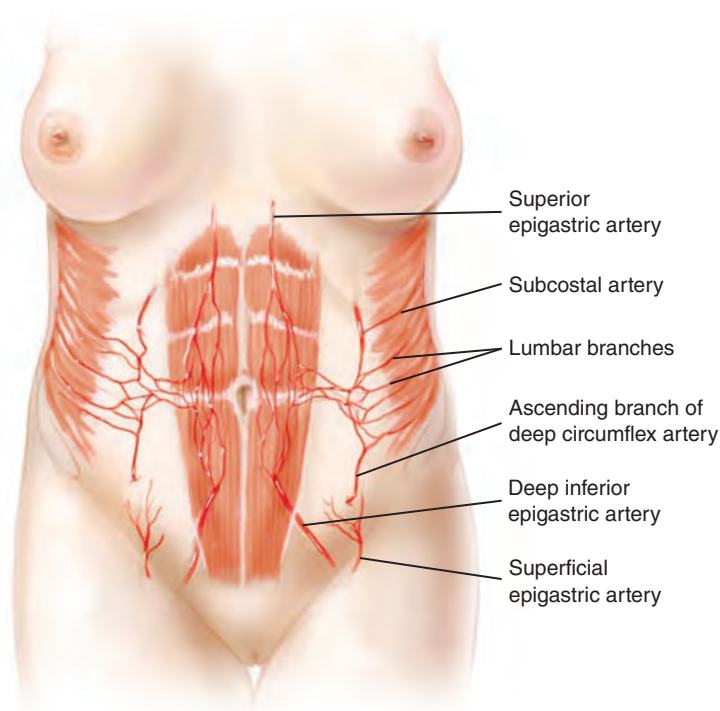


The adipose layer of the abdominal wall can be divided into two layers—superficial and deep—based on Scarpa's fascia. The superficial fat layer has a more robust blood supply, is usually thicker, and has a more dense and durable type of fat. Its vascular supply is from both the subdermal plexus and the underlying musculocutaneous perforators. The deeper layer of fat is typically less dense and receives most of its blood flow from underlying muscle, making it more prone to ischemia during abdominoplasty. This difference in blood supply to the superficial and deep layers of fat is an important factor to consider during lipectomy of the abdominal flap. Because the anterior abdominal wall fat deep to Scarpa's fascia is not involved in supplying circulation to the skin, it may be excised during an abdominoplasty. Conversely, preservation of subcutaneous fat superficial to Scarpa's fascia is crucial to survival of the overlying skin.

Muscle and Fascia

There are four principal paired muscle groups of the abdominal wall: the rectus abdominis, external oblique, internal oblique, and transversalis. The common purpose of these muscle groups is to support the abdominal contents, assist in breathing, and permit the flexion/rotation of the thorax and pelvis. The external oblique, internal oblique, and transversalis muscles form the anterolateral wall of the abdomen, spanning the costal margin to the midline. The rectus abdominis originates on the anterior surface at the lower midline of the rib cage and inserts on the symphysis pubis. The aponeurotic portions of the oblique and transversalis muscles envelope the rectus abdominis and blend in the midline to form the linea alba, a dense confluence of fascia that separates the left and right rectus muscles. The arcuate line is a transition point above which the external oblique and a superficial division of the internal oblique form the anterior rectus sheath, while the deep division of the internal oblique and the transversalis composes the posterior rectus sheath. Below the arcuate line, approximately midway between the umbilicus and symphysis pubis, the transversalis aponeurosis, along with the deep division of the internal oblique muscles, progressively transfers to the anterior fascial layer, leaving only the preperitoneal fat between the rectus muscle and the underlying peritoneum.

Blood Supply



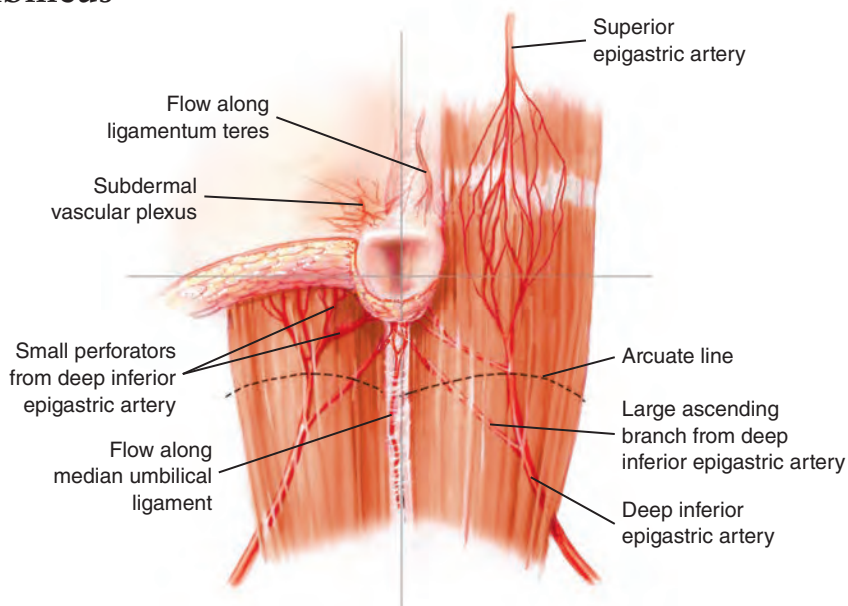
The blood supply to the muscles, skin, and fat of the abdominal wall comes from numerous major arteries of the thorax and pelvic region. These arteries exhibit many anastomotic interconnections that are important for abdominoplasty. Understanding their origins and routes is essential to avoiding ischemic complications.

For the purposes of this discussion, it is helpful to consider the blood supply to the abdominal wall from two areas: one that is superolateral in origin and the other that is inferior in origin. Superiorly, the superior epigastric artery, a branch of the internal thoracic artery, enters the posterior rectus sheath on its way into the rectus abdominis muscle as it emerges from the costal margin immediately lateral to the sternum. As it enters the rectus, it is situated medially in the muscle. It then perforates the rectus abdominis muscle, branching as it descends within the muscle until it anastomoses with the deep inferior epigastric artery. Perforators through the anterior rectus sheath, more densely present in the periumbilical area, supply the abdominal skin and fat overlying the muscle.

The other terminal branch of the internal thoracic artery is the musculophrenic artery, which passes inferolaterally deep to the ribs at the costal margin where it anastomoses with the lower and posterior intercostal vessels (direct branches of the aorta) at the last intercostal space. These posterior intercostal vessels travel between the transversalis and internal oblique muscles and have collateral, muscular, and cutaneous branches. Caudal to these are the subcostal and lumbar arteries, both dorsal branches of the thoracic aorta, which contribute to this anastomotic network of vessels that course between the transversalis and internal oblique muscles.

It is within this intermuscular space that one of the anastomoses between the superolaterally based vasculature and inferiorly based vasculature exists. The ascending branch of the deep circumflex artery, a branch of the external iliac artery, originates from the iliac crest and ascends to the aforementioned anastomotic network. The two other principal inferiorly based vessels are the paired deep inferior epigastric arteries (DIEAs), a branch of the external iliac artery, and the superficial epigastric arteries, a branch of the femoral artery. The DIEA travels superomedially from its origin, pierces the transversalis fascia, and runs along the posterior border of the rectus abdominis muscle before entering it. Once in the muscle, it branches on its way cephalad to anastomose with the branches of the superior epigastric artery. The principal perforators to the skin, on average five per side, emerge through the anterior rectus sheath more densely in the periumbilical region. These perforators receive more inflow from the DIEA than the superior epigastric artery. The superficial epigastric artery arises from the common femoral artery, 1 cm distal to the inguinal ligament at its midline, and ascends within the superficial abdominal fascia and fat toward the umbilicus. It often arises as a common trunk with the superficial circumflex iliac artery, superficial external pudendal artery, and deep circumflex iliac artery.

The Umbilicus



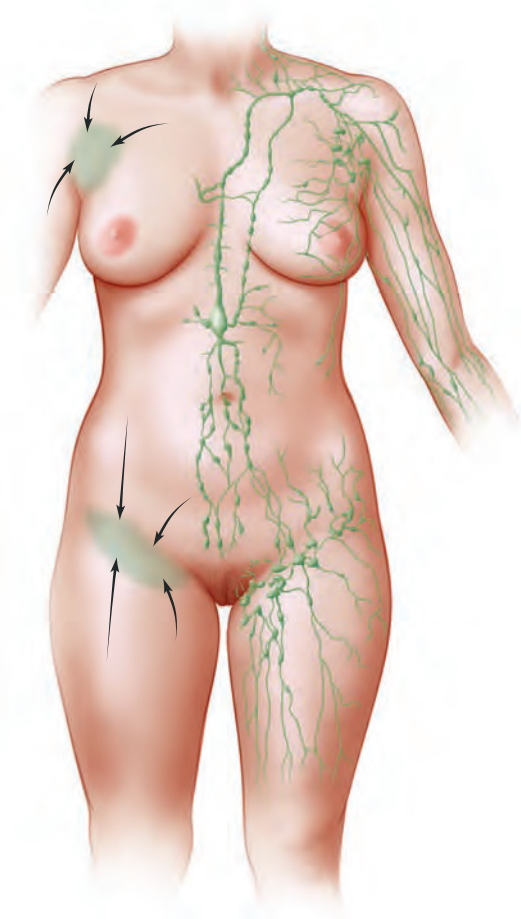
The umbilicus is an aesthetically important surface structure of the abdomen. It is typically situated approximately 14 cm above the symphysis pubis in the midline, or 10 cm above the pubic hair (at the level of the iliac crest). The aesthetically pleasing umbilicus is shallow, has a thin superior skin hood, and is round or elliptoid in shape. Blood flow to the umbilicus is from the subdermal plexus, in addition to three distinct sources: the principal supply is from branches of the right and left DIEAs; additional flow is from the ligamentum teres and the median umbilical ligament. Multiple branches of the DIEA ascend between the rectus muscle and the posterior rectus sheath on their way to the umbilicus. In a morbidly obese patient, the stretching and

descent of the tissues distorts the vascular anatomy and the umbilicus is elongated. Extra caution should be exercised when dissecting the umbilicus in these cases. The fascia around the umbilicus can be weak with a resultant umbilical hernia. Care should also be taken to dissect around the hernia sac to avoid bowel injury.

Nerves

Cutaneous sensation of the abdomen is derived from the lateral cutaneous and anterior cutaneous branches of intercostal nerves T7 through T12. The lateral cutaneous branches perforate the intercostal muscles at the midaxillary line to travel within the subcutaneous plane. The anterior cutaneous branches travel between the transverse and internal oblique muscles to penetrate the posterior rectus sheath lateral to the rectus muscle before entering the rectus muscle on their way to the overlying fascia and skin.

The anatomy of the lymphatic system of the abdominal wall is important, because it is clinically related to the occurrence of serous fluid accumulation and edema after abdominoplasty. A plexus of lymphatic vessels resides within the subscarpal fat layer just superficial to the anterior rectus sheath. Below the umbilicus, the lymphatic system drains inferiorly via the femoral route. Above the umbilicus, this system drains cephalad in the superficial plane to the axilla on its way to the thoracic duct.



Le Louarn and Mustoe published favorable results demonstrating that preservation of the suprafascial network of lymphatics (in addition to use of a quilting suture, in Le Louarn's case) diminishes time with a drain, and both stated that postoperative serous drain output, seromas, and abdominal flap swelling is diminished.

Preoperative Assessment

LORNE K. ROSENFELD

A comprehensive examination is crucial to enable the surgeon to properly prepare the patient and accurately plan surgery.

Physical Examination

The physical exam should include evaluation of all “layers” of the abdominal wall: the skin, the subcutaneous fat, and underlying fascia/muscle (with an indirect assessment of the extent of intraabdominal fat).

Skin

The skin examination should involve much more than just the assessment of the classic pannus of excess lower abdominal skin above the pubis.

Striae

The boundaries of striae are assessed. It should be duly noted and explained to the patient the extent of the striae that may not be included in the resection (particularly those above the umbilicus).

Excess Skin



Standing, this patient ostensibly has little excess skin



Same patient in relaxed sitting position

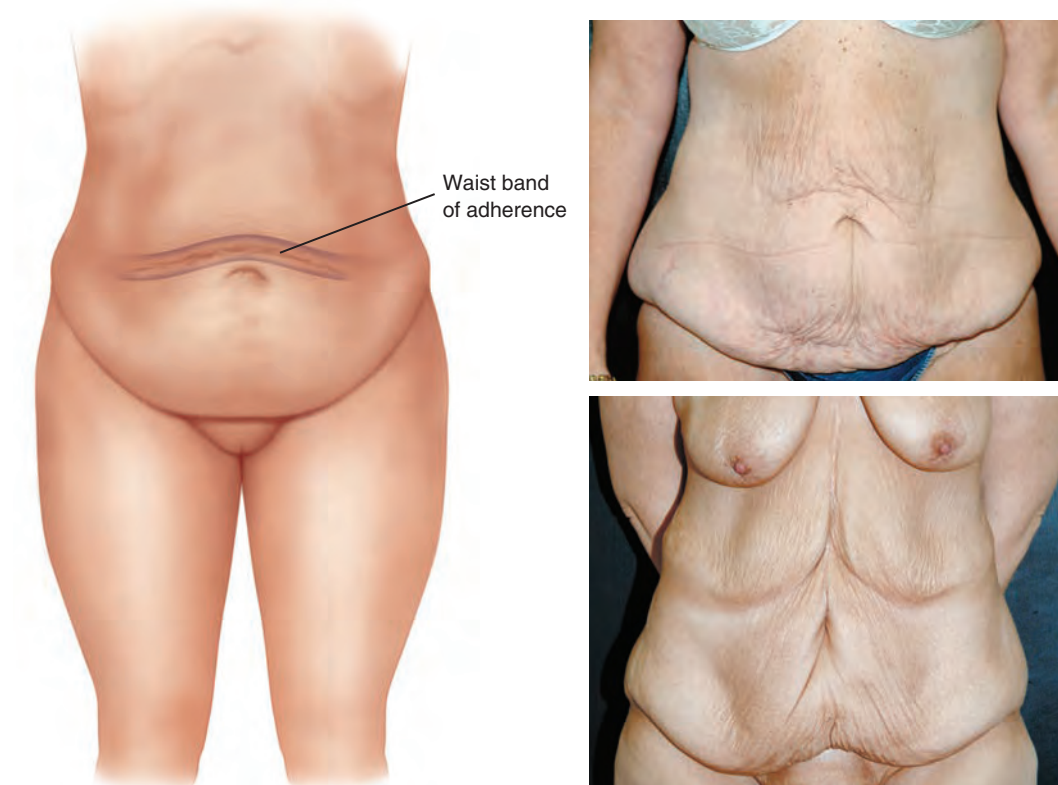
The extent of obvious anterior redundant skin (width of the pannus) is noted first. This evaluation determines the initial estimation of the length of the incision. However, a proper assessment must be made beyond the obvious excess lower abdominal pannus if a more complete correction is to be made at the entire anterior trunk “aesthetic unit”; that is, the extent of redundancy is evaluated not only above the inguinal area but also below the incision, at the hips, thighs, and pubis. If there is particular excess at the lateral thighs, then the incision will, necessarily be appreciably

longer, if the high lateral tension abdominoplasty (HLTA) approach is to be properly applied. On the other hand, if the patient demonstrates minimal excess laterally, then significant tension should not be planned, for fear of making the incision unnecessarily longer.



Any excess skin at the upper abdomen should be noted. Here there may be what may be called a secondary roll or wall of cascading skin, which really represents a migration of redundancy from the chest rather than the abdomen. Consequently, usually not all of this upper abdominal skin can be removed from the suprapubic approach. It is of greater value to conduct this examination with the patient not only in the supine and standing positions, but also when *sitting and bending over*. This is often the only posture in which one can see the areas of redundancy in a patient who demonstrates what appears to be primarily abdominal wall protrusion. Of equal importance, the mobility or what may be called the “translation” of the skin should be assessed, because it can be very telling; the looser the skin, the better the result.

Adhesions



The surgeon should note any adhesions of the skin at the thighs and abdomen proper. Although not previously described, adhesion can also be found at the level of the waist, particularly laterally: a waistline zone of adherence and contraction. In fact, there is most often what one may call a second roll of excess skin resting above this “valley,” most notably in the larger or weight-loss patient. This band essentially divides the abdominal excess skin into superior and inferior segments. The surgeon must be aware that this adhesion of tight skin will reliably resist the surgeon’s efforts to efface this upper abdominal excess. And because this zone harbors vital perforators, only a judicious release of the area by discontinuous undermining should be attempted. Otherwise, this upper abdominal redundancy is best addressed with either a fleur-de-lis-type abdominoplasty or a second-stage reverse abdominoplasty.

Scars

Any scars at the abdomen are assessed. Of greatest concern are those at the subcostal and midline areas. These scars require the surgeon to map out the safest and most effective surgical approach. For a subcostal scar, it is best to restrict the amount of undermining in this area and if possible even include this scar in the resection with a fleur-de-lis approach. Similarly, the upper midline scar presents a challenge. Either a fleur-de-lis-type pattern or a reverse abdominoplasty should be considered. Otherwise, the risk of abdominal flap necrosis is too high. Finally, if there is a full-length midline scar, the fleur-de-lis template is ideal.

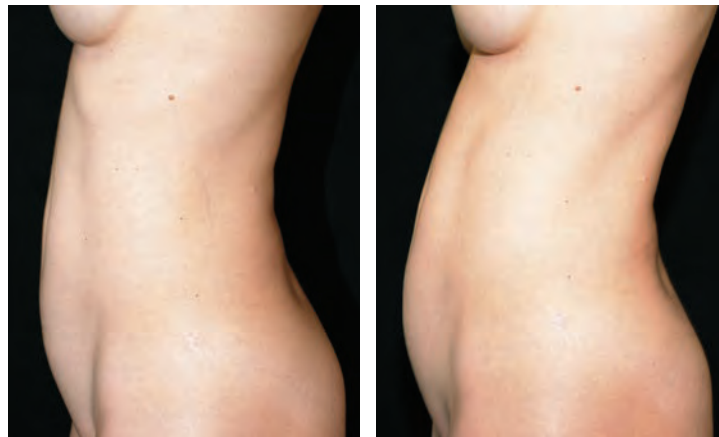
Subcutaneous Fat

Thickness of the Envelope

A topographic sense of the extent of underlying fat must be defined. This mapping will guide where liposuction could be conducted—and just as important, where it should not be performed. Usually contouring of the waist, hips, and lateral thigh accentuates the abdominoplasty's shaping affects and assists the HLTA by facilitating the translation of pull of the skin with its liposuction-induced discontinuous dissection. If the central flap is very thick with fat, it is best to inform the patient that a second-stage liposuction surgery may be necessary to complete the repair safely.

Abdominal Wall

The Location and Extent of Protrusion



The patient is asked to relax the abdominal wall

The degree of lower abdominal wall relaxation is assessed with the patient lying down with knees bent, as well as when standing. *The patient, while standing, is asked to make a conscious effort to relax the abdominal wall.* The additional extent of protrusion that occurs is both surprising and quite informative. Besides the obvious lower abdominal wall protrusion, one should also assess the magnitude of laxity at the upper abdomen. Compressing the lower abdominal wall and watching for “herniation” of the epigastric area will accomplish this task.

The Presence of a Hernia

The exam should explore for an incisional, epigastric, or periumbilical hernia. This is particularly relevant, not only for planning to repair the defect, but also to avoid performing liposuction in these areas before abdominal flap elevation for fear of intraabdominal penetration with the cannula.

The Shape of the Waist

If the waist is square and blunted by fat, aggressive liposuction can be very beneficial.

Preoperative Photographic Documentation

It is essential to obtain a consistent and complete set of photographs. This should include one set of eight views (quarter turns) of the patient from neck to knees with the arms up and a second set with the arms down. Including the anatomic regions above and below the abdomen mandates that the surgeon assess the entire truncal “aesthetic unit” to plan the initial surgery or subsequent stages. This allows proper assessment of the potential far-reaching salutary effects of the HLTA, fleur-de-lis, or reverse approaches postoperatively.

During the photographic session, the patient is again asked to totally relax the abdomen so a true representation of wall laxity can be documented.

Additional views may be photographed, as desired:

With the patient sitting/bending over to illustrate the true excess skin that is often hiding (particularly in front of the protuberant abdomen)

With the patient grasping the excess skin to reproduce the desired lift and potential result of the surgery (for HLTA, reverse, and fleur-de-lis abdominoplasties)

Patient Education

Informed Consent

Every patient is told that the general risks of bleeding, infection, delayed healing, and undesirable scarring are common to any operation. The risks specific to abdominoplasty are also explained, including loss of skin in the lower area of the flap above the pubis, distortion or malposition of the umbilicus, asymmetry of the scar or abdominal contour, failure to narrow the waistline, and postoperative seroma. The surgeon should also clearly define for the patient the extent and limitations of the planned surgery:

The excess skin that may not be fully removed: the potential dog-ears at the lateral margins and the inevitable residual skin or even rolls at the upper abdomen, above the zones of adhesion

The potential scar at the lower midline abdomen, the original site of the umbilicus: when all lower midline skin is intentionally not excised to facilitate a tension-free closure in an aesthetic location

The possible lateral extension of the abdominal scar: depending on the amount of excess skin present, the longer the scar, often the better the result

Patient Instructions

The patient is given a set of instructions covering preoperative, intraoperative, and postoperative considerations (see p. 2948).

Patient Information

Preoperative Preparation

To ensure that the patient is optimally prepared for surgery, the following instructions are given:

The patient is assisted to accomplish a regular bowel program.

The patient is instructed to take antiseptic showers and apply antibiotic ointment to the nares for a few days preoperatively.

The patient is encouraged to continue regular diet and exercise programs.

The patient is strongly urged to stop smoking altogether, but if this is not realistic, then to discontinue all smoking for at least 2 weeks before and 2 weeks after surgery.

The patient is advised to donate 1 or 2 units of autologous blood, depending on the extent of the surgery planned.

Intraoperative Information

To promote compliance, the surgeon must inform the patient of any relevant intraoperative activities:

Antiembolism stockings and pumps will be in place before, during, and after surgery.

Binder garments, drains, a Foley catheter, and a pain pump may be placed.

Postoperative Instructions

To encourage a predictable recovery, the surgeon must carefully instruct the patient in all aspects of the postoperative course:

The minimum time off work will be 2 weeks; the time away from exercise and heavy lifting will be at least 6 weeks.

The patient should be assisted to ambulate early, and calf exercises and spirometry exercises should be conducted regularly.

A full diet should gradually be introduced over several days.

Drains and sutures will usually be removed within several to 10 days.

The timeline of healing includes bruising for at least 2 to 3 weeks and swelling that will resolve over a minimum of 3 to 6 months.

Preoperative Planning

LORNE K. ROSENFELD

Decision-Making

Before the first stroke of the marking pen is made, the entire anterior trunk must be analyzed and staged plans made to address all areas of deformity. The key to designing a comprehensive repair is to envision the entire trunk as composed of aesthetic units rather than focusing solely on the obvious lower abdominal excess:

1. The hips and thighs: Is there extra fat or skin? If there are discrete noncellulite fat deposits with nominal excess skin, concomitant liposuction is wise. How-

ever, if skin traction at the hip effects a good contour change at the thigh, then one needs to consider a high lateral tension procedure.

2. The lower rib cage and upper abdomen: Is there significant redundant skin? It is unlikely to change after an HLTA; a reverse abdominoplasty at a later stage or an initial fleur-de-lis–type abdominoplasty would best treat this difficult zone.
3. The epigastric and supraumbilical abdomen: Is there a prominent subcutaneous layer of fat? If so, the surgeon should consider a second-stage aggressive liposuction procedure to treat this deformity definitively and with greater safety.
4. The pubis: Is it redundant and/or full? If so, liposuction of the area, with or without excision of excess pubis, will prevent a residual distracting deformity in this area.
5. The waist: Is it square? Additional fascial sutures and liposuction in the area could “nip in” this area. If this area harbors large skin excess, a fleur-de-lis approach should be considered.
6. The breasts: Are they in need of rejuvenation as well? This deformity should be broached at this time, because the breasts must be considered an aesthetic unit if a complete repair is to be planned. In addition, any redundant upper abdominal skin can be efficiently resected at a later stage through the breast incisions as part of a reverse abdominoplasty.
7. The skin: Are there subcostal or midline scars? In the patient with significant redundancy, the surgeon should seriously consider a fleur-de-lis approach that could excise most if not all of these scars and obviate potential ischemia concerns.

Once all components of the abdomen and its “environs” have been evaluated, the surgery can be definitively mapped out: A number of surgical approaches are available to treat abdominal deformities. These range from liposuction only to full abdominoplasty with fascial plication. The decision is based on evaluation of the abdominal skin, subcutaneous fat, and underlying fascia. The patient’s desires must also be taken into account: Is she seeking recontouring to look better in her clothing, or is she looking for recontouring and skin tightening so that she can look good in a two-piece bikini?

Liposuction

The best candidates for liposuction are nulliparous women with a modest amount of excess fat, tight abdominal musculature, no hernias, and tight skin of normal elasticity. Some women who have had children with minimal to modest loss of skin elasticity and no diastasis may also be candidates for liposuction if they understand that their skin quality will not be improved but their contour will be greatly enhanced, especially when they are fully clothed. These women should understand and accept this tradeoff for a less-invasive procedure.

Traditional Abdominoplasty

Patients who have excess skin above and below the umbilicus, periumbilical hooding, fat excess, and diastasis or abdominal wall hernias are appropriate candidates for traditional abdominoplasty. Traditional skin excision and more extensive skin excision is required to deal with the supraumbilical skin excess. These patients should anticipate improvement of their appearance in and out of their clothes.

Limited Abdominoplasty

Patients with nominal excess skin above and limited excess skin below the umbilicus are reasonable candidates for a more limited abdominoplasty. This approach is most conducive in a patient with a high-riding umbilicus. The patient may have a diastasis or even an umbilical hernia, which can be repaired through the limited approach. The effect on umbilical position is an important determining factor to candidacy for this approach. The limited skin incision combined with musculo-fascial tightening with liposuction above and below the umbilicus will enhance the patient's appearance in and out of her clothing.

High Lateral Tension Abdominoplasty

The "pure" Lockwood type of abdominoplasty is effective for patients with excess skin at the abdomen, lateral hip and thigh, pubis, and even the anteromedial thigh. If there is a significant amount of excess skin superolaterally, then either conversion to a fleur-de-lis approach or a plan for a second-stage reverse abdominoplasty should be considered. A concomitant reverse abdominoplasty is not recommended, because the intervening band of blood supply may not be enough to sustain the flaps.

Fleur-de-Lis Abdominoplasty

The fleur-de-lis abdominoplasty is appropriate for patients who require more aggressive treatment for excess skin throughout the abdomen and trunk, particularly at the upper pole of the abdomen and lower chest and back as well as at the waist, hips, and thighs. The patient must accept the tradeoff of a full midline scar for a more complete skin resection. This approach is also efficacious in a patient with abdominal scars that could otherwise compromise the blood supply of a more traditional abdominoplasty.

Reverse Abdominoplasty

The reverse abdominoplasty is particularly relevant in patients with primarily or residual excess upper abdominal skin. This approach can be very synergistic when combined with a Wise pattern type of breast surgery.

OPERATIVE APPROACHES

Liposuction

GILBERT P. GRADINGER

Some nonobese women who have a protuberant lower abdomen without excess skin present with good skin tone, excess lower abdominal fat, and some muscle laxity. Typically, liposuction alone can improve their contour.



Use of a tumescent technique (usually injection of 500 to 1000 ml Ringer's lactate with 50 ml of 1% lidocaine and 1 ml of 1:1000 epinephrine) enables the surgeon to suction fat with very little blood loss and a nice improvement in abdominal wall contour.



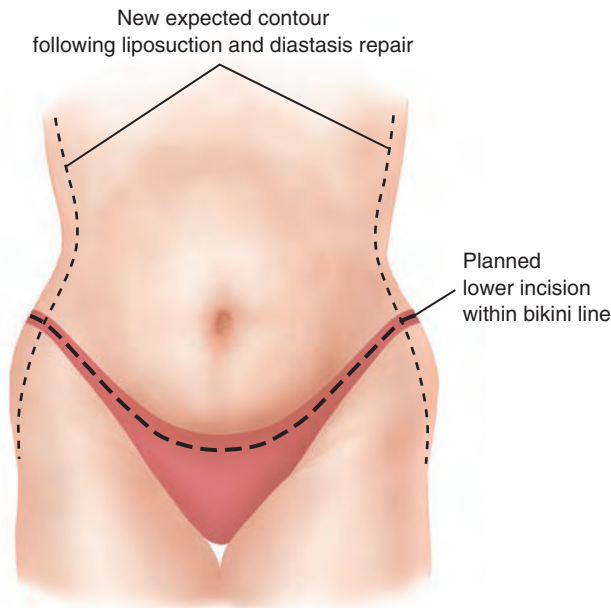
Although liposuction will never improve stretch marks, abdominal wall contour can be improved in some patients who do not want any form of abdominoplasty, as can be seen in this patient with poor skin tone and stretch marks.

Traditional Abdominoplasty

GILBERT P. GRADINGER

Anterior abdominal dermolipectomy, with or without liposuction, constitutes traditional or classic abdominoplasty, which has two significant variations, depending on the management of the umbilicus. Dermolipectomy of the anterior abdominal wall removes excess skin and fat, primarily in the vertical direction. The repair results in tightening and flattening of the abdominal wall. The additional surgical component, fascial tightening, further flattens and contours through horizontal tension narrowing the waistline. Variations on the traditional abdominoplasty include lower abdominoplasty, HLTA, and fleur-de-lis abdominoplasty.

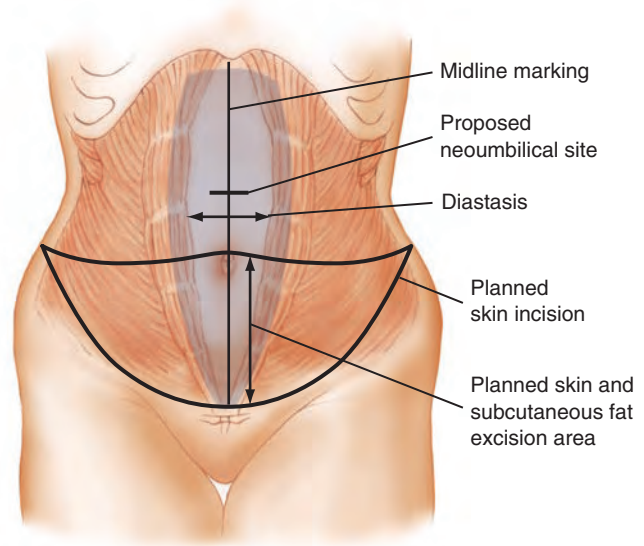
Markings



The patient is examined and marked for surgery the day before the procedure. She has been advised to wear her usual style of underpants or swimsuit bottom (her choice), so that the garment will conceal the planned incision and resultant scar. The practice of marking the patient in the office the afternoon before the day of surgery has served my patients and me well.

An office nurse is present and assists in making the patient feel more comfortable in this private setting, in contrast to the preoperative holding area. The patient is able to see the markings in the office, ask questions, and offer an opinion (particularly in liposuction marking). Thus she will have a better understanding of the location of incisions and resultant scars.

Planning is vital to successful surgery, and it can be done more accurately in a controlled situation. Photography is achieved with precise consistency of positioning, lighting, and background. I do not have to arrive in the preoperative holding area to arouse a medicated patient or request that she not be medicated until I have completed the markings.



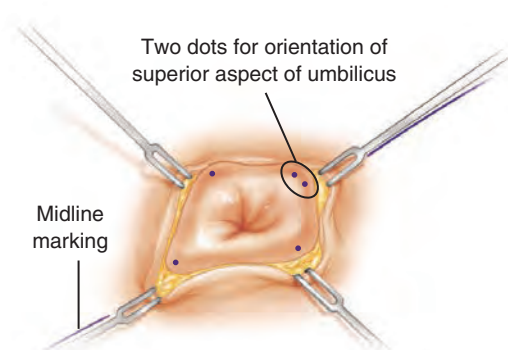
Surgical marking is performed with the patient standing. The excess skin and fat to be excised are usually from the umbilicus to the pubis vertically and from one anterior superior iliac spine to the other horizontally. The maximum excision is in the midline, and it tapers laterally. The surgeon makes a clinical judgment as to whether supraumbilical skin will reach to the pubis after removal of the intervening skin. This can be done by grasping the tissue and bringing the proposed midline points together. The surgeon should be alert for patients with a greater-than-usual distance from umbilicus to pubis and a short distance from the xyphoid to the umbilicus.

The patient should urinate before leaving the preoperative holding area for the operating room. By going to surgery with an empty bladder, the patient avoids the need for a Foley catheter. Operating time is usually less than 2 hours. The patient will have recovered well enough from anesthesia to void spontaneously. Therefore the risks associated with an indwelling catheter are eliminated.

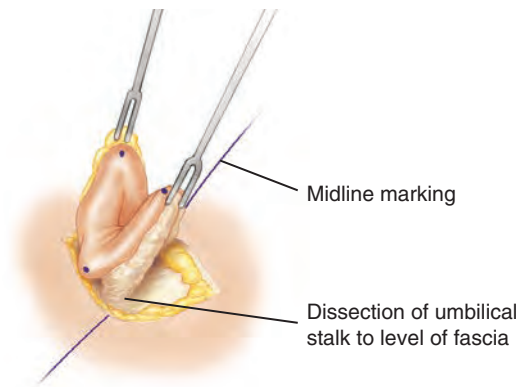


The periumbilical markings are made with the patient supine on the operating table, as is the vertical midline mark from the xyphoid process to the umbilicus. The estimated location of the new umbilical skin site is marked.

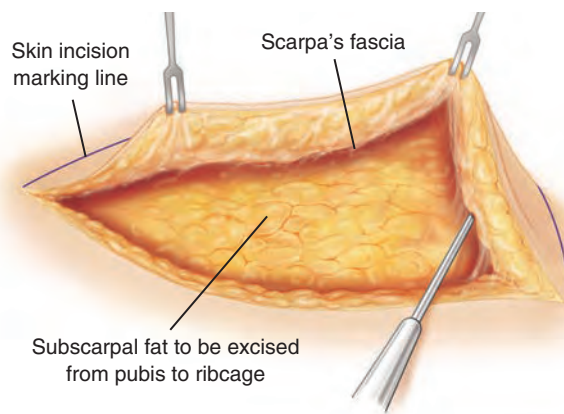
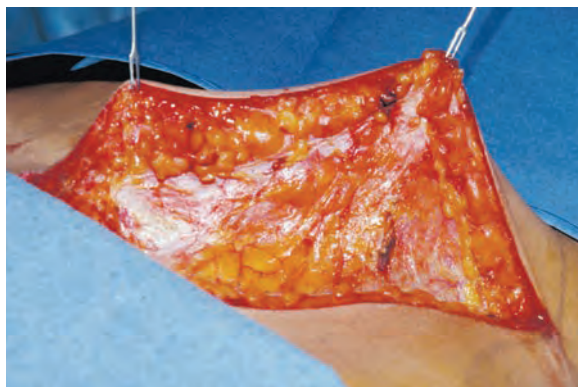
Operative Technique



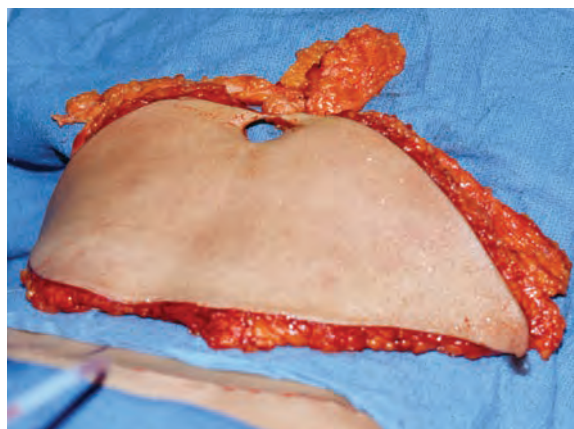
After general anesthesia has been induced and the patient has been prepared and draped, the 3, 6, 9, and 12 o'clock positions of the umbilicus are needle-tattooed and the circumferential incision is made. Two dots are tattooed at the 12 o'clock position to prevent accidental rotation of the umbilicus at the time of repair.



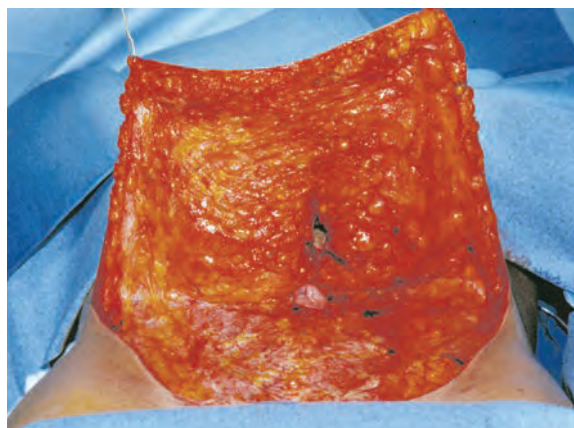
The umbilical stalk is dissected to the level of the anterior abdominal fascia.



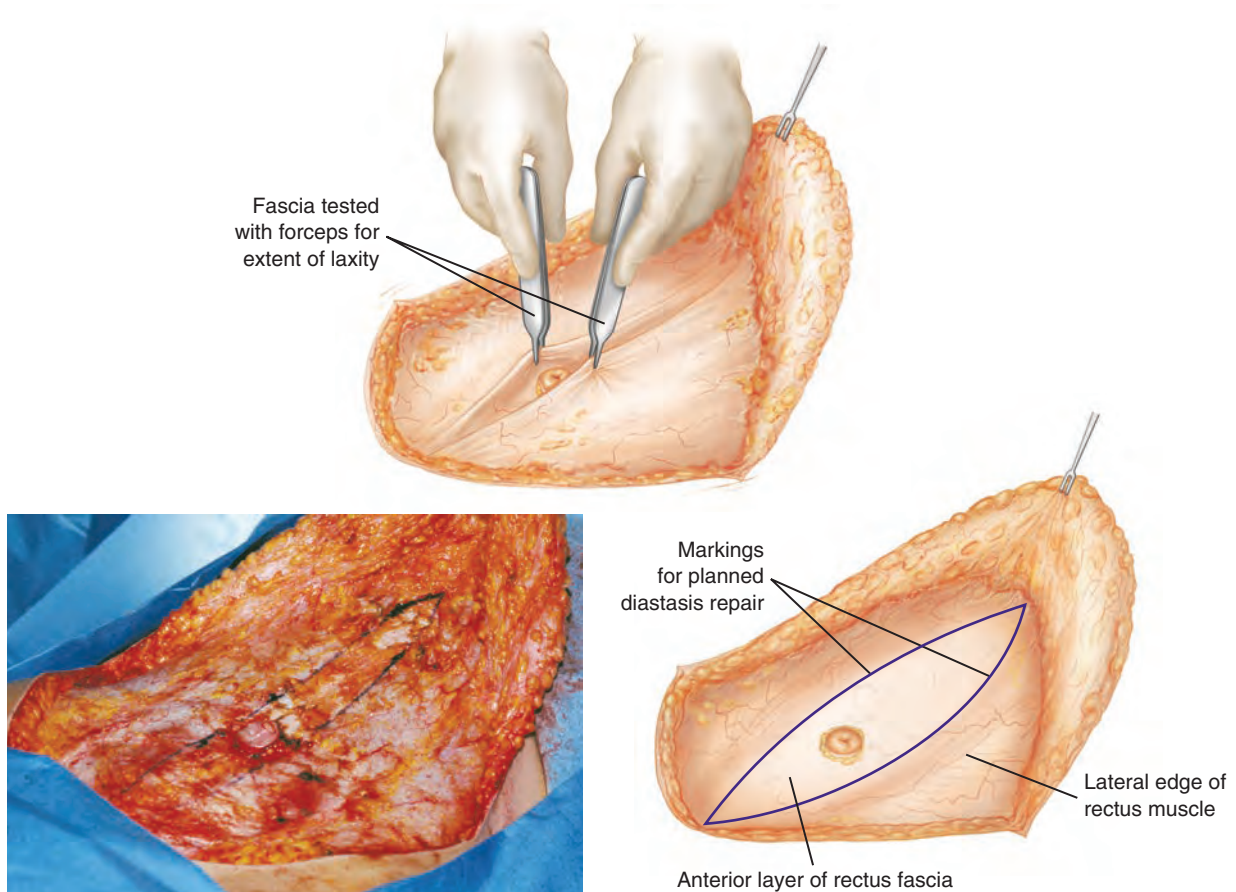
The skin and subcutaneous flap are dissected from the pubic/inguinal region cephalad at the level of the anterior abdominal wall fascia. Dissection continues cephalad to the lower border of the rib cage laterally and the xyphoid centrally.



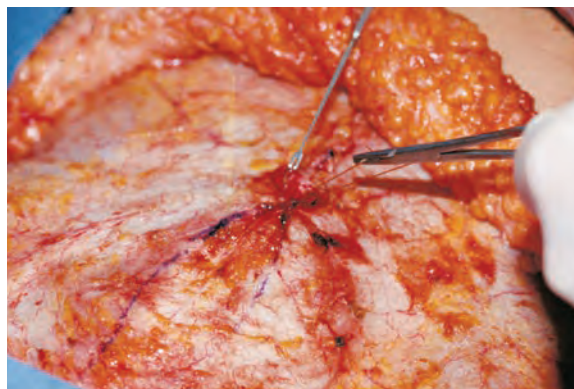
The tissue excised is a full-thickness skin and subcutaneous block including subscarpal fat cephalad to the skin excision.



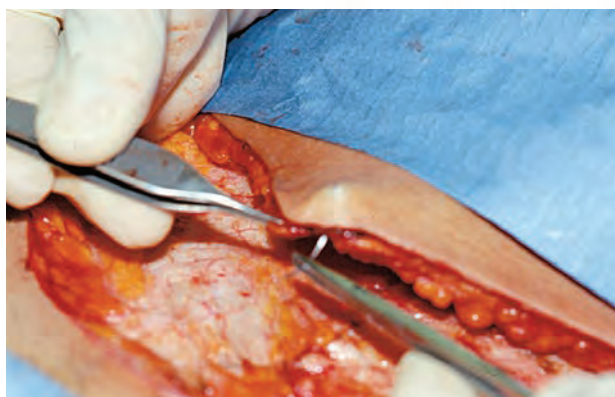
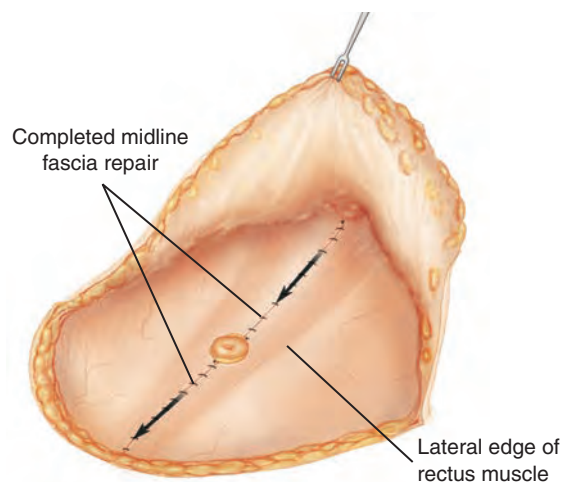
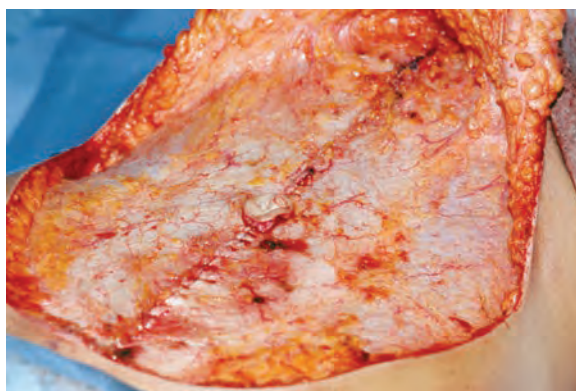
The elevated fat flap from which fat deep to Scarpa's fascia has been excised is shown. Dissection and hemostasis are achieved with an electrosurgical unit.



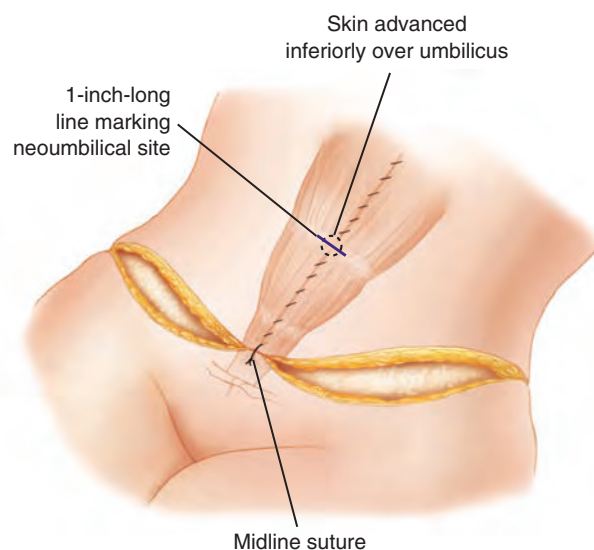
The extent of anterior abdominal wall midline fascial laxity is tested with forceps and the width of laxity marked for repair.



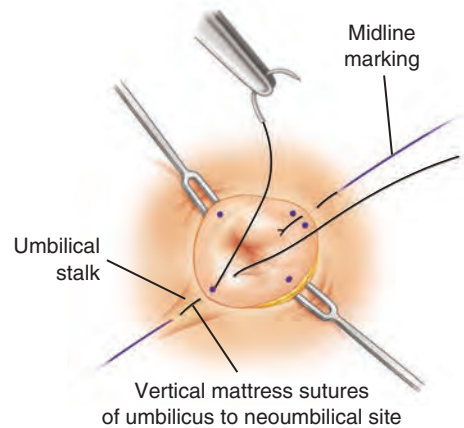
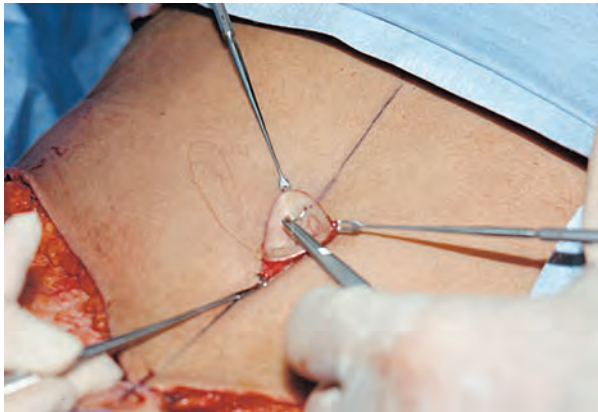
The laxity and underlying diastasis are repaired by a running absorbable monofilament suture (for example, Monocryl) from the xyphoid to the umbilicus (and the umbilicus to the pubis). Liposuction is performed, then the wound is irrigated with saline solution and hemostasis is ensured. Jackson-Pratt drains (No. 7) are inserted in each side through separate incisions in the pubic region.



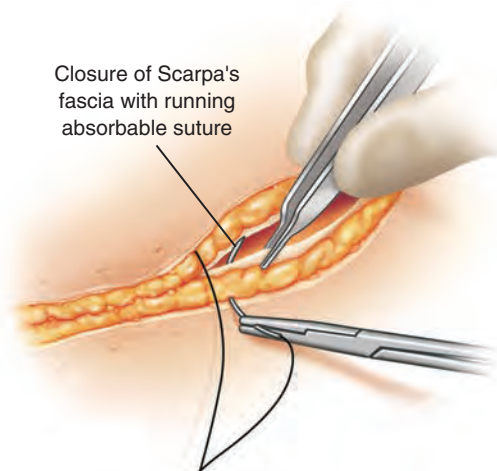
The lowest midline point on the flap is advanced inferiorly to be sutured to the midline pubic skin. Subcutaneous fat is retained at the margin in the midline; this is important for skin circulation.



The 1-inch-long horizontal skin incision is marked in the midline directly over the umbilicus. It is anticipated that the umbilicus will again be vertically oriented after healing, because the tension placed on the flap by the closure will convert the horizontal opening into a vertical one.



The umbilicus is delivered through this incision and sutured at the 12, 3, 6, and 9 o'clock positions with one-half dermal (on the skin side) vertical mattress sutures of 5-0 nylon. The circumumbilical repair is completed with a running subcuticular 4-0 Vicryl suture.

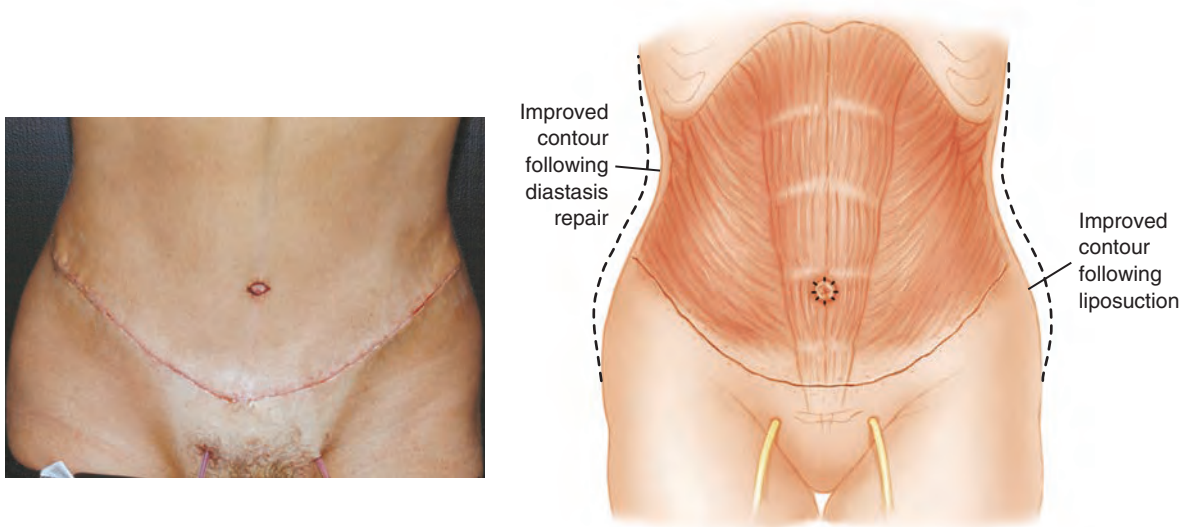


The wound is closed in two layers (Scarpa's fascia and subcuticular) using 4-0 Vicryl sutures. It will be obvious that the lower incision is longer than the upper one; it is more curvilinear, whereas the upper incision is straighter. Closing these incisions of unequal lengths is not a problem because of the tension and stretching of skin in the flap, which allows good approximation.

Postoperative Care

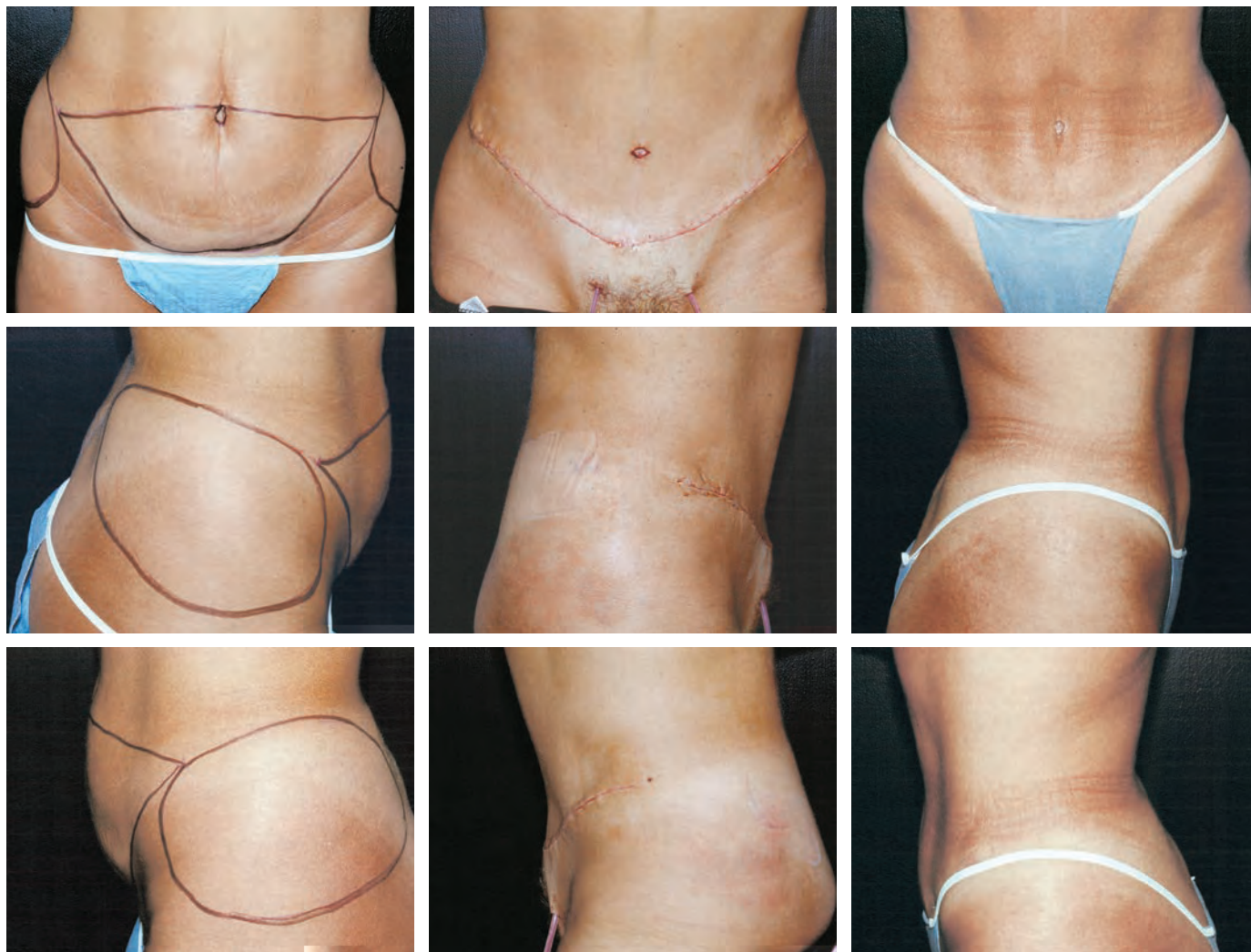
Fine mesh, nonadhering gauze and layered 4×4 sponges, ABD pads, and an abdominal binder (three panels, not four, so that respiration is not restricted postoperatively) are used for dressing. The patient is placed in bed with the head, knees, and feet elevated. Intermittent compression stockings, full leg length, are put on the patient in the operating room before surgery; these are activated throughout surgery, in the recovery room, and in the patient's hospital room postoperatively until she is fully ambulatory, at which time full-length support hose are used and continued for 3 weeks after discharge. Surgery is performed either on an outpatient basis, as was done in the patient described in this sequence, or with a 1-night hospital stay. Antibiotics are administered intravenously at the beginning of the surgical procedure and are not used again unless there is a problem postoperatively.

Results

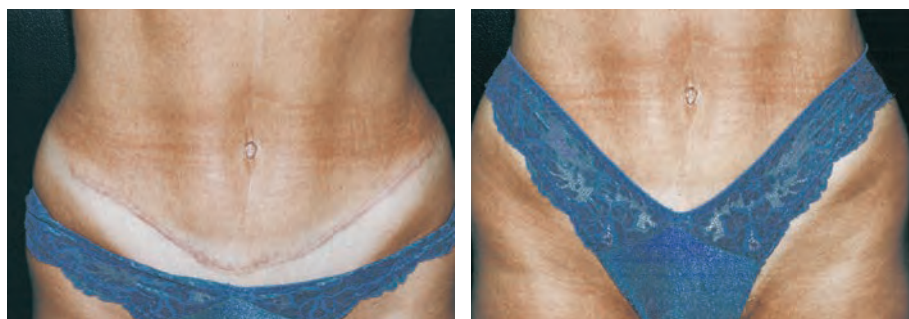


In this photograph of the patient's appearance on postoperative day 1, the patient is erect and drains are in place. Drains were removed on postoperative day 3, when drainage was less than 30 ml per 24 hours.

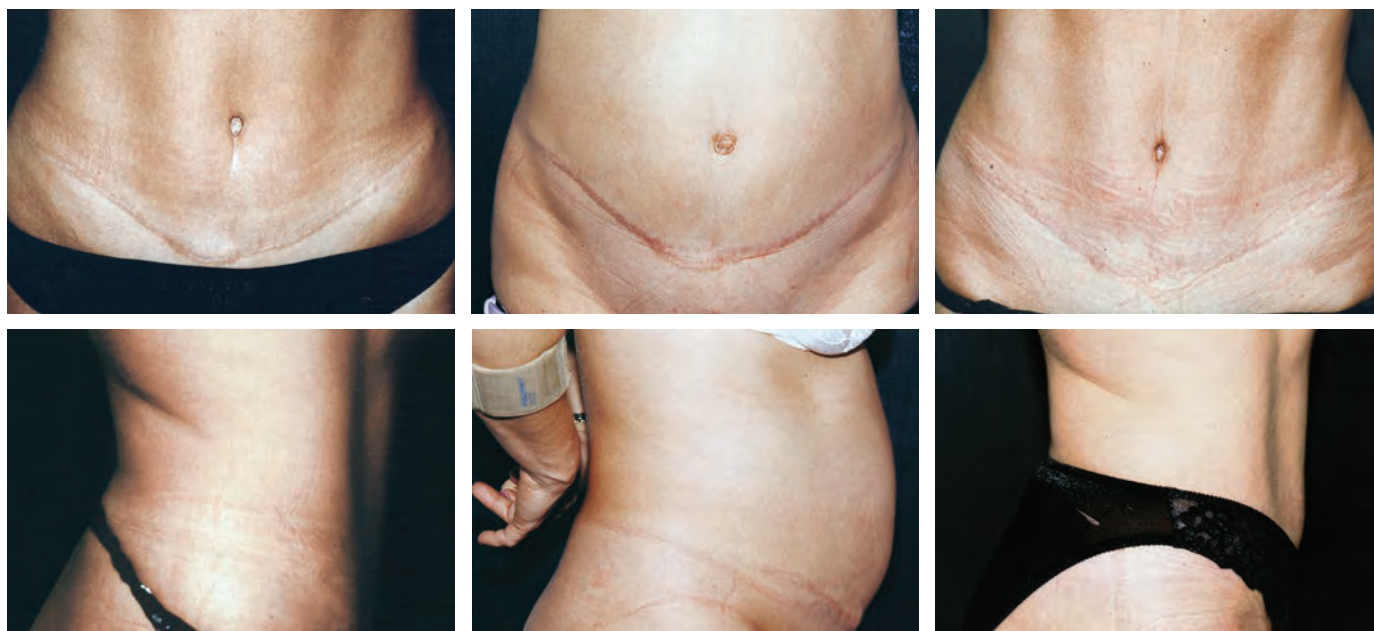
Patients often ask how the benefits of abdominoplasty would be affected by future pregnancy and childbirth. To my knowledge, this is the only patient in my practice who had a child after abdominoplasty. In this instance, because she controlled her weight and exercised during and after the pregnancy, the benefits of the abdominoplasty persisted. (Obviously, one needs to be careful in drawing conclusions based on a single case.)



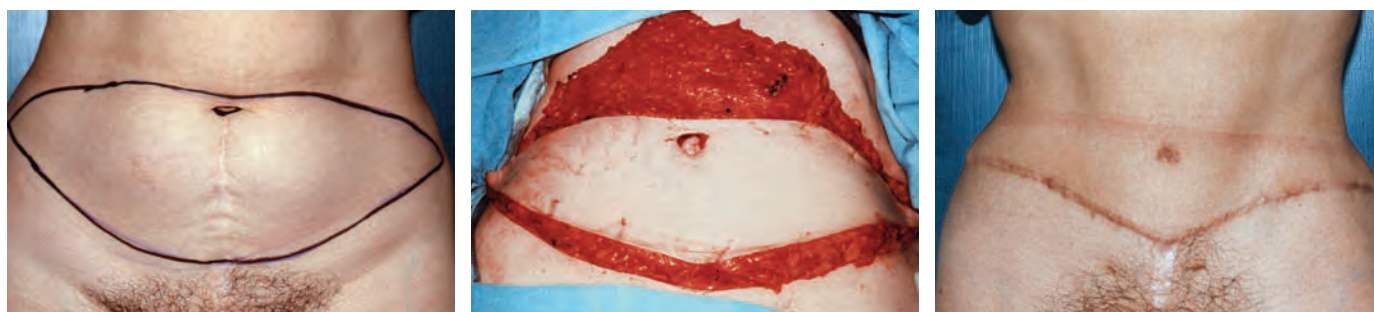
The patient is shown preoperatively, 1 day postoperatively, and 1 year postoperatively in all three views. Note the shape of the umbilicus in the three anteroposterior photographs.



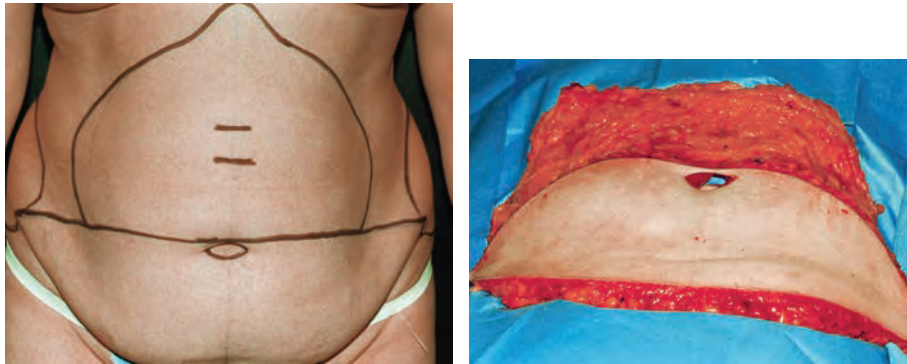
The scar is seen and concealed at 2 years postoperatively.



The patient is shown 3 years postoperatively, 1 year later when she is 6 months pregnant, and 7 months after that (4 months after vaginal delivery of a 7-pound, 2-ounce boy).



Another patient is shown to demonstrate the dramatic improvement achieved in abdominal flattening and waist contouring.

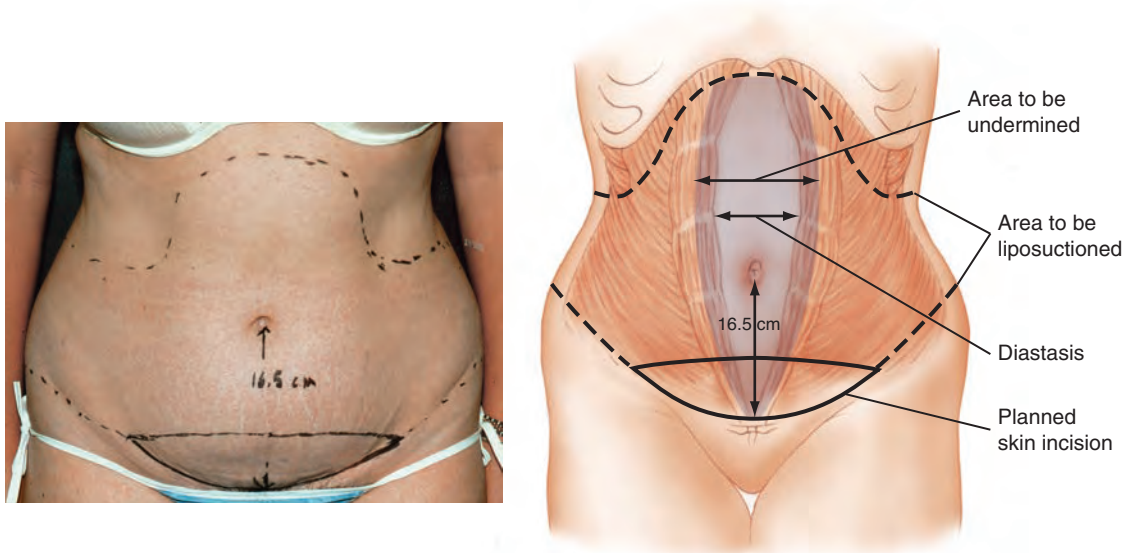


This patient's preoperative markings and tissue specimen demonstrate the extensive removal of fat deep to Scarpa's fascia. This fat excision, in my opinion, is a safer way of thinning the upper flap compared with suctioning, because it preserves the blood supply to the skin through the subcutaneous fat that is superficial to Scarpa's fascia.

Limited Abdominoplasty

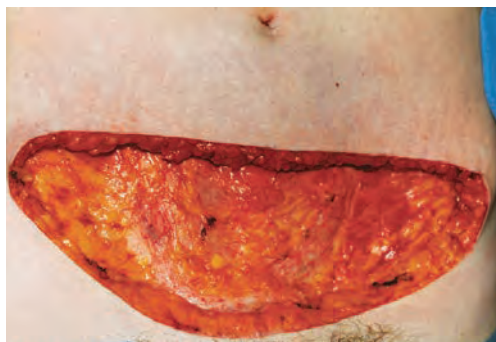
GILBERT P. GRADINGER

In some patients it is not feasible to remove all of the skin between the umbilicus and the pubic area: a patient who has a relatively high umbilicus, and a patient who has a low suprapubic scar that dictates where the lower incision should be placed. Both factors may coexist in some patients.

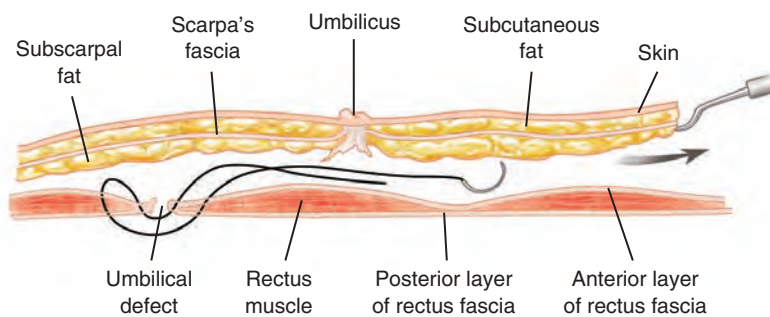
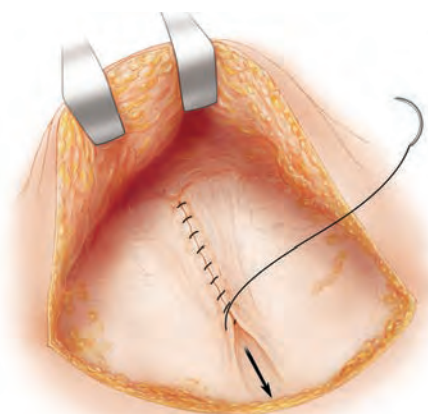
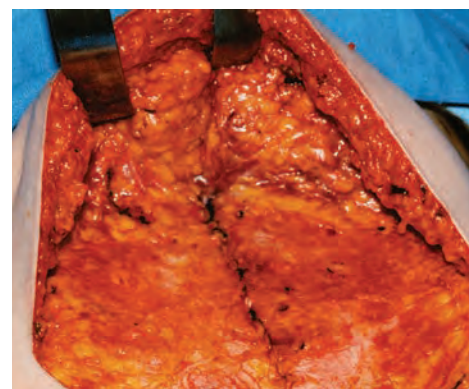
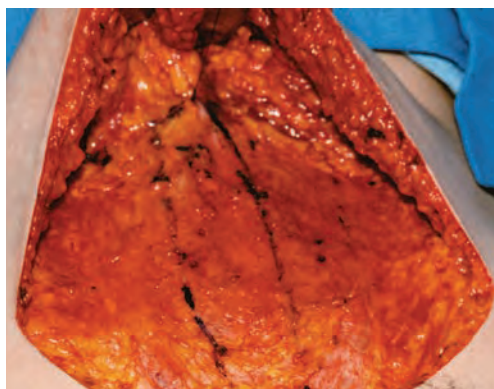


This patient had a low surgical scar; the distance from the scar to her umbilicus was 16.5 cm, approximately the same distance as from her xyphoid to the umbilicus. To reach the pubis, the skin of the upper abdomen would have to be stretched to double its normal length.

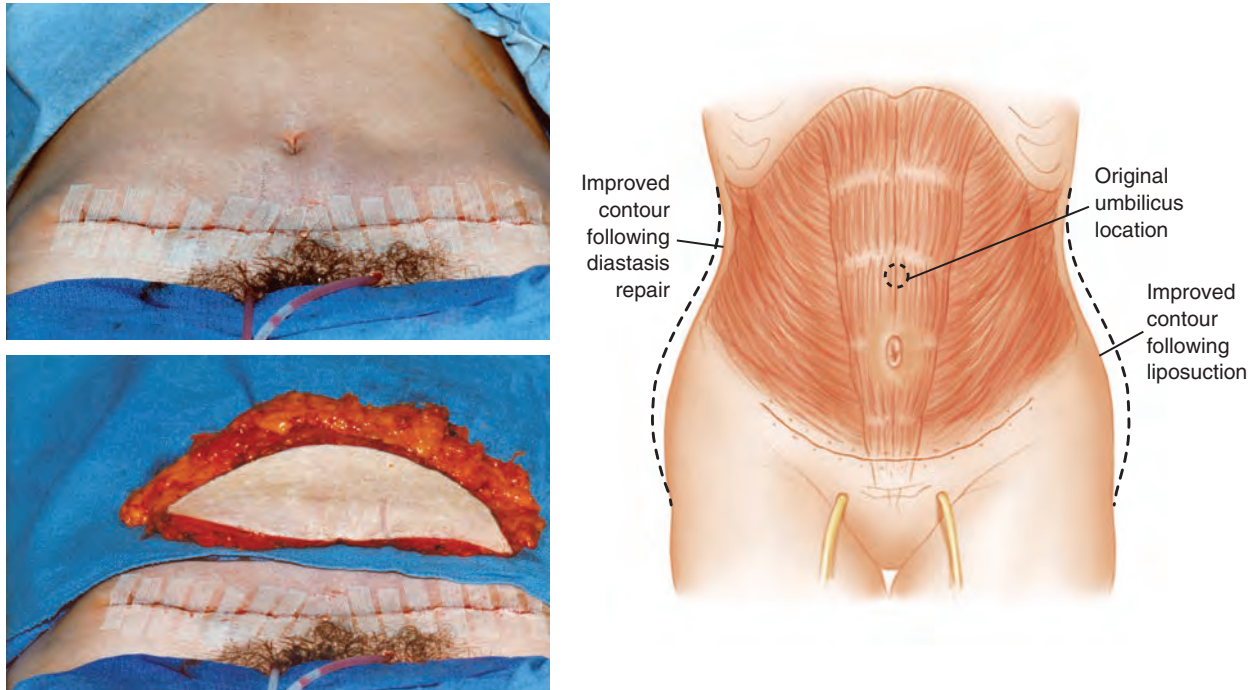
Operative Technique



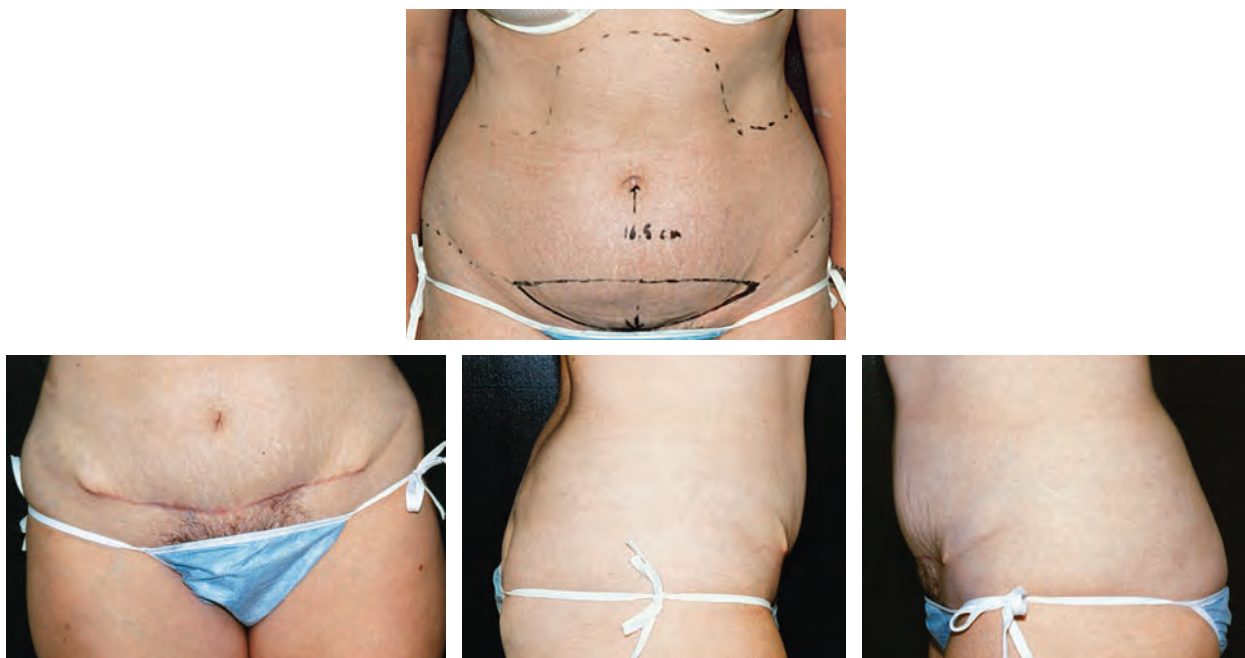
The abdominoplasty was modified, with more-conservative excision of skin and fat, and instead of leaving the umbilicus attached to the abdominal wall, it remained part of the flap—its stalk having been transected at the level of the anterior abdominal wall fascia (demonstrated with the surgeon's hand interposed between the flap and the fascia).



The umbilical fascial defect and diastasis were identified and sutured.



The flap was advanced inferiorly carrying the umbilicus, and the incision was sutured. The umbilicus can be seen to be lower on the abdominal wall than it was preoperatively. Drains have been placed and the surgical specimen is seen.



The patient is shown 18 months postoperatively. Because of the tension on the flap created by the closure, the umbilicus is stretched; it is more vertical than it was preoperatively. Unfortunately, the result is compromised by the presence of “dog-ears” (faulty surgical technique). This complication could have been avoided if suturing had been begun at the lateral ends of the incision instead of medially.

Comprehensive Abdominoplasty: High Lateral Tension Abdominoplasty With Complementary Fleur-de-Lis and Reverse Techniques

LORNE K. ROSENFELD



83-1 Comprehensive
abdominoplasty

The abdominoplasty can be deceptively easy to perform yet maddeningly inconsistent in its results. The plastic surgeon is challenged to excise all the excess anterior trunk skin and fat through the shortest possible incision and to ensure optimal healing with an inconspicuous scar. To begin to rise to this challenge requires one to become a student of the abdominoplasty. By continuously honing one's surgical planning and execution, a more balanced technique can be realized that is both reliably safe and aesthetically successful. The high lateral tension abdominoplasty, with some "2.0" modifications, is such a technique.

Traditionally, the primary goal of any abdominoplasty has always been to excise the central lower abdominal excess skin or pannus and plicate the abdominal fascia through a suprapubic incision. Unfortunately, this traditional abdominoplasty may often fall short of this goal: a scar that may ride too high; persistent skin and lipodystrophy at the pubis, thighs, flanks, and hips; and a consistent incidence of mid-line skin necrosis or wound dehiscence.

The HLTA addresses these shortfalls. It may be defined as a more complete treatment of the lower trunk aesthetic unit from the abdomen to the pubis, hips, and thighs, with a greater overall aesthetic result as well as a greater margin of vascular safety. What follows outlines the techniques and tools to accomplish these superior results safely and consistently.

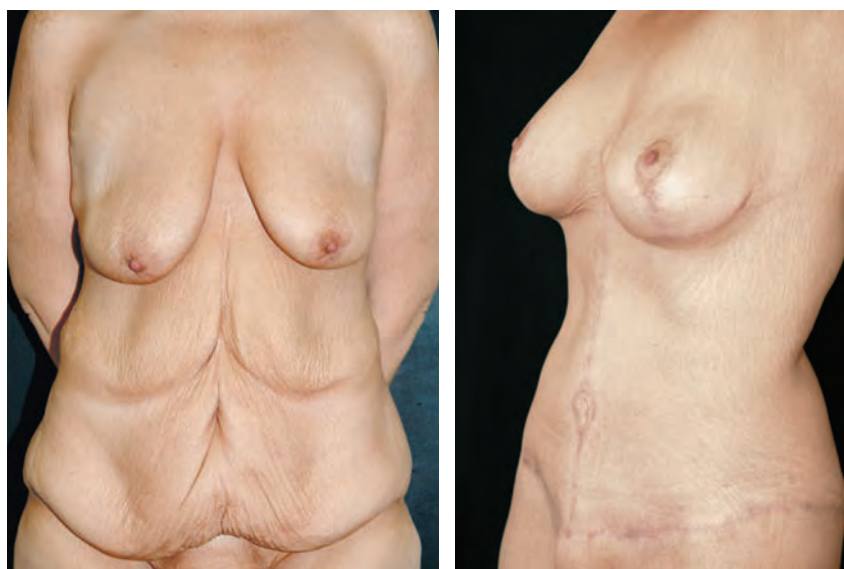
Evolution of the Modern Abdominoplasty

The abdominoplasty technique has evolved significantly over the last four decades. The modern abdominoplasty was born in South America in the 1960s. The basic surgical tenets have always been to conduct a rectus plication, with maximal excision of the central skin excess by extensive undermining of the entire abdominal wall. The closure is often under some tension and is therefore of necessity conducted with the patient in significant flexion. When liposuction was introduced in the 1980s, it soon became apparent that blithely and aggressively adding this modality to the abdominoplasty led to an unacceptable incidence of flap ischemia and skin necrosis. Liposuction then evolved into a more conservative adjuvant treatment.

Although there were indeed fewer physiologic problems with this technique, the aesthetic results were once again more constrained.

Then in the early 1990s Lockwood published a series of seminal articles that single-handedly changed the tack of the abdominoplasty technique. Based on his extensive experience with body-contouring surgery, he decisively demonstrated and definitively modified the surgical principles of abdominoplasty and reported greater safety and improved aesthetics. He enumerated several surgical tenets that were in many ways diametrically opposed to those of the classic or traditional abdominoplasty: the undermining of the central skin flap only to facilitate plication and *discontinuous dissection elsewhere* (to enhance vascularity and allow *judicious* concomitant liposuction) and the *initial* resection of the *lateral* excess skin, with more-conservative resection of the central skin flap to accomplish a more complete and natural repair, and the use of a planned and controlled *high-tension closure*, with diligent use of the underlying superficial fascial system. Thus was born the high lateral tension abdominoplasty.

The High Lateral Tension Abdominoplasty: A “2.0” Version



For a result to be called truly successful, three strict standards must be balanced equally: the case has to demonstrate the greatest degree of *safety* (zero tolerance for complications), with the maximal *aesthetic* result (correction of all “deformities”), and a *consistent* reliability (regardless of patient presentation). As a result, several important expanded principles of the high lateral tension abdominoplasty validate this 2.0 advancement.

The surgeon performing an HTLA procedure should not slavishly follow the otherwise arbitrary mandate that all the skin between the pubis and the umbilicus must be excised. This approach will only truly work in a patient with an enormous pannus. Otherwise, the excisional marking must be placed above the pubic hairline to accomplish closure of the wound, often with an overly tight closure. This approach may result in an excessively high scar and superiorly retracted pubis, an unnaturally flat hypogastrium, and, more seriously, an exaggerated rate of wound dehiscence and skin necrosis. Instead, any redundant pubis should be corrected with excision, rather than be used to help close an overly tight suprapubic wound, as is often the case with a traditional abdominoplasty. The pubis is then closed under no tension and rests in a lower, more inconspicuous location. As a result, it is most often necessary to close the original umbilical site, since all the skin between the pubis and the umbilicus may not be excised. The surgeon must resist the temptation to remove even a few centimeters of intervening abdominal skin for fear of recreating the usual overly tight closure. This small scar is a reasonable tradeoff when compared with the traditional closure, which can lead to complications.

Any abdominoplasty should consider not only what is above the future incision (the traditional pannus) but also what is below; that is, the pubic excess, anterolateral and medial thigh redundancy, and buttocks laxity. Otherwise, the tissues below the incision may appear distractingly untreated postoperatively, and the full effect of the HTLA may not be realized. This tenet underlines one of the greatest benefits to the HTLA that is not usually considered possible with the traditional abdominoplasty: one can realize a true “body lift” effect through an anterior incision only. Therefore this procedure is really simply a “tension abdominoplasty,” with sequential tension placed from lateral to medial.

This notwithstanding, *the goal of the design and placement of the future scar should primarily be to hide the scar.* Lockwood originally described a very high (“French-cut”) lateral closure, probably because that style of clothing was more fashionable at the time, and a more oblique vector of pull does more efficiently treat the upper abdominal excess, as described above. However, considering how fashion changes, and that a hidden scar will usually trump some residual excess skin, the surgeon should mark the patient *within* the margins of her preferred clothing. This becomes particularly relevant when the patient favors low-cut jeans.

The *location and extent of the remaining subcutaneous fat* must be evaluated and respected. This assessment represents an age-old plastic surgical battle between “beauty and blood.” That is, at what cost to the blood supply does the surgeon attempt to remove all remaining excess subcutaneous fat? Lockwood originally described a reasonable detente: liposuction should only be conducted beneath tissues that have not been undermined. However, most recently, the pendulum has swung back: published articles are once again advocating more aggressive full truncal lipo-

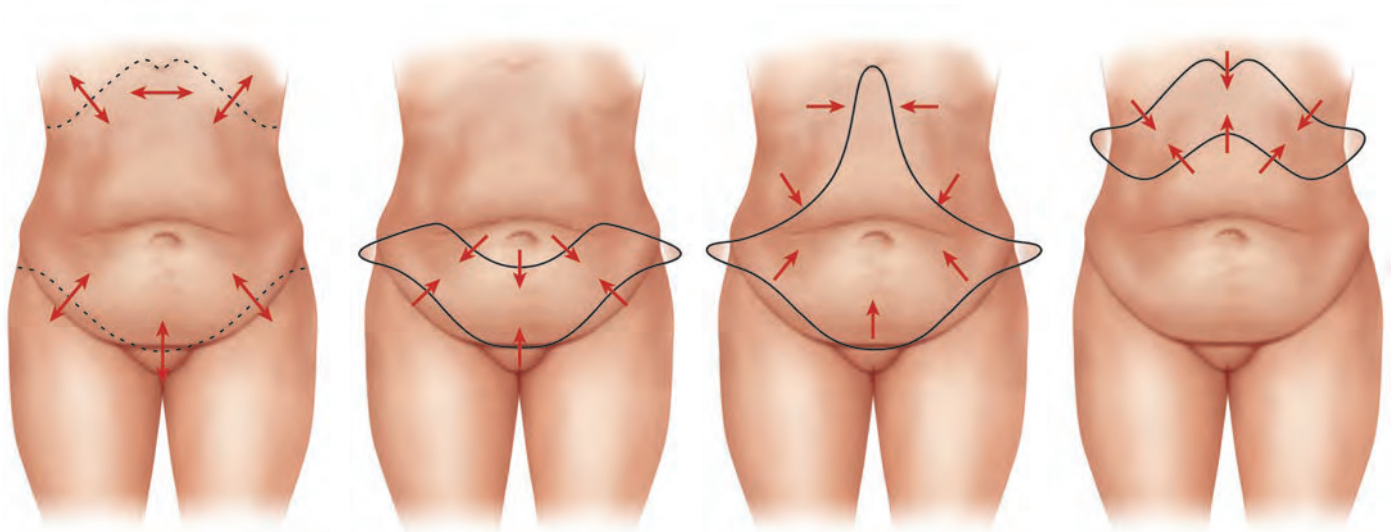
suction at the time of the abdominoplasty. This recommendation is predicated on the idea that if one follows the original Lockwood admonition to restrain the flap dissection only as much as needed to conduct a fascial plication, enough perforators will be preserved to allow for this aggressive liposuction. However, as stated earlier, Lockwood also warned that despite this conservative undermining, liposuction of the remaining central skin flap should not be done for fear of skin flap necrosis. And realistically, some of these same precious perforators are often sacrificed to repair the more protuberant abdomen. This principle should be respected when one considers Lockwood's extensive experience.

If the premise is to preserve the central flap's blood supply by undermining only centrally to allow fascial plication, it may indeed be self-defeating to then disrupt the very same flap with liposuction. Ironically, the only patients who might be candidates for such an aggressive approach would be those without a significant amount of fat in the first place; that is, patients with a low BMI. Otherwise, the usual abdominoplasty patients with higher BMIs could undergo liposuction at the waist and hip rolls, but a *second-stage* liposuction 6 months to a year later should be planned for the central skin flap. Only then can a zero tolerance for skin flap necrosis and dehiscence be realized.

It has always been important to evaluate *the magnitude of excess skin to be excised*. But to actually design the most "efficient" length and direction of the incision, *it is critical that the extent and orientation of the skin left behind also be assessed*. At once, the surgeon must ensure that the remaining skin is both sufficient to close the defect and efficiently relieved of its own redundancy. This principle may be applied to both the central and lateral closure. Specifically, laterally, the excess skin at the hip and thigh is often neglected by the traditional abdominoplasty. This primarily *obliquely* oriented excess tissue is efficiently removed through the *oblique* incision/vector of the HLTA. Centrally the superfluous skin at the epigastrium is in fact a primarily *horizontal* excess (that has migrated from the chest) that can neither be efficiently removed nor "used" to close a lower abdominal defect through a *horizontal* incision. Therein lies the potential flaw in the traditional abdominoplasty as well as the efficacy of the high lateral tension technique. An incongruent consequence may occur: the wound closure may be too tight despite the apparent epigastric redundancy, which can in turn be left behind, and the lateral excess cannot be effectively treated because the remaining abdominal flap has been primarily used for the central closure. To reconcile this paradox, *less skin should be excised centrally and more skin must be removed laterally* through an HLTA-oriented incision and repair. These concepts are illustrated on p. 2970: Using "vector analysis," the lateral tissue above and below the incision is redundant in a more oblique vector and so should be removed through an opposing oblique incision. Serendipitously, this matches the relative direction of the desired HLTA lateral scar placement. In addition, this oblique vector also treats the more horizontal excess in the epigastrium. Similarly, this same

concept can be applied to the fleur-de-lis and reverse abdominoplasties. *Thus the more a procedure follows the vectors of excess of both what is taken and what remains, the more efficient the treatment of all redundant skin.*

Equally, the abdominoplasty should not only consider the obvious suprapubic pannus, but also *the deformity of excess tissue in the epigastric/midline, subcostal, and lateral chest*—zones that have generally been neglected by the modern abdominoplasty. This problem is significantly exaggerated in post-weight loss patients compared with average abdominoplasty candidates. However, the challenge cannot be ignored, and indeed, experience with post-weight loss patients brings significant clarity and urgency to addressing the issues. In fact, the good corrective techniques originally described many years ago have been equally neglected: the fleur-de-lis and reverse abdominoplasties. The solution is to reharness these procedures as a *complement* to the high lateral tension approach and in so doing, forge a more *comprehensive abdominoplasty*. Then, the inclusion of a vertical incision to the high lateral tension procedure makes a better fleur-de-lis abdominoplasty, and the staged application of a full submammary incision to the results of the HLTA creates a more powerful use of the “reverse” abdominoplasty. In effect, the abdominoplasty becomes a true rejuvenation procedure of the *entire* abdominal aesthetic unit.



This potential marriage of procedures is illustrated above. The vectors of skin laxity at the abdomen are marked and applied in each complementary variation of abdominoplasty. As one can see, *the more a procedure follows the vectors of excess, the more efficient the excision of redundant skin.* In turn, *the more vectors of excess that are addressed by surgery, the better the results.* Thus by building a suitable procedure using these harmonizing techniques, a more comprehensive abdominoplasty emerges.

To summarize, the primary advantage of these variations on the theme is the more inclusive repair of the entire anterior trunk. These procedures are entirely predicated

on careful discontinuous undermining and proper use of the superficial fascial system. Then one is assured of viable flaps and a secure and predictable final closure and scar.

However, the more extensive surgeries can be a disadvantage. These cases require more surgical time, longer and often a greater number of incisions, and planned but nonetheless greater closure tension, with the attendant increased risk of dehiscence.

Traditionally, the primary goal of any abdominoplasty has been to excise the suprapubic pannus and plicate the abdominal fascia through a relatively hidden incision. Unfortunately, this established abdominoplasty can fall short of this goal: a scar riding too high; persistent skin and subcutaneous lipodystrophy in the midline, thighs, flanks, and hips; and midline skin necrosis.

The comprehensive abdominoplasty addresses these shortfalls. It may be defined as a more complete treatment of the entire anterior trunk aesthetic unit from the submammary and lateral chest area to the pubic, thigh, and buttock zones, with a greater overall aesthetic result and margin of vascular safety.

Pertinent Anatomy

The general abdominal anatomy is well described in the section of this chapter by Dr. Farzad Nahai. Therefore I will highlight the specific anatomy most relevant to the understanding and application of this high lateral tension abdominoplasty. There are three critical anatomic points that should be understood and respected when planning and performing the HLTA:

1. The superficial fascial system: this layer must be identified and utilized fully to harness the full lift that this technique can provide and to prevent wound dehiscence.
2. The perforator blood supply: the abdominal flap's viability is predicated on the preservation of as many fascial perforators as possible.
3. The zones of adherence: these various points of skin attachment must be released, at least bluntly, to realize the maximum "translation" of pull of the remaining skin envelope, particularly at the anterolateral thigh region. There is often what may be called a "waist band of adherence" at the patient's midsection that can significantly inhibit this same translation.

Markings

The marking starts and is entirely driven by the delineation of the final position of the scar. The 2.0 modification ensures that the scar will rest within the patient's underclothes. The next marking outlines the extent of excess skin *below* the incision (if any) relative to the final scar, and the final marking is simply an estimate of the excess skin *above* the incision.

Marking is performed with the patient in an upright position against a wall so that she can be supported as necessary during the “tension” marking.



The placement and length of the lateral scar are discussed with the patient; this decision should be made by balancing the merits of the best surgical approach to treat the problem with the patient's preferences in clothing styles. The surgeon must consider the planned procedure with the patient wearing his or her most revealing clothing: underwear, a one- or two-piece swimsuit, and low-cut jeans. The incision will rise or fall at the hip markings, depending on the style of clothing.

Location of the Eventual Scar



Boundary marking: First, the outline of the patient's preferred clothing is drawn (underwear, low-cut jeans, or a swimsuit).



Suprapubic marking: Next a point 6.5 to 7.5 cm measured superiorly from the upper incisura of the vagina or base of the penis is marked on the skin as it rests.

Lateral limit marking: A vertical line is marked on each side at the lateralmost extent of the excess skin (pannus).

Closure marking: Finally, the pen is moved superolaterally from this suprapubic mark on each side to meet somewhere along the lateral mark, always staying within the borders of the outlined clothing. This line usually rests between the natural inguinal and abdominal wall gullies. NOTE: One can measure the distance between the fixed point (anterior superior iliac spine) and this marking to aid in an intraoperative cross-check and adjustment of the final resting place of the closure.

To ensure a harmonious scar, particularly in a very “ptotic” patient, it is useful to extend the marking to include the design of a posterior body lift that may be planned or desired in the future.

Defining the Lower Margin of Excision



The marking pen is placed over the line of future closure, and this position is maintained this while pulling the excess skin is vigorously pulled upward until taut (this is the “tension” in the HLTA); then the surgeon marks the skin that is now below the tip of the pen.



This maneuver is performed across the width of the abdomen as needed to define the lower incision. NOTE: Because the maneuver can and should be quite forceful, it is helpful to have the patient lean against a wall during the marking.

Estimating the Upper Margin of Excision



The excess skin is pinched with the thumb on the lower incision line and the fingers at the superior extent of the excess, while maintaining the premarked final closure line visible at the middle of the skin roll. Marking begins laterally and extends medially. The resultant line will usually rest several centimeters above the level of the umbilicus laterally and a few centimeters below the umbilicus centrally.

Deciding How to Treat the Umbilicus

Depending on the patient's body habitus, the umbilicus should be about 9 to 12 cm above the superior margin of the pubis. The umbilicus should rest slightly above the latitude of the superior margin of the iliac crests. However, in the final analysis, as with many challenges in plastic surgery, a critical eye should ultimately drive the surgeon's decision.

The treatment of the umbilicus is determined by two factors: The amount of *excess* skin above and below the umbilicus and the *location* of the umbilicus in conjunction with the *length* of the abdomen and waist.

If there is no excess above and mild excess below, the excision may be conducted with the umbilicus left intact, as a mini-abdominoplasty.

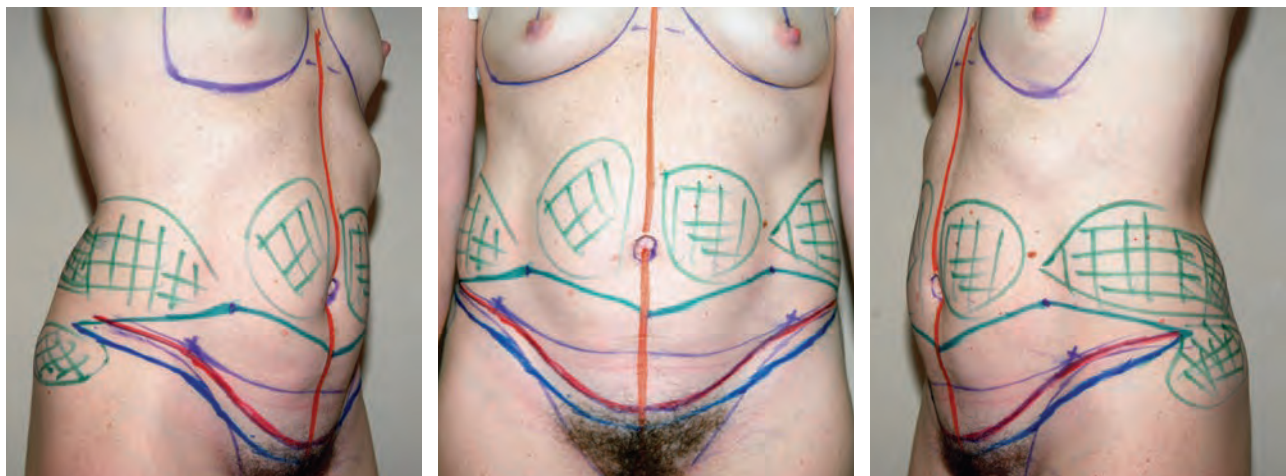
If there is moderate excess below the umbilicus and little to no excess above, and the umbilicus appears high-riding on the abdomen, it can be maintained in situ and stretched on its stalk for a couple of centimeters.

If there is moderate excess of skin below and above and the umbilicus is relatively high-riding, the umbilicus may be “floated” inferiorly with release of its stalk, again for a few centimeters.

If there is a large excess, above and/or below the umbilicus, then it must be circumscribed and translocated.



The areas for liposuction are marked as needed, including the hips, waist, pubis, and thighs. Finally, the surgeon checks the surgical plan markings and reconciles expectations by simply instructing the patient to reproduce the desired result by performing an “examination room lift” (*right*). This maneuver is particularly valuable with a weight-loss or postpartum patient.



Green line: estimated upper incision

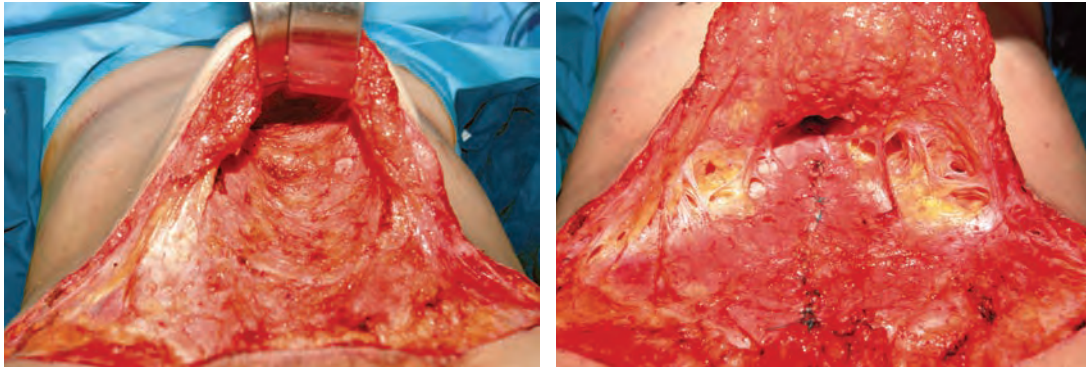
Red line: planned location of final closure

Blue line: defined lower incision

The final markings are shown above.

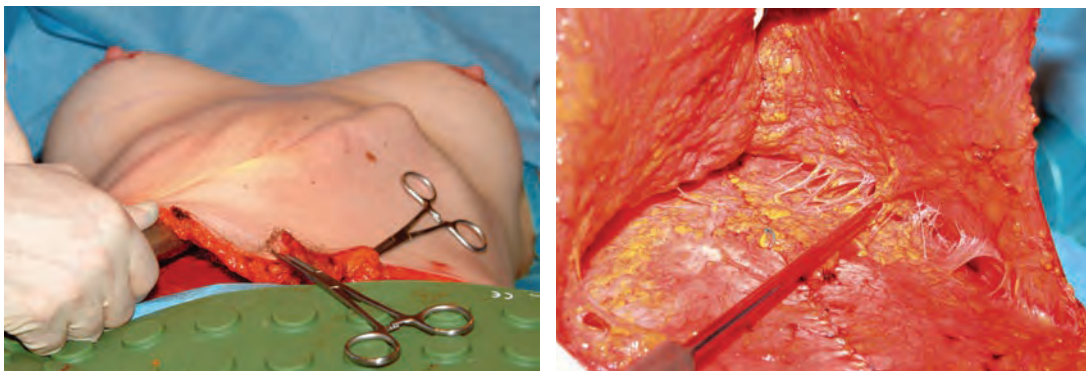
Operative Technique

The patient is positioned supine on a warmer, an antiembolic compression device is applied, and a Foley catheter is usually inserted. With a needle and dye, the quadrants of the umbilicus are marked; the center point of the pubis and the estimated location of the future umbilical site are also marked.



The lower markings are incised and the skin flap is elevated off the deep fascia, just wide enough to allow plication of the rectus fascia. One should also attempt to leave behind as much of the fascial and particularly inguinal “lymphatic” tissue as possible.

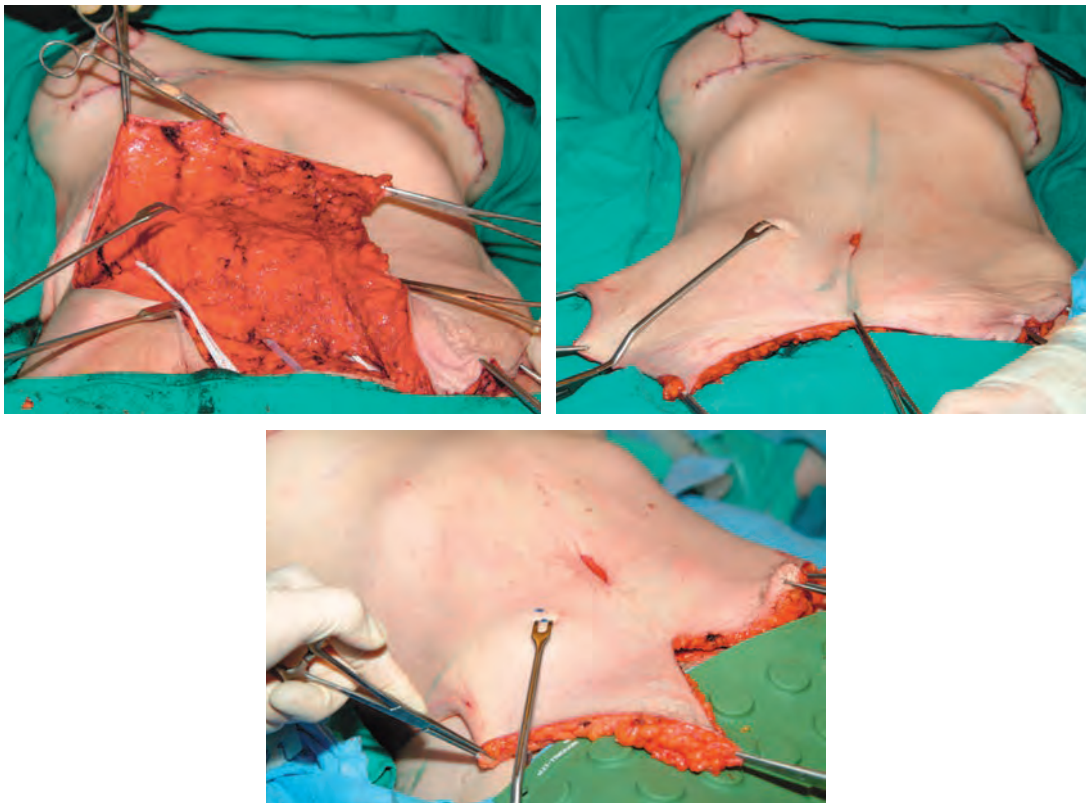
Plication of the midline abdominal wall fascia is then accomplished using a heavy stitch (0 or 1-0 PDS) in a running pattern. The surgeon should try to avoid capturing any of the underlying muscle. A second running suture is performed to reinforce and allow for further plication of the fascia as necessary. Additional plication may be carried out in an oblique or horizontal vector at the anterolateral abdominal wall to narrow the waist and further flatten the abdominal wall.



Further mobilization of the flap and release of the skin flap adhesions may be conducted cautiously beyond the midline. The guiding principle is to preserve as many perforators as possible. The surgeon could use either a measured, vertically oriented

spreading of a large Mayo-like scissors or a gentle penetration with one or more fingers, oversized suction cannula, or, as I prefer, a Lockwood underminer cannula (Byron Medical, Tucson, AZ).

With a Lockwood abdominal demarcator (Byron Medical), a modified D'Assumpção-type clamp, the excess skin is marked for resection. This must be performed from the lateral aspect of the abdomen toward the center to truly carry out a high lateral tension resection. As an insurance maneuver, the preoperatively determined desired distance between the anterior superior iliac spine (ASIS) and the future closure can be checked intraoperatively and appropriate adjustments made (and more or less skin removed).



First, Kocher clamps are placed on the upper flap and the skin clamp tongs are secured into the skin edge of the lower margin of the incision. Then with simultaneous pulling of the Kocher clamps on the flap and the pushing of the Lockwood instrument at the lower incision, the excess skin is marked. The vector of pull of the flap is decidedly inferior and lateral.



The tip of the demarcator is pulled back a centimeter or so and the incision is skived to maintain a little more skin than subcutaneous tissue. In this way, when the deep closure is performed, the tension will be more on the fascia, and the skin will “heap up,” with virtually no wound tension.

An effort should be made to avoid closure over the ASIS itself to prevent additional tension to the wound. And contrary to the traditional approach, it is not necessary or desirable to place the operating table in a “lawn chair” position, because the Lockwood technique does not mandate the excision of all the infraumbilical skin and thus excess tension on the suprapubic closure and the resulting side effects are prevented.

As planned, not all the skin between the umbilicus and the pubis is usually excised, so depending on the amount of skin resection, the umbilicus can be stretched in place, allowed to float, or circumscribed and translocated with the original umbilical site closed vertically when necessary. As needed, a triangular segment of mons pubis can be excised if there is significant horizontal excess.

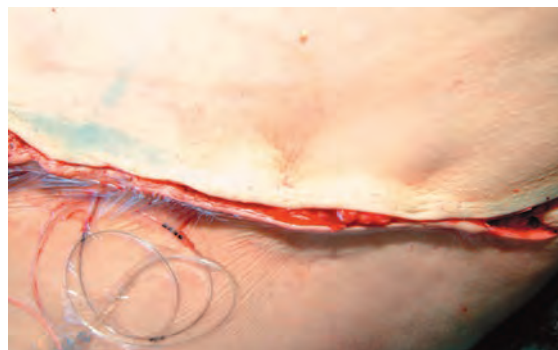
Once skin is excised and tacking sutures are placed, tumescent fluid is suffused and liposuction conducted at the waist, hips rolls, pubis, and thighs as planned. The areas that deliver the greatest reward, yet are most often neglected, are the waist and the pubis.

The new umbilical site, when needed, is then incised in a *vertical* direction, since this wound will be pulled open to an appropriate shape with the significant lateral pull of the high-tension approach. A small elliptical excision of skin on either side of the vertical incision may be conducted as needed to increase the width of the umbilicus.

Three or four 10 mm flat drains are placed before closure, along with a bupivacaine catheter for postoperative pain control.



Bupivacaine may also be injected directly into the fascia for immediate postoperative relief. Using 1-0 or 0 PDS suture, the superficial fascial system is reapproximated every few centimeters. This is probably one of the most important steps in the whole operation. *The more confident one is of the fascial closure, the more definitive and aggressive one can be of the skin traction/resection.* The final closure is then made with 2-0 Vicryl for deep dermis and 3-0 Monocryl for superficial dermis.



The closure should have a decidedly rolled border, indicating no skin tension. Shortened Steri-Strips (to prevent edema-induced blisters) are placed. Fluffs are applied along with an abdominal binder to complete the dressing.

Postoperative Care

Immediately after surgery, the patient is placed on a hospital bed in a “lawn chair” position, with the Foley catheter in place. The patient is transferred to an outpatient facility for 1 to 3 nights to ensure proper pain control and hydration, assistance with ambulation, showering, and so on. A spirometer, antiembolic pumps, and TED-like hose are all ordered for continuous use until the patient is ambulating regularly. The Foley catheter is usually removed at that time. Patients are given stool softeners once they are taking food by mouth. The pain-control catheter is removed in 4 or 5 days. Drains are left in place for 5 to 14 days, depending on the amount of drainage. The patient wears a Velcro binder as much as possible for up to 2 weeks; then the patient is encouraged to wear some form of commercial girdle-type compression undergarment for an additional 6 weeks.

Complications

The entire purpose of the HLTA is to deliver the optimal correction with the lowest complication rate. Just as with Lockwood's original opus on the subject, the 2.0 upgraded version described here is predicated on a zero tolerance for complications. As well, many of these outcomes are not really complications but rather planned trade-offs for better or safer results. When a patient is informed of an expected residual deformity, he or she will then consider it as part of the surgical plan rather than as a complication; that is, the patient will then appreciate a secondary surgery as a stage rather than a revision. Otherwise, complications may include aesthetic mistakes, which may be irreversible, as well as physiologic misadventures, which can be devastating. These are discussed next, with a brief description of methods of prevention and treatment.

Aesthetic Complications

Abdominal Scar Too Long

The scar can only be “too long” if the patient was not clearly informed of its often requisite length. The lateral scar is the primary literal footprint of the HLTA; that is, if any tension lifting is attempted at the lateral thigh and hip area, the incision will inevitably be longer. *Therefore the surgeon should critically evaluate this anatomy preoperatively and decide, with the patient's input, whether there is enough laxity to warrant extending the incision.* Otherwise, experience would indicate that as long as a scar is of good quality, corrects the deformities, and, what is most important to the patient, is hidden, the patient will always accept a lengthier repair.

Lateral Scar Too High or Too Low

In general, the greater the excess skin present, the more unpredictable the scar placement can be. This outcome is usually caused by a poor marking design; that is, an overestimation or underestimation of the magnitude of skin redundancy below the incision. There are several ways to avoid this problem, depending on the magnitude of redundant skin:

If there is significant excess below the incision, there is a real danger of unpredictable scar placement (usually riding too high), and during the marking the surgeon must be certain to place the skin on maximum tension and, like any good tailor, measure twice and cut once—that is, recheck the markings and “test” them by having the patient recreate the lift by pulling up the excess tissues to the desired location.

If there is not a notable excess below the incision (usually in the thicker, less mobile skin envelope), the scar could be predictably too low if too much inferior skin is removed. Therefore the surgeon should place the skin on less tension when marking.

Intraoperatively, the preoperative measurement of the distance between the fixed ASIS and the desired level of the final wound may be used as a guide. It is best to be conservative with any additional resection (especially in a more adipose-filled flap), since the thigh skin below may drift inferiorly postoperatively.

Finally, after surgery the surgeon should always critically assess the preoperative markings against the final result to properly hone his or her tailoring techniques.

Pubis Too Tall or Too Short

A pubis with an incongruent height is usually the result of inaccurate estimation of the true redundancy of the pubic area. The surgeon must put the pubis on maximum stretch during marking and leave at least 6.5 cm of pubic height. The pubis can also be too wide, with the tension surgery potentially worsening the aesthetic effect. If necessary to prevent this appearance, a wedge resection of the pubis can be done concurrently or at a later stage. Again, the surgeon should always revisit and the preoperative markings and compare them with the postoperative scar placement.

Poor Umbilical Closure Scar

Poor umbilical closure is often the most feared (more by the surgeon than the patient) but least realized complication. These scars uniformly resolve into short, thin, white lines. Rarely, a steroid injection or revision will be necessary. Even so, as the patient is made aware, this 1-inch scar is a small price to pay for the alternative: a 1½-foot-long abdominoplasty scar that rests too high, pulling the pubis along with it.

Residual Fat at the Suprascar and Central and Superior Abdomen: The Inverted-T

This “complication” is more accurately a deliberate “neglect” of this subcutaneous fat in an effort to preserve the maximum blood supply to the central flap. The surgeon must decide what his or her individual tolerance is for the very real complications that may ensue from an attempt to remove this fat. Otherwise, patients are simply informed that they may be best served with a second-stage, unfettered abdominal liposuction procedure.

Residual Skin at the Upper Abdomen

Residual skin is a complication not really unique to the HLTA. In fact, there is a good argument that because this technique has a more oblique vector of pull, it can efface more of this redundancy. However, the patient with significant excess (a second pannus) should be informed preoperatively of its probable persistence. Only a fleur-de-lis or reverse abdominoplasty can treat this zone definitively and should otherwise be considered in the first place.

Lateral Dog-Ears

The best way to avoid lateral dog-ears is to fully liposuction this area and to intrepidly extend the incision as necessary, particularly the more tension-filled the lift.

Epigastric Recurrent/Residual Protrusion

Because of the more conservative dissection in the upper abdomen with an HLTA, in a patient with a very protuberant abdomen it is possible that a less than complete repair will be performed. Consequently, there can be some degree of epigastric recurrence/residual deformity postoperatively.

Physiologic Complications**Superficial Fascial System Stitch Abscesses**

The stitches used for the tension closure of the fascia are per force of large caliber with abundant knots. Therefore, stitch abscesses may arise postoperatively (surprisingly very late) particularly if permanent suture is used. This problem is far less likely with well-buried, absorbable sutures.

Seroma

Because there is far less dissection and no central liposuction with an HLTA, the annoying problem of seromas should be rare. For the same reason, the idea of flap adhesion stitches is not really applicable to the HLTA. When a seroma does occur, a consistent set of aspirations usually solves the problem within a few weeks. The primary modes of prevention include maintaining the web of lymphatic-containing tissue overlying the fascia and groin when elevating the flap, and placing multiple drains (three or more).

Deep Venous Thrombosis and Pulmonary Embolism

Volumes of analysis and advice have been written on this subject, particularly in the last few years. Clearly, with good patient selection, consistent use of antiembolism pumps, and early mobilization, the incidence of this problem should remain rare. As for chemical prophylaxis, considering the still unsettled status of this approach, the surgeon should always refer to the latest recommendations in the literature.

Skin Necrosis

Skin necrosis is a dreaded complication that can occur if the surgeon pushes the envelope during surgery: the usual culprits are maneuvers of overaggressive flap mobilization in an effort to remove the maximum amount of redundant skin (particularly from the upper half of the abdomen) and excessively zealous flap fat removal (by liposuction or direct excision) to thin the flap as much as possible. Unfortunately, the patients who would need these additional efforts to be taken are often the candidates that present the greatest risk, with high BMIs and massive excess of fat and/or skin. And for the patients who fall in between, there is no accurate selection mechanism to determine who will do well with these more-invasive techniques; therefore surgeons must decide for themselves between “blood and beauty.”

Outcomes

The essential advantage of this technique is the ability to deliver consistently superior and safer results:

The incision is maintained low and hidden within the patient's clothing.

More skin is removed below the incision both laterally (which, in effect, results in a significant "lift" of the anterolateral thighs) and centrally (which promotes a lift of the pubis and anteromedial thighs).

There is little opportunity for flap ischemia because a maximal blood supply is maintained: local perforators are preserved with judicious and discontinuous undermining, and the flap's integrity is respected with restraint of any liposuction or direct fat removal from the flap itself.

There is less tension at the lower central abdomen, resulting in a lower incidence of flap ischemia and a more aesthetically pleasing mild convexity at the hypogastrium.

The excess skin in the horizontal plane of the abdomen, particularly in the upper poles, is more effectively treated with the oblique vector of excision.

Any residual fat, particularly within the abdominal flap itself, can be treated aggressively, with relative impunity, as a second-stage procedure within 6 months to a year of the abdominoplasty.

If there is residual skin resting laterally and posteriorly, this can be addressed at a second-stage procedure with a posterior extension of the abdominal incision for a completion posterior body lift. If there is remaining skin superiorly at the epigastric and subcostal areas, this can also be treated later with either excision through submammary incisions or with a proper reverse abdominoplasty.

If the lateral scar rests slightly outside the patient's preferred clothing, the scar can be easily moved up or down by excising the appropriate amount of skin with the patient under local anesthesia.

Fleur-de-Lis Abdominoplasty

Dellon first popularized the fleur-de-lis technique in 1985. He pointed out that his technique was an extension of Regnault's classic "W" technique. For a longer historical perspective, the fleur-de-lis, as Dellon describes, is really a direct, albeit melded, descendant of the transverse resection technique described by Kelly in 1910 and the vertical resection approach considered by Babcock in 1916.

The basic principle and power behind the fleur-de-lis approach is the ability to definitively excise not only the traditional lower abdominal pannus but also much of the aforementioned redundant upper abdominal tissue. Put another way, this approach realizes a more complete resection of not only the vertical but also the horizontal vector of excess. But it is important to realize that this technique, in contrast to its original description, can now be “supercharged” with the addition of the high lateral tension procedure. The corollary would be that the fleur-de-lis is really an HLTA with the addition of a vertical incision. Thus the fleur-de-lis approach becomes even more potent at correcting the entire abdominal unit. In fact, if a reverse abdominoplasty is also included, either conservatively at the time or in a staged repair, this trio of techniques can make the most complete and impressive correction.

In combination with the high lateral tension technique, the fleur-de-lis can deliver far-reaching effects: in addition to recontouring the upper abdominal zone with direct excision, there is an indirect corset effect of the entire anterolateral chest, the flank, and the back. In fact, this technique can truly address the residual excess skin rolls beyond the pannus, tissues often left untreated by any “regular” abdominoplasty. This advantage is particularly relevant in weight-loss patients. In fact, in these patients, when the surgeon has completed a proper fleur-de-lis resection, the extent of skin resection can expose most of the anterior abdominal wall. Then, dramatically, the peripheral “waistcoat” of skin, lying in the wings, advances to close the defect.

Markings

The basic principle behind the marking of the fleur-de-lis is to evaluate, measure, and mark the horizontal excess independent of the vertical redundancy.

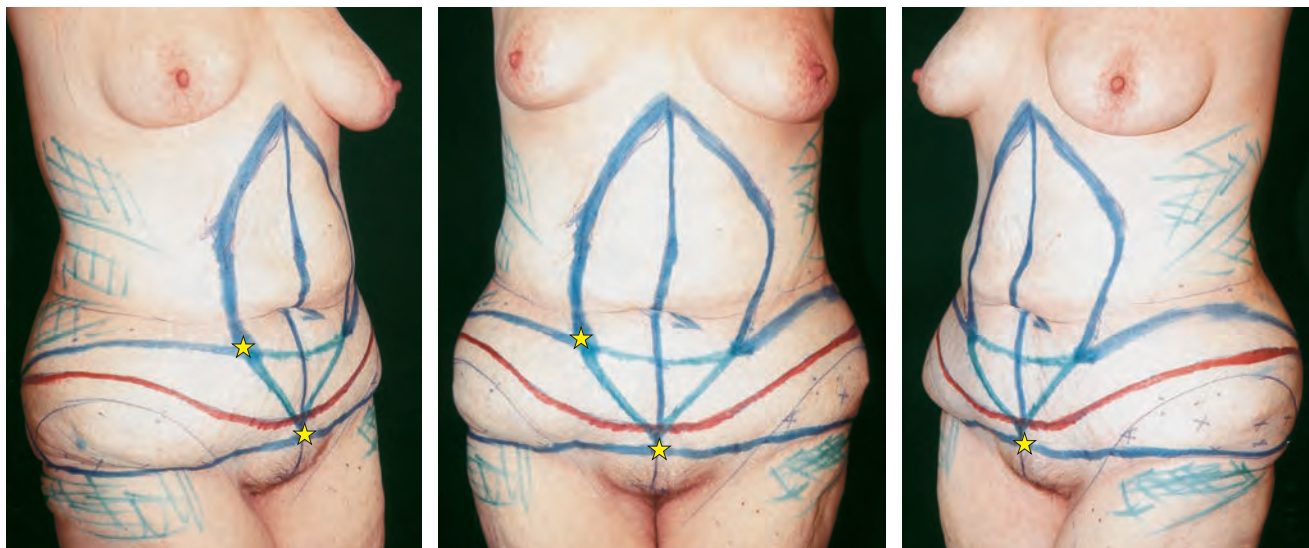
Horizontal marking: With the patient standing, HLTA marking is performed as though it were to be the only procedure planned.

Vertical marking: Next, with the patient supine, the horizontal excess is outlined, again as though it too were the sole surgery to be conducted. The surgeon simply gathers the excess skin with an aggressively wide pinch, marks the margins, and “connects the dots” to realize the vertical marking.

Fleur-de-lis design: With these two apposing markings, the outline of the fleur-de-lis is actually realized. The outline of the intersecting markings is drawn to define the borders of the fleur-de-lis abdominoplasty.

Key point: The pivotal point in the marking is the intersection of the horizontal and vertical markings laterally. This is the best estimation of the location of the wound edge that will ultimately contribute to the inverted-T closure.

Marking test: The excess skin is inverted and the T closure is reproduced. Clearly, the thinner the patient, the easier and more accurate this maneuver will be. The primary objective of this step is to estimate the adequacy of skin for comfortable closure of the T wound. Otherwise, one runs the risk of an excessively tight closure that in turn can lead to problems ranging from an unaesthetic, constricting, high-riding scar and pubis to a devastating skin necrosis.

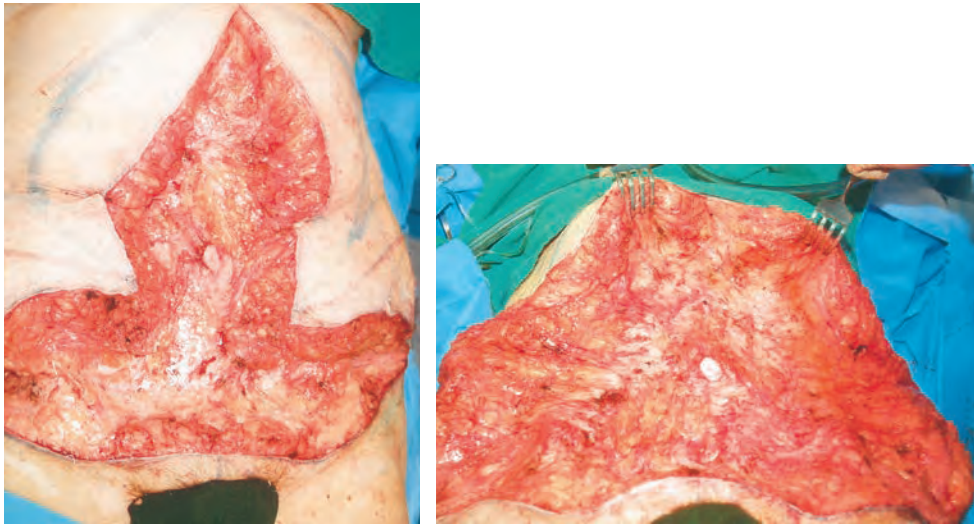


The final markings are demonstrated. The yellow stars indicate key points marking the tips of the upper flaps and the midline of the suprapubic area. The blue lines are the estimated margins of the fleur-de-lis. The red line is the estimated future site of the scar.

NOTE: The only marking that is actually used in surgery is the lower horizontal line of the HLTA portion of the design, with the rest of the outline acting as guideposts. *The important point is to reserve final judgment regarding the margins of excision until surgery.*

It is very important to *resist marking the superior pole of the incision much above the xiphisternum*, which could cause the final closure to rest between the breasts (and even worse, cause synmastia). That is, one should expect the upper wound to ride up several centimeters with the removal of the heavy abdominal skin and closure of a very wide wound.

Operative Technique



The horizontal and vertical premarked incisions are performed down to the underlying fascia.

The skin flaps are raised cautiously, roughly within the boundaries of the premarked fleur-de-lis template, to preserve the maximum blood supply. Routine abdominal plication is then performed using a 1 or 0 Ethibond type of suture in running, locking fashion.



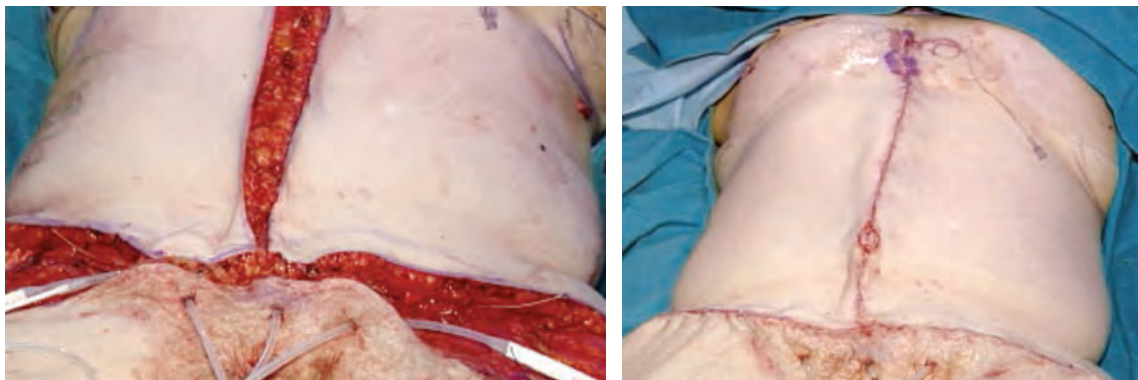
Then, using a large staple gun or suture and an assistant's help, the surgeon vigorously tailor-tacks the wound by rolling the excess skin below the flaps. *As described previously, it is critical that one begin this tailoring at the suprapubic inverted-T wound to confirm that there is adequate skin for closure.* In effect, this medial commencement of tacking is opposite the traditional Lockwood abdominoplasty in which the excision is estimated and conducted starting laterally.

Once the lower midline closure is estimated, the tacking should continue alternately between the midline toward the xiphisternum and laterally toward the hip, in an at-

tempt to evenly distribute the estimated excision of the excess. As noted earlier, *the surgeon should not tailor-tack the vertical closure superiorly any higher than the xiphisternum* to ensure that the eventual scar lies on the abdomen rather than between the breasts.



The excess skin is then marked at the margins of the tailor-tacking, and the skin is excised through both the vertical and horizontal incisions.



Then the T closure is tacked again to guarantee the adequacy of the skin for closure. At the vertical wound, one can often tailor-tack and excise skin a second time, especially in a patient with very thick or excessive skin. Any remaining skin at the horizontal wound should be removed, as one would with an HLTA using the Lockwood skin clamp.

The closure is then performed in the same manner as in a routine abdominoplasty. An ellipse of the wound margin from each flap is excised at the site of the umbilicus, which is then inset.

With experience, particularly in thinner patients, the surgeon can consider just tailor-tacking the skin at the inverted-T closure only, directly excising the vertical marking and then applying the Lockwood abdominoplasty to the lower excess.

Problems and Complications

The midline scar can extend too far superiorly with the creation of some synmastia unless care is taken to prevent its migration. The primary tactic to avoid this problem is marking the repair deliberately no higher than the xiphisternum and resisting the impulse to chase the excess skin superiorly onto the chest. Also, if the tacking or excision itself is not symmetrical, the vertical scar can be crooked. If this is noted at surgery, an attempt at correction should be made with the necessary skin resection from one side or the other.

Outcomes

The effects of the fleur-de-lis procedure can be the most dramatic of all abdominoplasties: because of the significant recruitment of skin from the lateral trunk, an impressive correction is made at the waist, back, and flank folds. With excision of most of the horizontally redundant skin, particularly at the upper abdomen, the result is clearly more complete. Additionally, because of the wide exposure of the fascia, the abdominal wall deformity can be fully corrected with this technique. This is especially true in the epigastric area, where the repair can be otherwise constrained by the HLTAs narrow tunnel of dissection.

The inverted-T scar heals surprisingly well and becomes a thin white line. Despite the impressive dissection, since primarily all the undermined skin is excised (especially the suprapubic swath of skin), flap ischemia is not a major concern.

Reverse Abdominoplasty

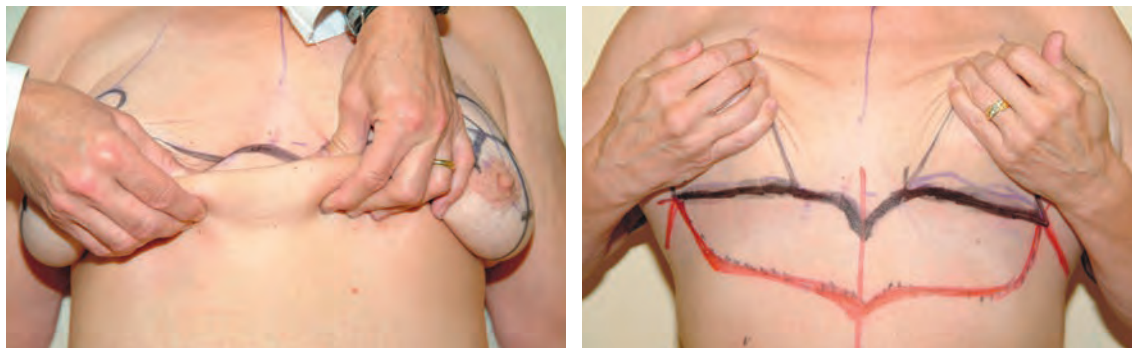
The reverse abdominoplasty was initially described in 1972 by Rebello and Franco in the South American literature. In 1979 Baroudi et al published the first paper in the United States describing the technique in combination with reduction mammoplasty. The reverse abdominoplasty is most efficacious when combined with the other abdominal contouring surgeries already described; that is, the principal indication for reverse abdominoplasty is for cleanup of the residual redundant tissue at the superior abdominal pole after any lower abdominoplasty. This approach is particularly relevant when treating weight-loss patients. Even after proper application of the high lateral tension technique, a reverse abdominoplasty should be anticipated as a second stage. Otherwise, this technique is indicated in the relatively rare patient who presents with skin excess and abdominal protuberance primarily in the upper pole of the abdomen. The utility of this approach is even more compelling if the majority of striae and surgical scars are also principally confined superiorly. A reverse abdominoplasty may be easily married to a Wise pattern breast procedure, since joining the two submammary incisions entails only a few centimeters of additional scar.

Otherwise, with more limited skin excess, direct excision of skin through separate submammary incisions could be considered, particularly in a Wise pattern type of breast surgery.

Markings



The patient is marked in the supine position. The upper margin of the skin resection is outlined initially. The mark should start as far lateral as the excess skin demands, always maintaining the final closure within the bra strap line. The markings then continue along the submammary line, with the two sides meeting at the epigastrium as a V. If there is to be concomitant breast surgery, the mammary markings should be conducted first.

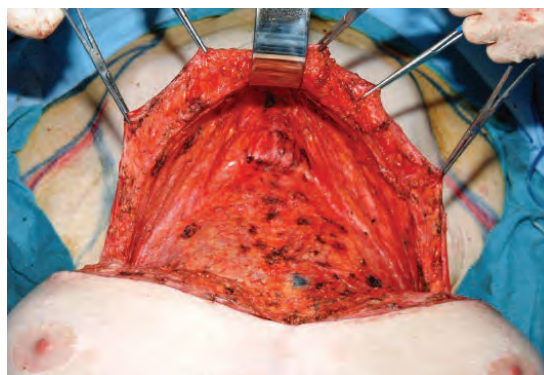


The excess skin at the upper pole of the abdomen is then pinched and pulled superiorly, and an approximate line of redundancy is marked. The extent of excision is guided by observing the maximum tautness of the upper abdominal skin.

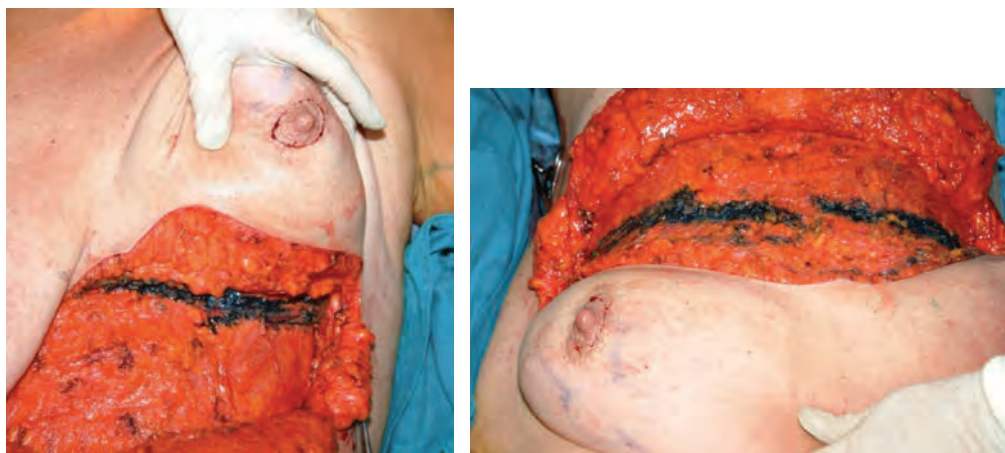
The mobility of the inframammary crease is gauged. The more ptotic the breast, the greater the potential inferior displacement of the crease. Thus the crease must be secured at the time of surgery.

The laxity of the umbilicus (the length of its stalk) must also be assessed. The surgeon should attempt to prevent excessive superior displacement of the umbilicus with advancement of the upper flap.

Operative Technique



The upper incision is made and the abdominal flap elevated several inches beyond the skin redundancy. This dissection should be no farther than several centimeters from the umbilicus to block the potential excessive advancement superiorly.



The most critical step in this technique is to define the inframammary fold at the appropriate level so that the skin excision can be more accurately estimated. This is accomplished by first marking the position of the future breast fold on the chest. This should be done with the patient in the upright position to more accurately determine the natural coordinates of the inframammary fold. Otherwise, in the supine position, the fold can rise unnaturally by several centimeters, and the eventual crease could then be sutured too high.



Using Kocher clamps and upward and slightly lateral traction, the surgeon marks the excess and sequentially excises it. As with the abdominoplasty, skin excision is made 1 or 2 cm more proximal to the marked excess point to prevent too much wound tension. The resultant wound can be as much as 6 to 8 inches in height.



The upper abdominal flap is then inset along the now “tamed” inframammary crease. The deep fascia is employed to ensure a secure closure, along the length of the chest using 0 or 1-0 PDS-type suture. As with the abdominoplasty, the suture should be placed in the superficial fascial system approximately 2 cm behind the upper margin of the abdominal flap to ensure a rolled, tension-free skin closure. If a breast lift or reduction is to be performed at the same time, it is preferable to perform the reverse abdominoplasty first. This surgical order creates a solid shelf on which the breast can then be built. Otherwise, a completed breast repair may be compromised by the possible recruitment of some of the lower breast skin when the abdominal flap is inset.



Final closure is similar to that for routine abdominoplasty, using 2-0 Vicryl for the dermis and 3-0 Monocryl for the skin. Two 10 mm drains are placed before closure.

Problems and Complications

With or without a concomitant breast surgery, the sheer heft of the inset abdominal flap can result in some deformation of the breast shape as the tissues relax. The best measure of prevention is to “overengineer” the repair of the abdominal flap to the defined inframammary crease, with an abundance of sutures.

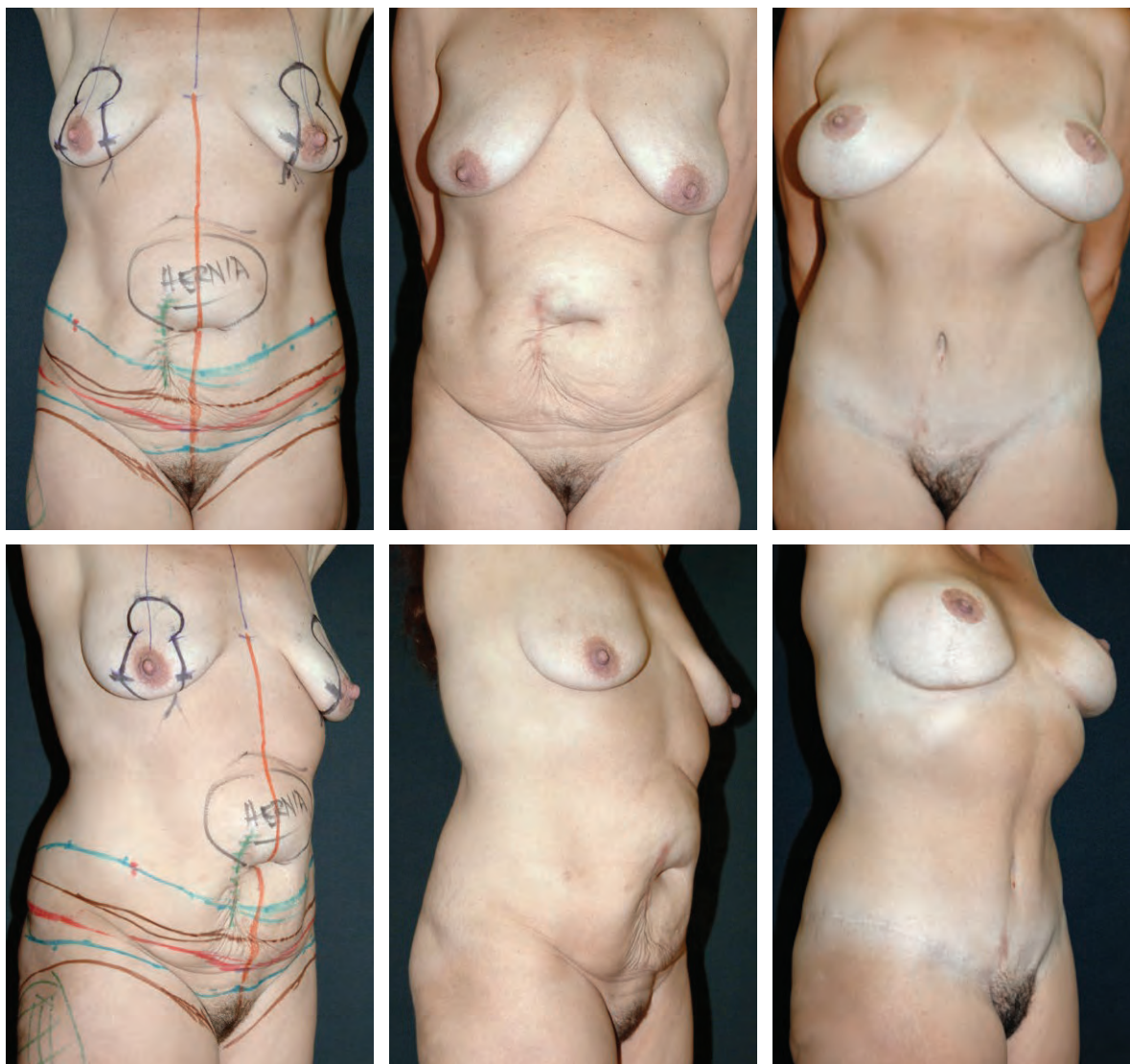
By virtue of the advancement of the upper abdominal flap, the umbilicus can be tethered superiorly. This is particularly true with an umbilicus with a longer stalk. Maneuvers to resist this displacement include reining in such a stalk with direct sutures to the rectus fascia and halting the upper skin flap mobilization several centimeters above the umbilicus.

Outcomes

With an aggressive application of the reverse abdominoplasty technique, there can indeed be a rewarding correction of the disturbingly persistent excess skin at the upper abdomen after a routine abdominoplasty. The central 3 inches of additional scar resting between the breasts heals remarkably well. It can be even more inconspicuous if it is designed to rest inferiorly in a V shape. Postoperatively the breast should remain in a stable, aesthetic position as long as a secure reinsertion of the abdominal flap is performed at the appropriate inframammary level. Some superior advancement of the umbilicus can occur despite all efforts to the contrary.

Results

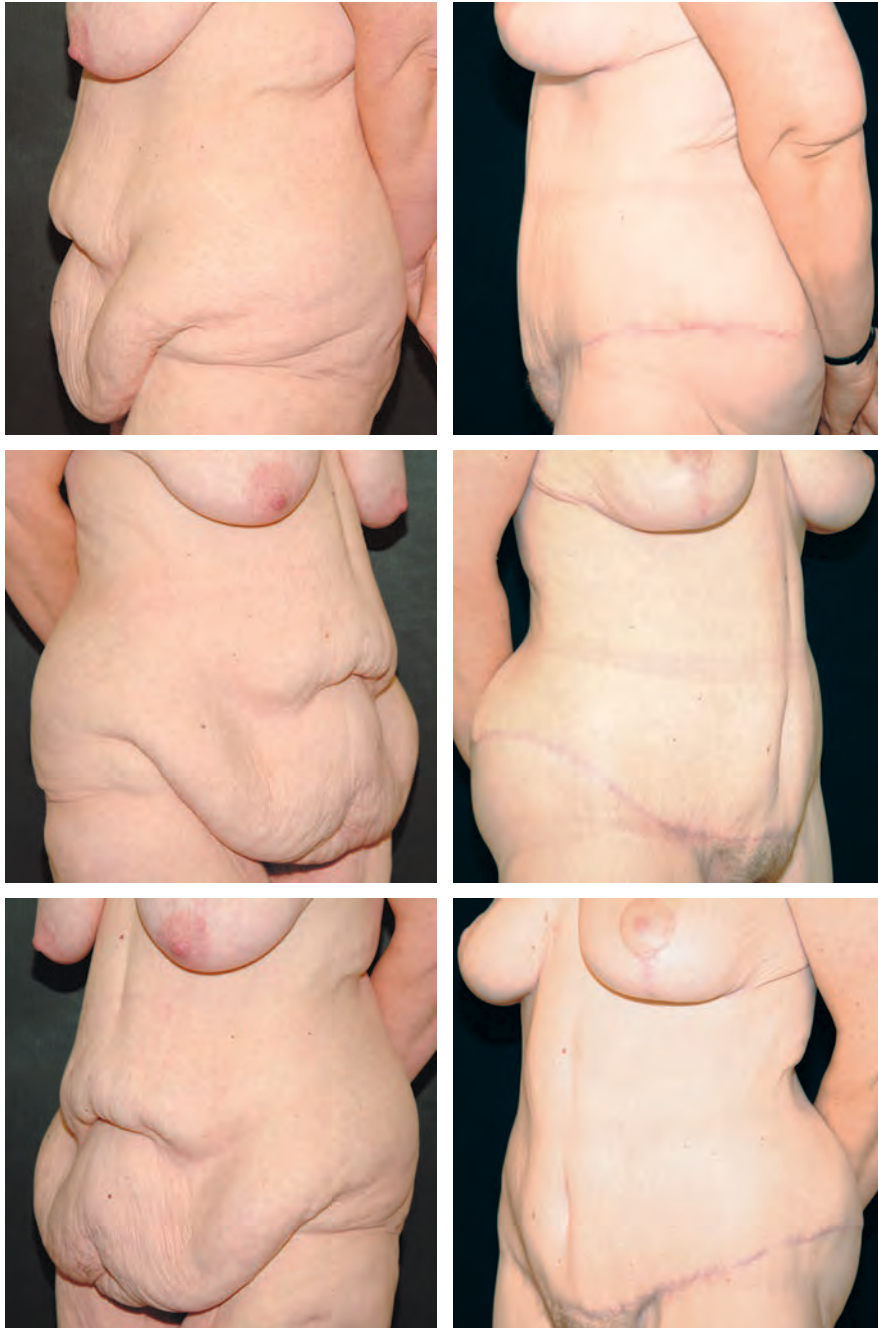
High Lateral Tension Abdominoplasty



This 46-year-old woman who had had four children requested abdominal repair after her last child was born. A high lateral tension abdominoplasty was performed, along with a mastopexy/augmentation. She is seen 4 years postoperatively, revealing evidence of the significant lateral excision accomplished with this technique, by virtue of the removal of her entire tattoo. The benefits of the HLTA with a more aesthetic waistline and smoother epigastric zone are apparent.

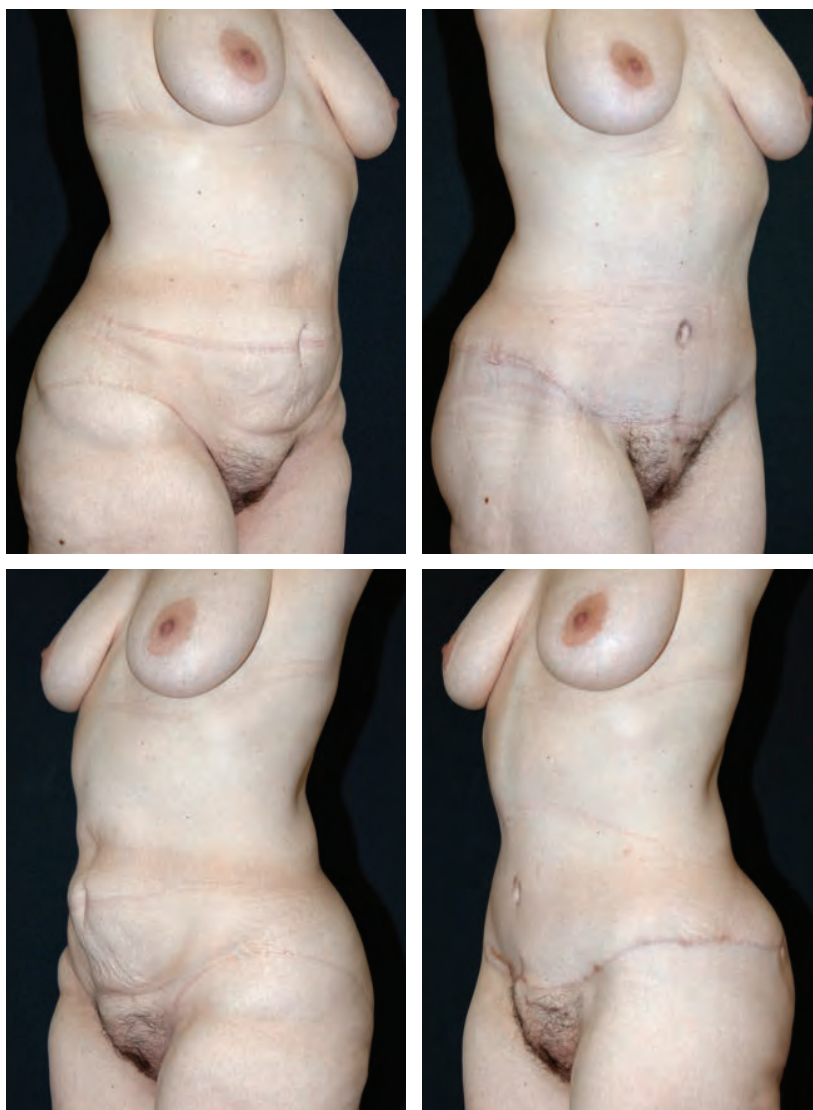


This 46-year-old nulliparous woman was seen after losing 66 kg (145 pounds) following a gastric bypass. She did not want a midline scar, but otherwise desired as much improvement as possible. She underwent a high lateral tension abdominoplasty with liposuction of the hips and lateral thighs. A mastopexy was performed at the same surgery. Note the presence of the supraumbilical line of demarcation carrying the more redundant skin above. Therefore dissection was deliberately discontinuous in this area and the patient was informed of the likelihood of residual epigastric excess postoperatively. She healed without complication. She is seen 8 months postoperatively. Note the correction of the abdominal deformity, even in the epigastric area, because of the oblique vector of its excision. The HLTA's body-lift effect was realized in the anterolateral thigh and buttock areas.





This 57-year-old woman had had two children and had lost close to 45 kg (100 pounds). She underwent an HLTA with liposuction of the hips and thighs and a breast reduction. Note the reconstitution of an aesthetic abdomen and the lifting of the buttocks.



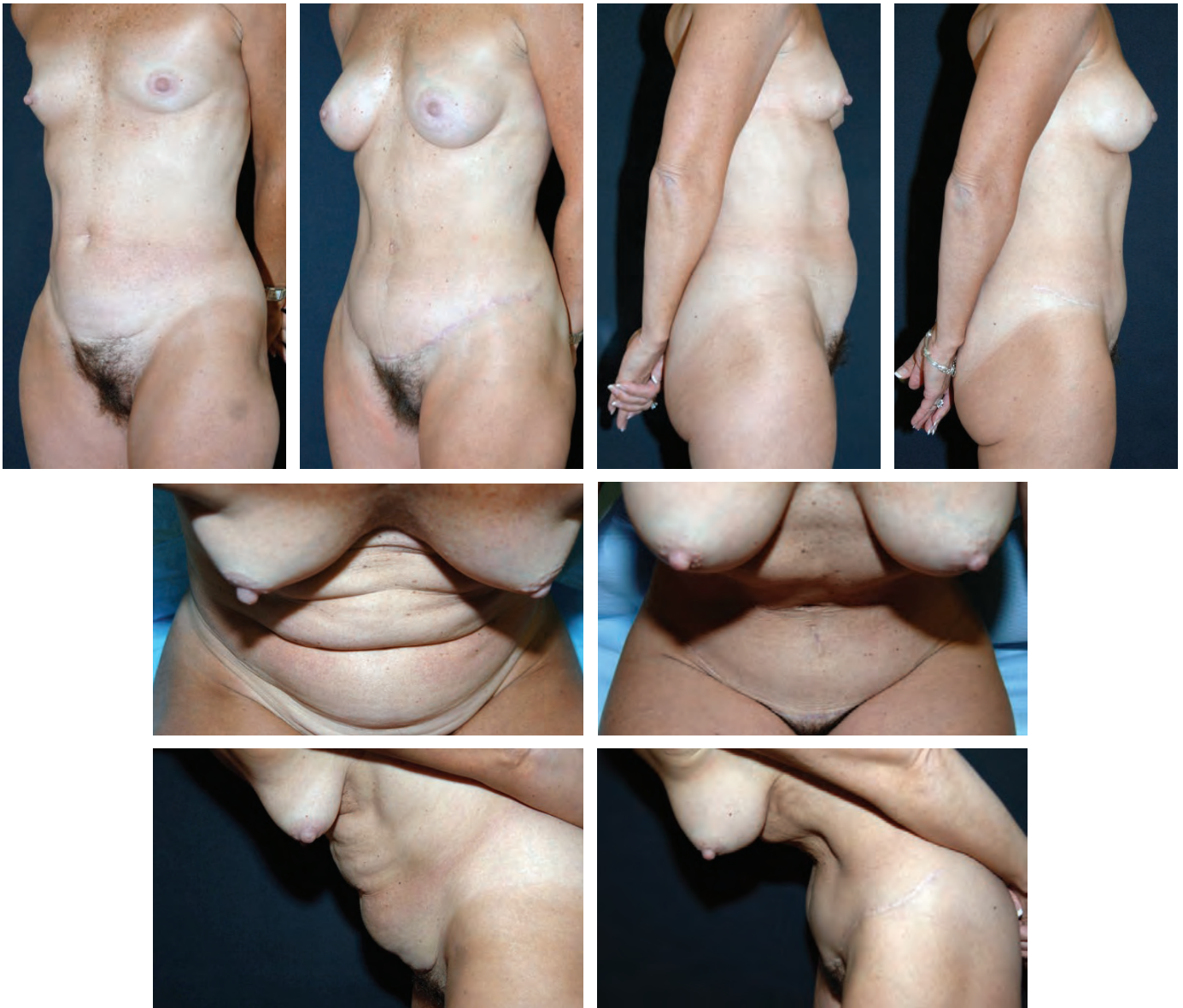
This 43-year-old nulliparous woman lost more than 45 kg (100 pounds) through a gastric bypass procedure. She elected to have an HLTA with liposuction of the hips and thighs. In evidence are the lift and correction of the lateral thigh/buttock region through well-placed scars.



This 39-year-old nulliparous woman had lost 91 kg (200 pounds) through diet and exercise alone. She demonstrated the most desirable skin envelope: thin and mobile. The patient underwent an HLTA using an extended posterior incision so that a more complete excision and lift of the lateral trunk could be achieved, while still properly treating the central tissues. Liposuction of the hips and lateral thighs as well as mastopexy with implantation were also performed.

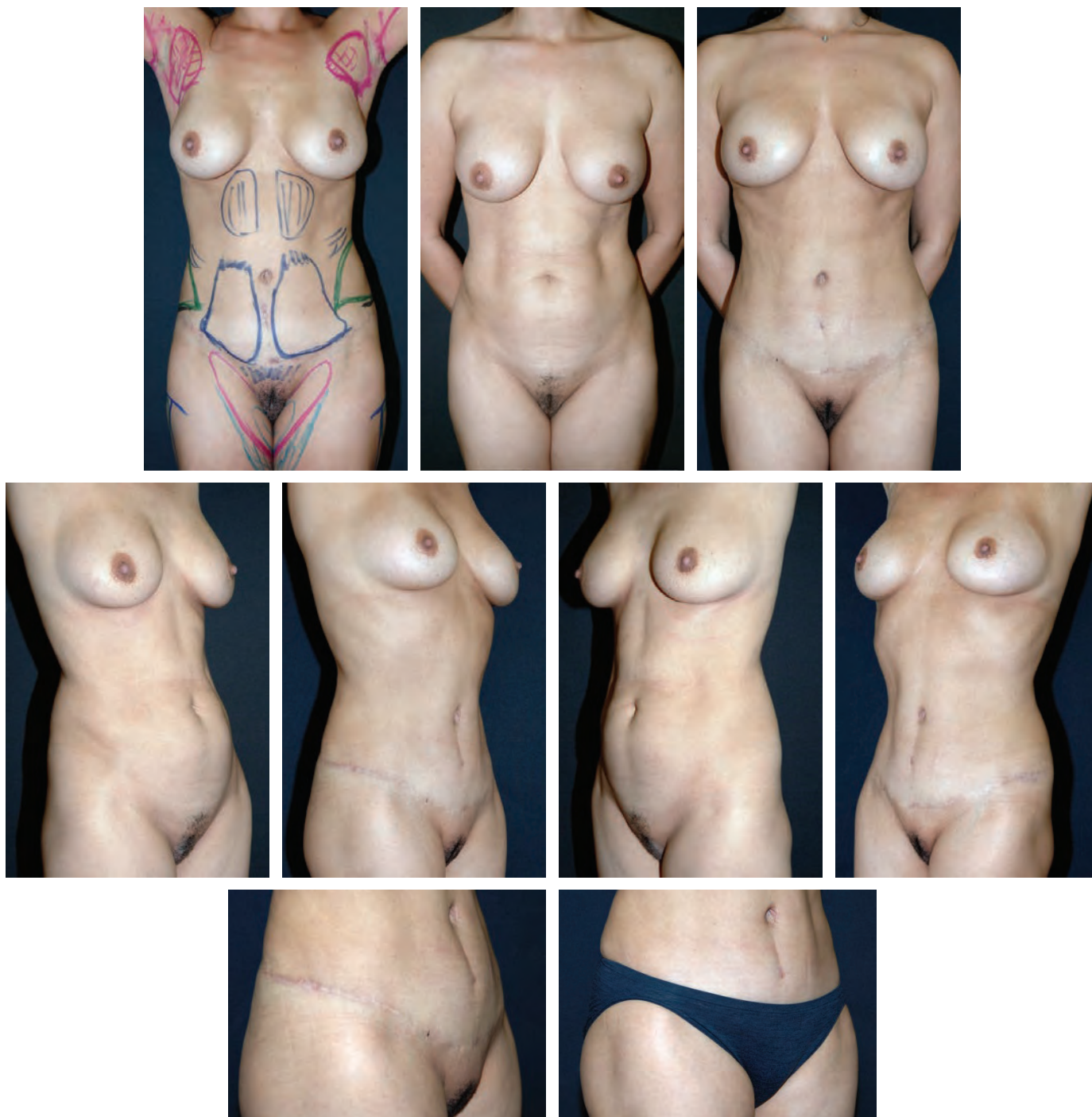


This 43-year-old nulliparous woman had undergone a bypass procedure and achieved a 66 kg (145-pound) weight loss. She subsequently underwent an HLTA and is seen 9 months postoperatively. The hallmarks of the HLTA effects are evident: the scar rests in a hidden position, the suprapubic skin is not overly tight, and the thigh and hip regions have been lifted. The closeup photo of the thigh reveals the qualitative improvement in the skin extending practically to the knee.

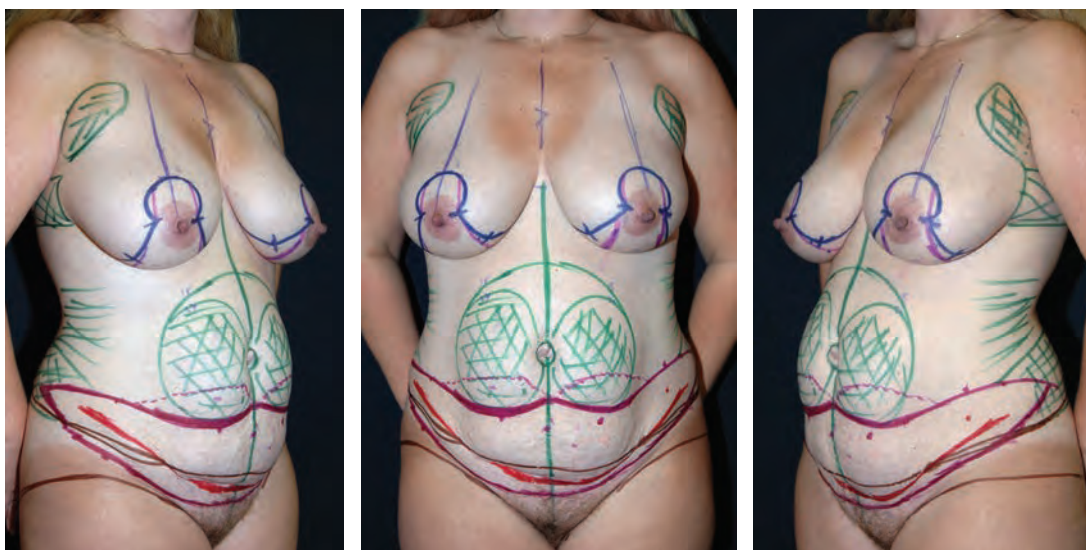


This 50-year-old woman requested rejuvenation of her abdomen; she had had one child. She underwent an HLTA with liposuction of the hips and lateral thighs and augmentation mammoplasty. The pleasing aesthetic of the abdominal repair is realized with a well-placed scar, a not overly tight suprapubic region, and an improved hip-thigh contour. Note the “stealth” skin redundancy, visible when the patient is sitting and bending, and its repair postoperatively. And still there is some residual skin excess in the epigastric area postoperatively.

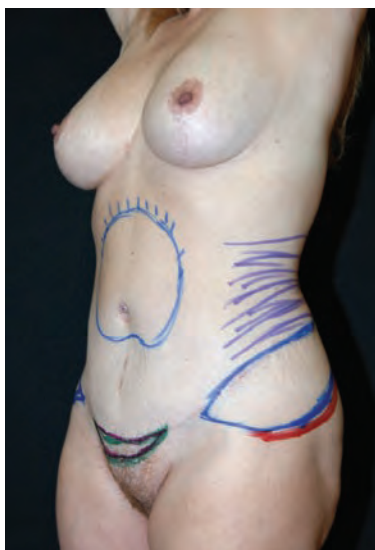
High Lateral Tension Abdominoplasty With Staged Liposuction



This 35-year-old woman had one child; she desired correction of her abdominal protrusion. She demonstrated a similar excess of skin when bending or sitting. An HLTA was performed with liposuction of the hips and thighs. The benefits of this technique are demonstrated with the return of her prepregnancy contour. As planned, the scar is properly hidden within the patient's underclothes. For safety, a planned second-stage liposuction was performed of the abdominal flap to complete the repair.



Markings for HLTA



Markings for post-HLTA liposuction

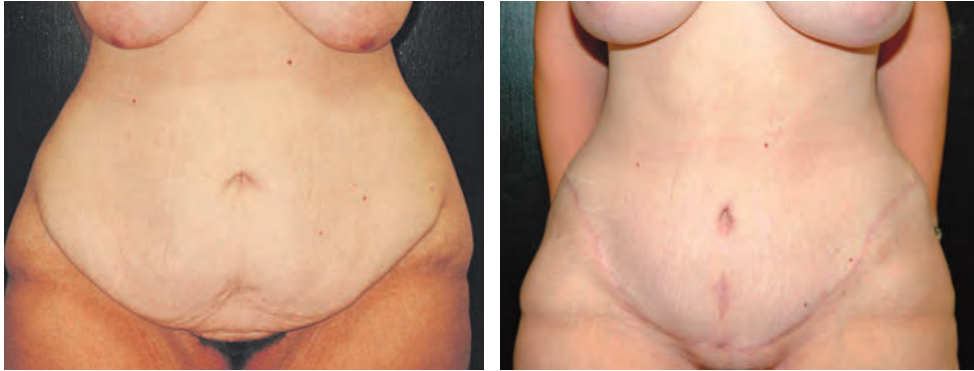
This 36-year-old woman, 5 feet 3 inches tall and 70 kg (155 pounds), complained of residual abdominal deformity despite aggressive diet and exercise. She had had three children.



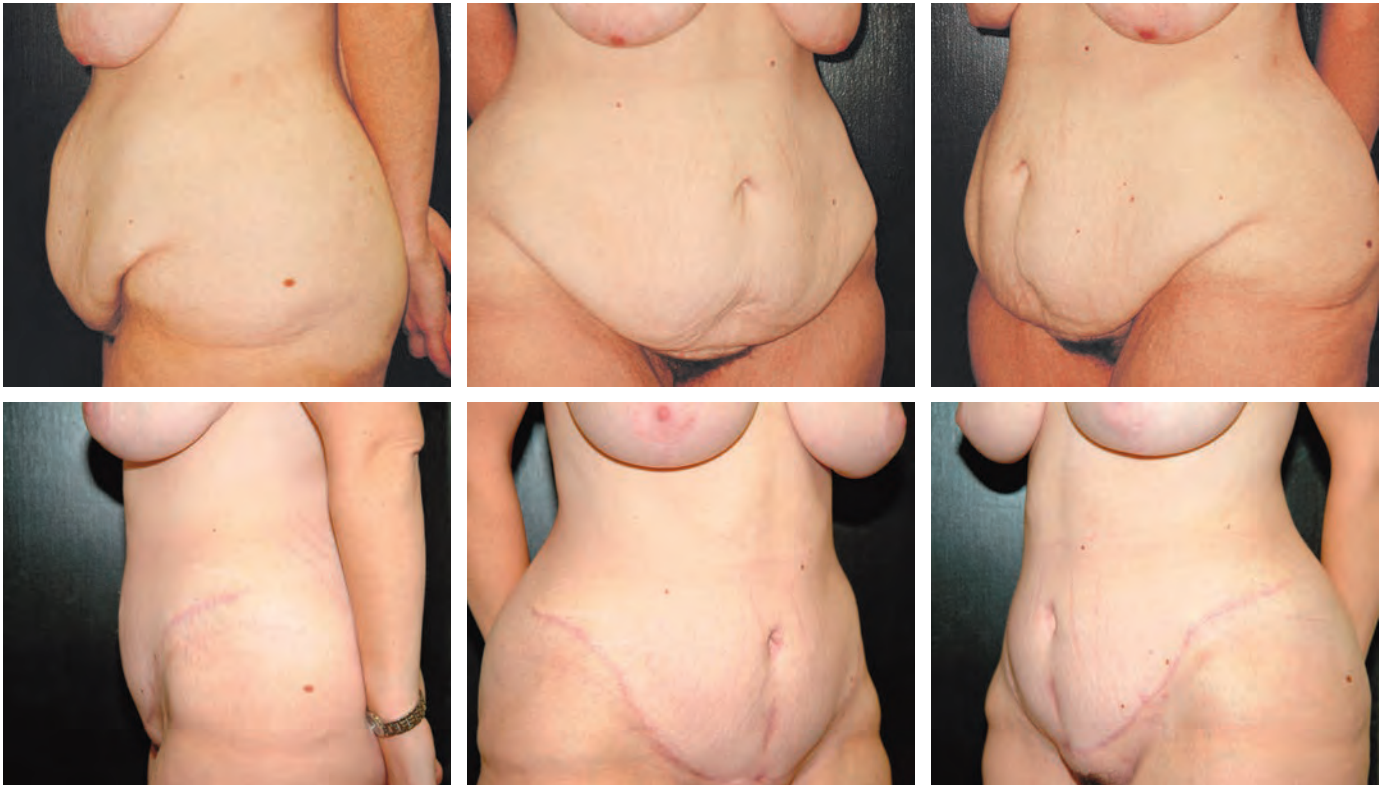
The patient underwent an HLTA with aggressive liposuction of her hips and thighs. Note the relative lift of both the buttocks and thighs. Rather than potentially compromising the blood supply at the first surgery, a secondary liposuction of the abdominal flap was performed instead.



As planned, the very productive, although lengthy, scar is hidden within her underwear.

First Stage: High Lateral Tension Abdominoplasty**Second Stage: Reverse Abdominoplasty With Mastopexy**

This 32-year-old nulliparous woman had undergone a gastric bypass procedure. She had lost approximately 60 kg (132 pounds) and wished to improve the appearance of her anterior trunk, abdomen, and breasts.



A high lateral tension abdominoplasty was performed with a concomitant mastopexy; no implants were placed. In these photographs, taken approximately 15 months post-operatively, improved contours are evident, particularly full correction of the inguinal and hip areas as well as the waist.



The patient then requested correction of the residual redundant tissue at the upper abdomen. Approximately 7 to 8 inches of excess tissue was marked for excision.

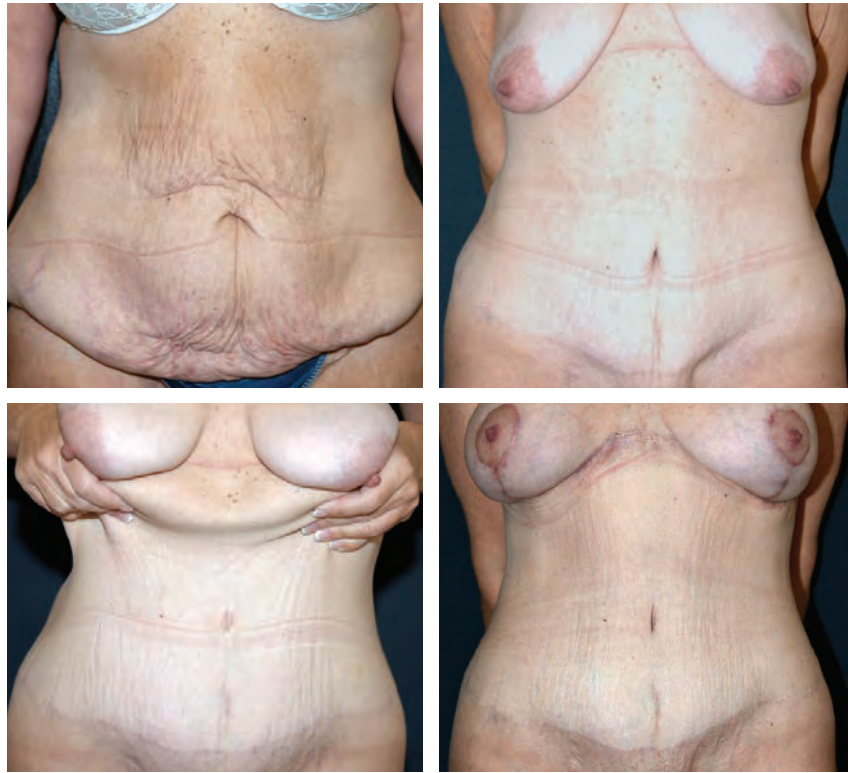


A reverse abdominoplasty and synchronous mastopexy were performed. This resulted in a rewarding correction of her upper abdominal deformity. Seen 9 months post-operatively, the appropriate location of the inframammary crease is evident after proper fixation at the time of the abdominoplasty. The photos also demonstrate a slightly overly raised umbilicus, a potential minor stigma of a productive reverse abdominoplasty. As outlined, the surgeon should maintain tissue above the umbilicus undissected and secure the umbilicus to the underlying fascia.



This 43-year-old woman who had had three children underwent a gastric bypass with a resultant loss of 66 kg (145 pounds). She complained of redundant skin throughout her abdomen. Although she would have been an ideal candidate for a fleur-de-lis abdominoplasty, she did not want a midline scar. A high lateral tension abdominoplasty was performed with the ultimate plan of including a reverse abdominoplasty at the time of breast rejuvenation to address the inevitable residual upper abdominal tissue. She is seen approximately 18 months postoperatively. On the oblique views, note the significant reshaping of the hip and lateral thigh contours.





The patient later underwent a reverse abdominoplasty and mastopexy/augmentation to complete her repair. The excess upper abdominal skin remaining after the HLTA is now corrected.

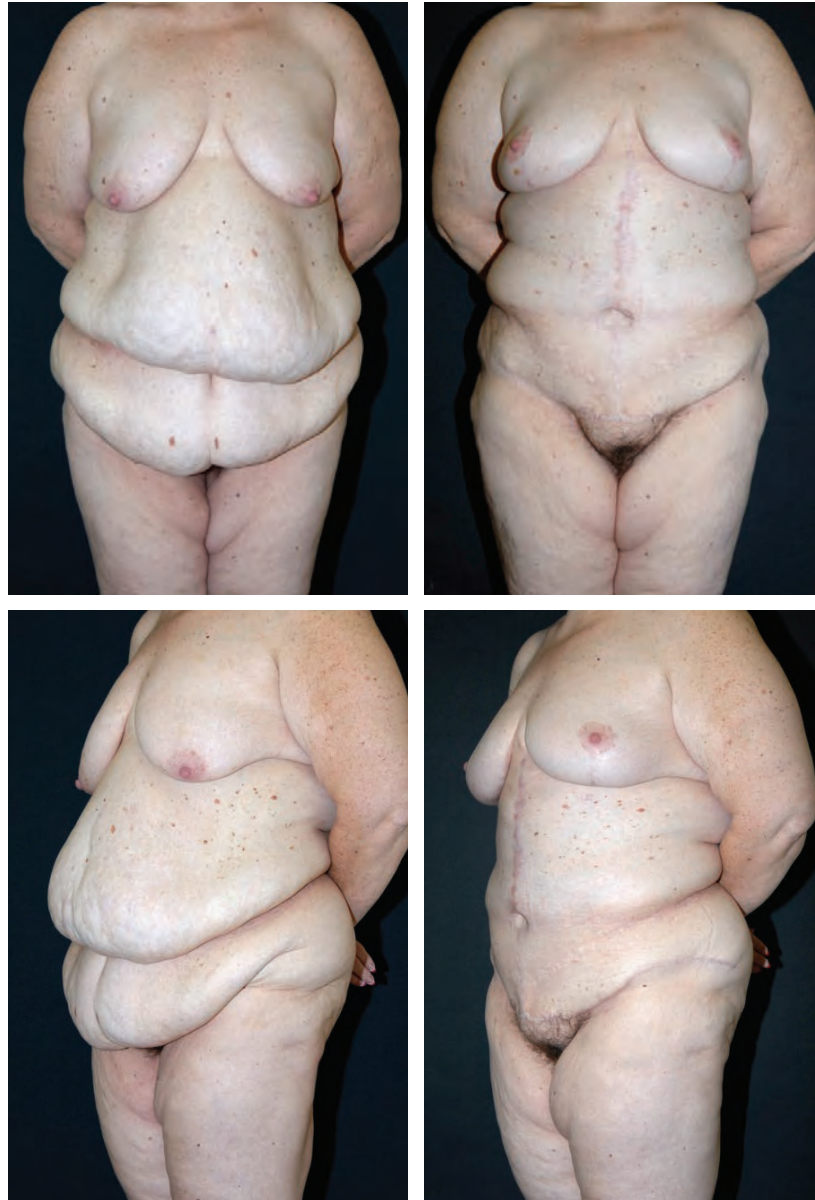
First Stage: High Lateral Tension Abdominoplasty

Second Stage: Reverse Abdominoplasty With Augmentation/Mastopexy

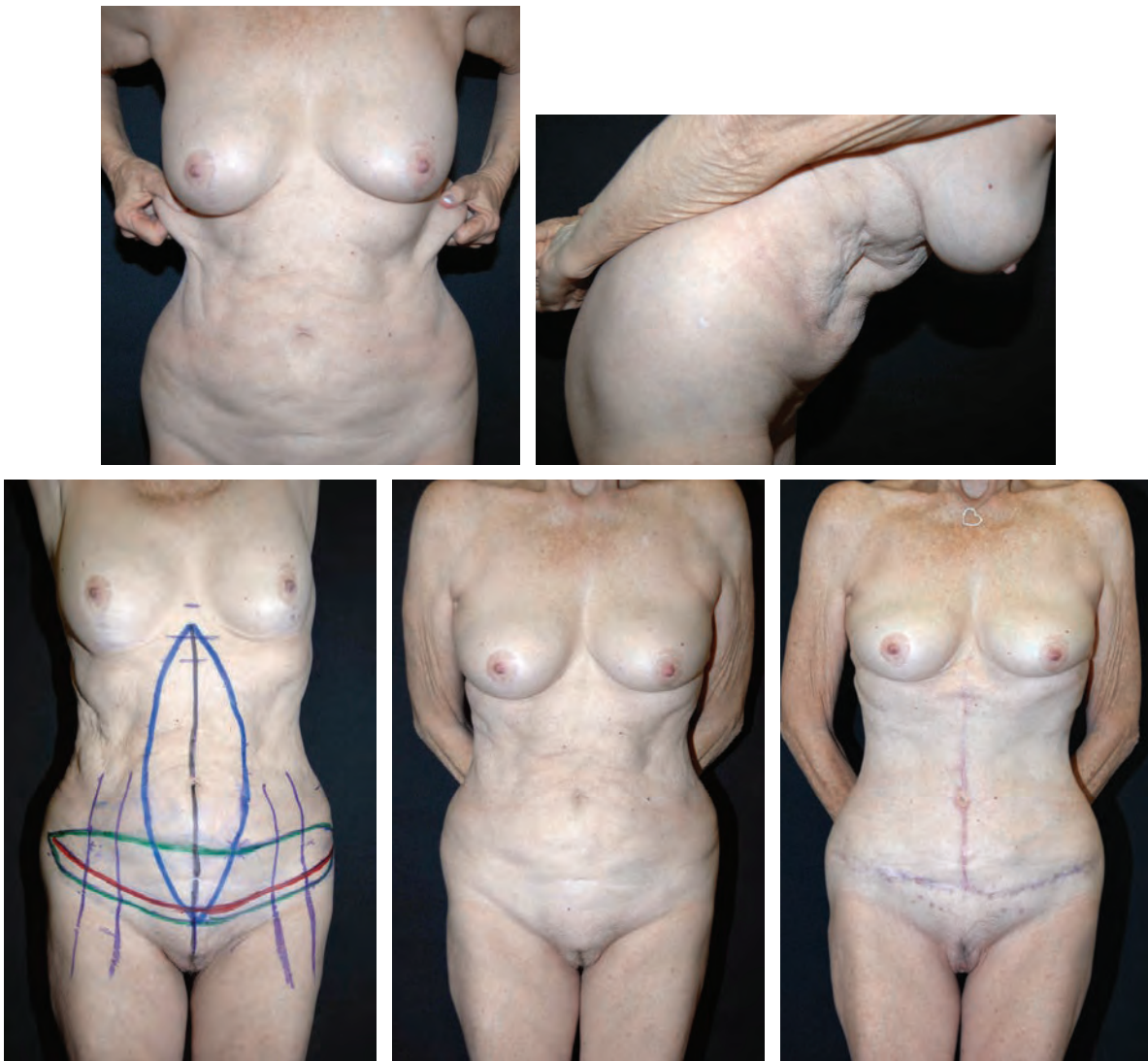


This 46-year-old woman had undergone a gastric bypass procedure. She had an HLTA first and then a staged reverse abdominoplasty for correction of the excess tissue at the upper abdomen and chest. The progressive results are seen.

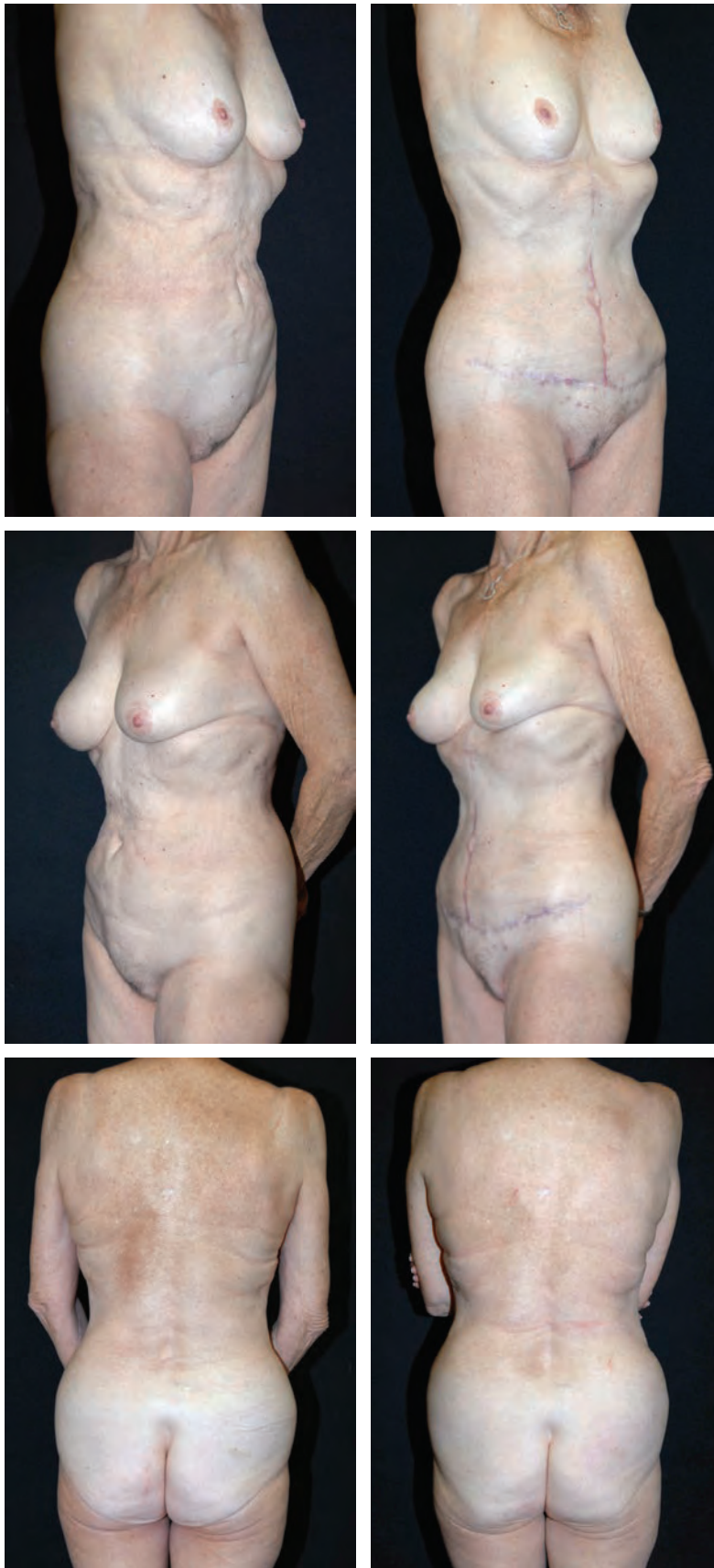
Fleur-de-Lis Abdominoplasty With High Lateral Tension

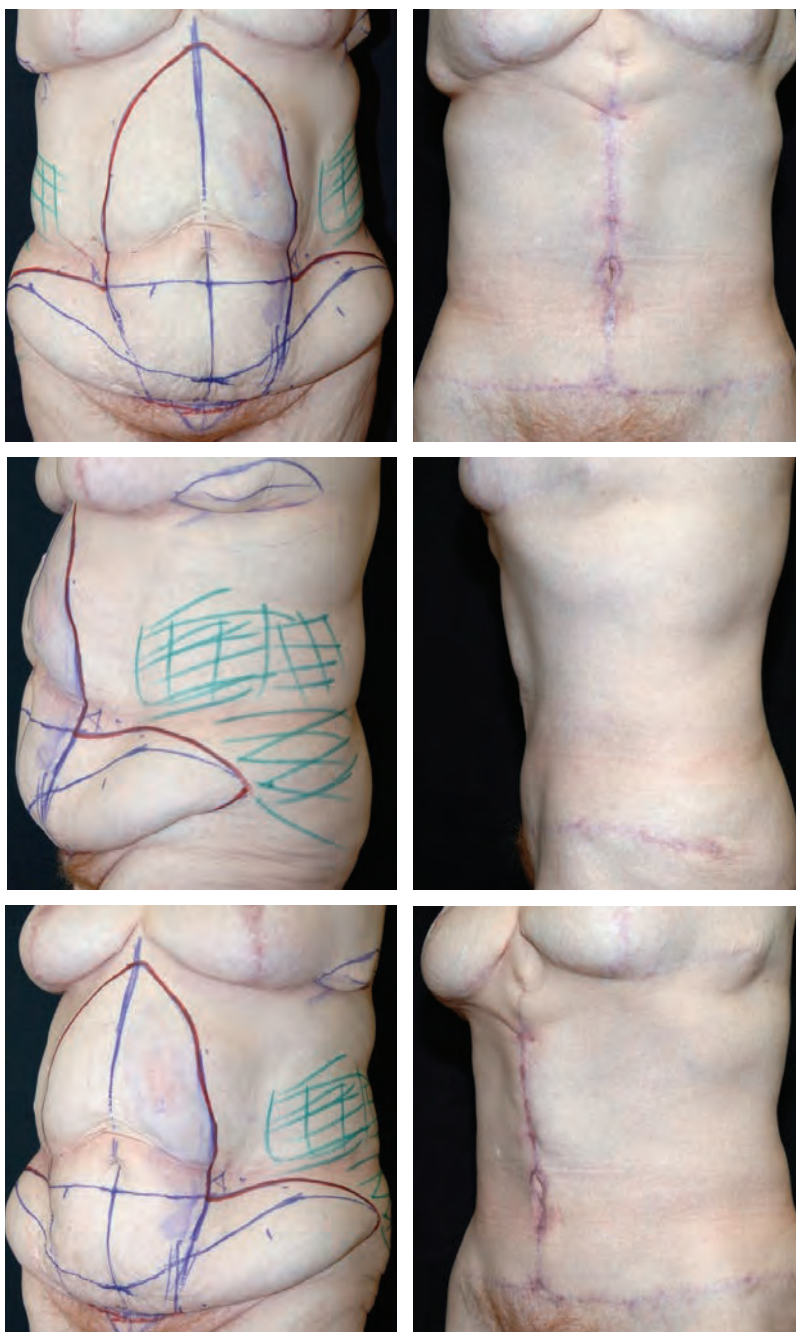


This 41-year-old female achieved a 64 kg (140-pound) weight loss from gastric bypass surgery. Her goal was simply to have the abdominal redundancy improved as much as possible. The patient was otherwise very healthy. The massive upper abdominal “second pannus” could only be properly and safely repaired with a fleur-de-lis technique. Significant body contouring was accomplished despite the patient’s thicker habitus. She also underwent a concomitant mastopexy.



This very fit 65-year-old woman desired a better contour with correction of her abdominal redundant skin and protrusion. She had had two children. She elected to have a fleur-de-lis procedure to more fully improve her shape. Note the excess stealth skin that becomes more obvious with change in position or when put on tension. Her aesthetic habitus allowed the full effect of the fleur-de-lis to be expressed with a particularly dramatic improvement in her pubis, waist, upper abdomen, and back folds. In addition, the patient's posture appears to have improved.

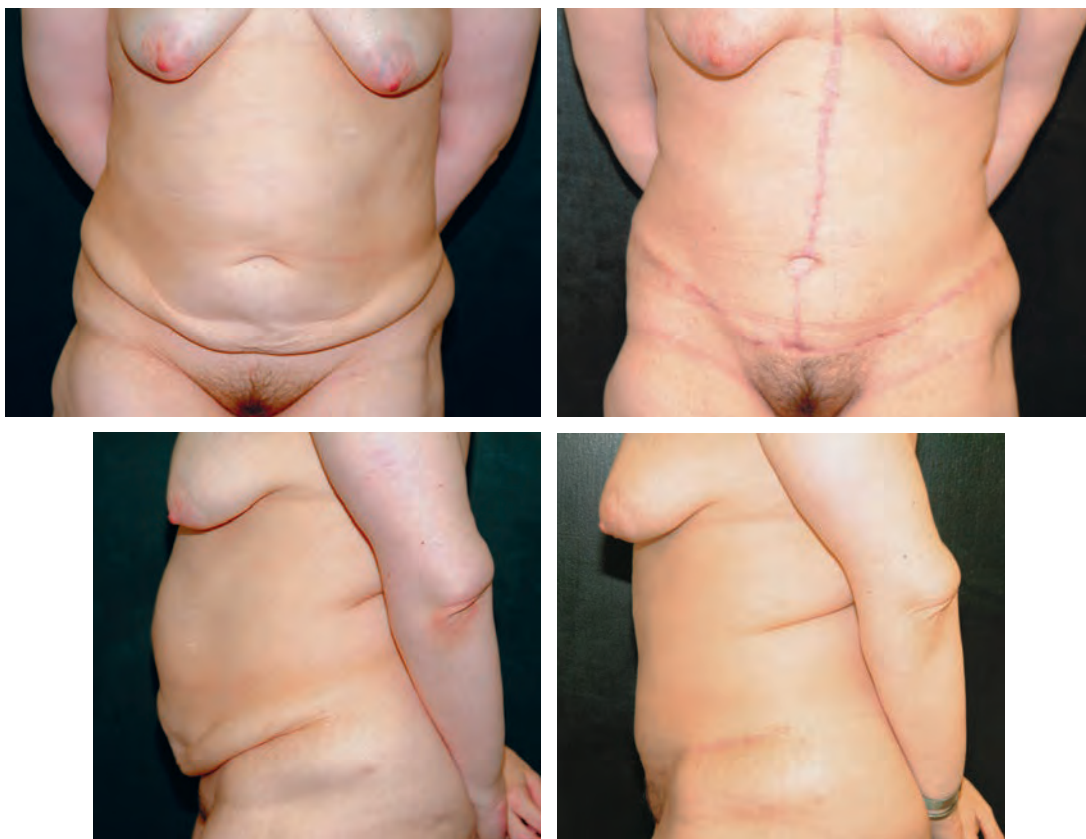




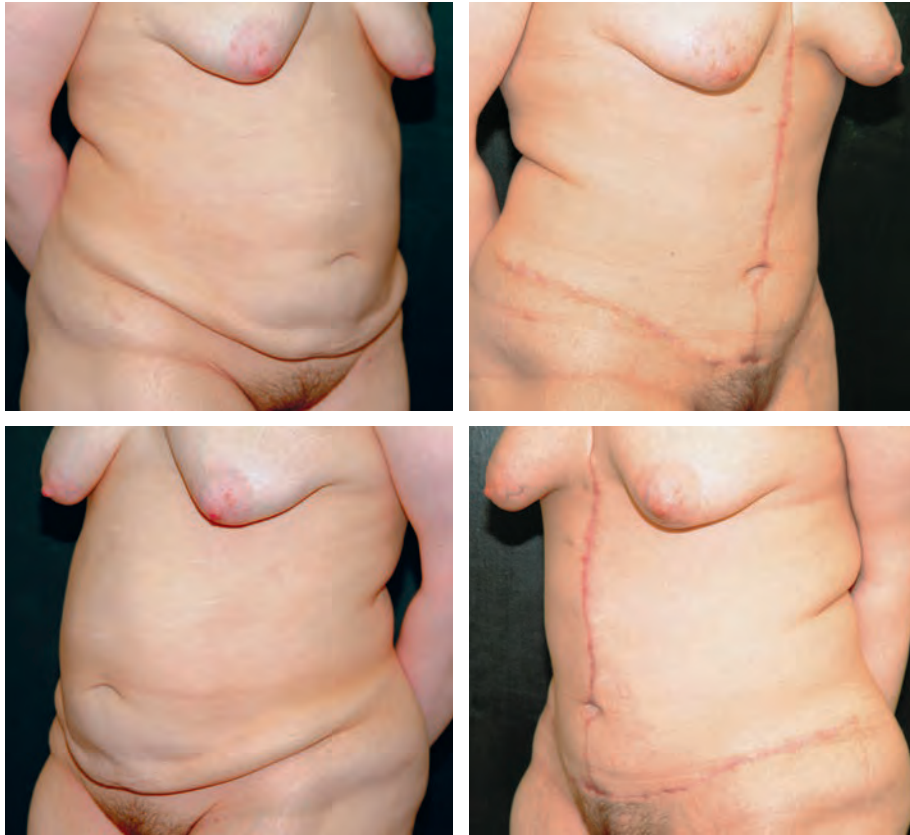
This 59-year-old woman underwent a gastric bypass and a subsequent weight loss of more than 45 kg (100 pounds). She requested abdominal correction, and because of the excess skin in the upper poles of the abdomen, we elected to perform a fleur-de-lis abdominoplasty with a proper high lateral tension approach to the lower abdomen.



The results demonstrate the rewarding improvement not only of the abdomen, but also a more far-reaching correction of the waist and back (fleur-de-lis) as well as the thighs and buttocks (HLTA).



This 33-year-old nulliparous woman had undergone a gastric bypass and lost 50 kg (110 pounds). She desired as complete an abdominal recontouring as possible in one stage. Therefore she was very accepting of a fleur-de-lis approach and equally pleased with the relatively full repair of her redundant tissue, as seen here 7 months post-operatively.



Fleur-de-Lis Abdominoplasty With Posterior Body Lift



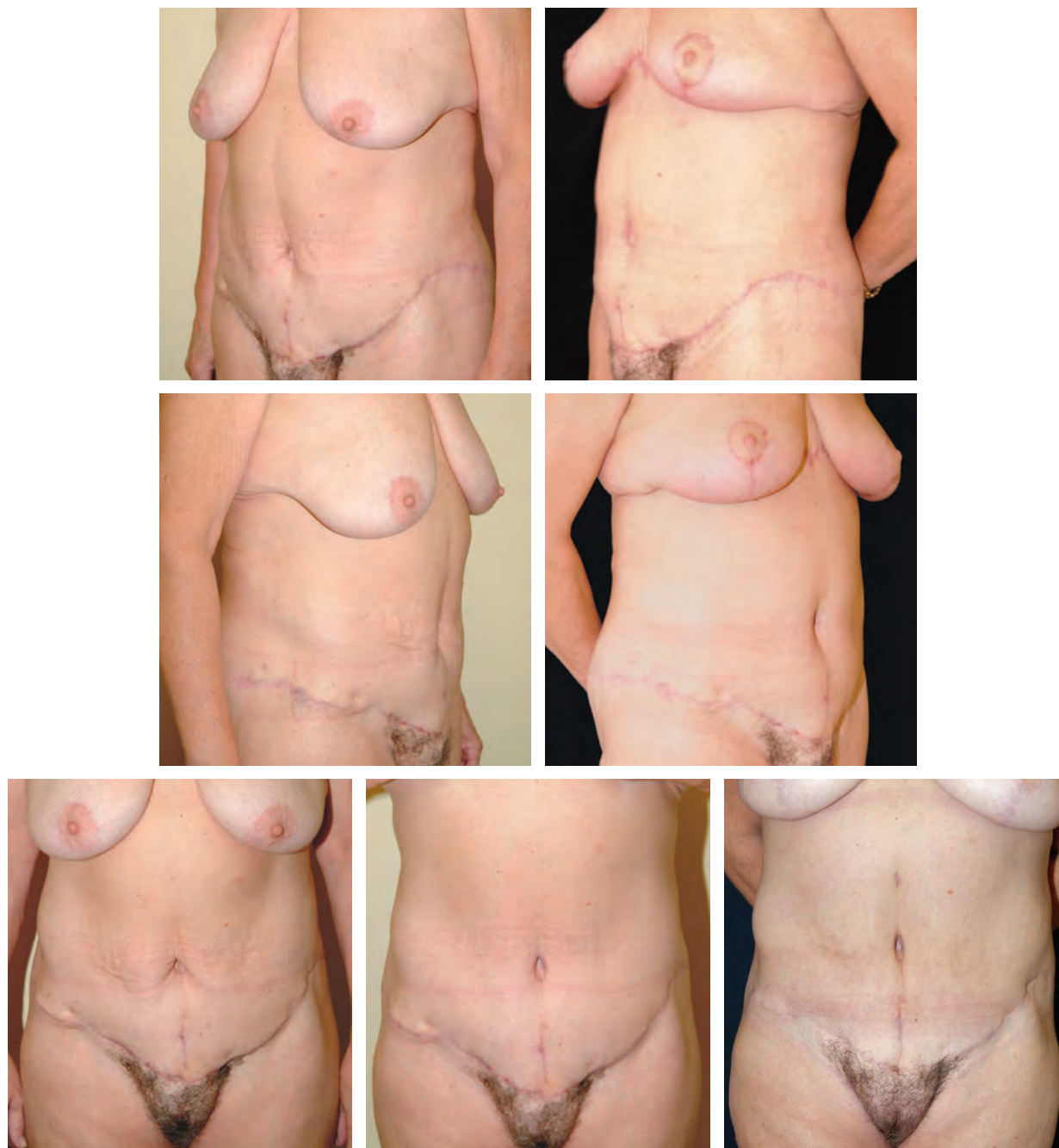
This 40-year-old nulliparous woman had lost 73 kg (160 pounds) as a result of gastric bypass surgery. A concomitant fleur-de-lis abdominoplasty and posterior body lift were performed. Note the correction of both the abdomen and the surrounding aesthetic units.

First Stage: High Lateral Tension Abdominoplasty With Posterior Body Lift

Second Stage: Reverse Abdominoplasty With Augmentation/Mastopexy



This 53-year-old nulliparous woman had originally lost 50 kg (110 pounds) after a gastric bypass. She was seen 6 months after an HLTA with a posterior body lift and now desired repair of a significant redundancy of the upper abdomen. At the time of the reverse abdominoplasty, a mastopexy with augmentation was also performed. By inseting the abdominal flap before the breast surgery, a definitive breast platform was created. At 4 months postoperatively, note the tight appearance of the upper abdomen. The sequential results are illustrated (see p. 3018).



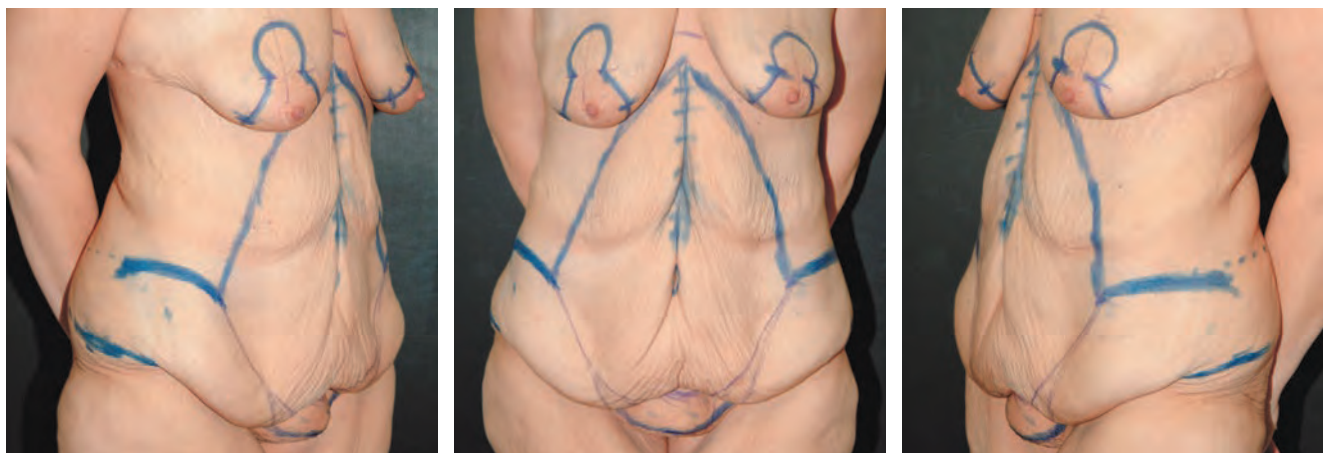
It is instructive to ask the patient to perform an examination room “nonsurgical lift” (see p. 2975) of the excess skin to demonstrate her goals. As can be seen, the results came very close to meeting those goals.

Fleur-de-Lis Abdominoplasty Using High Lateral Tension and Reverse Abdominoplasty With Augmentation/Mastopexy During One Operative Session

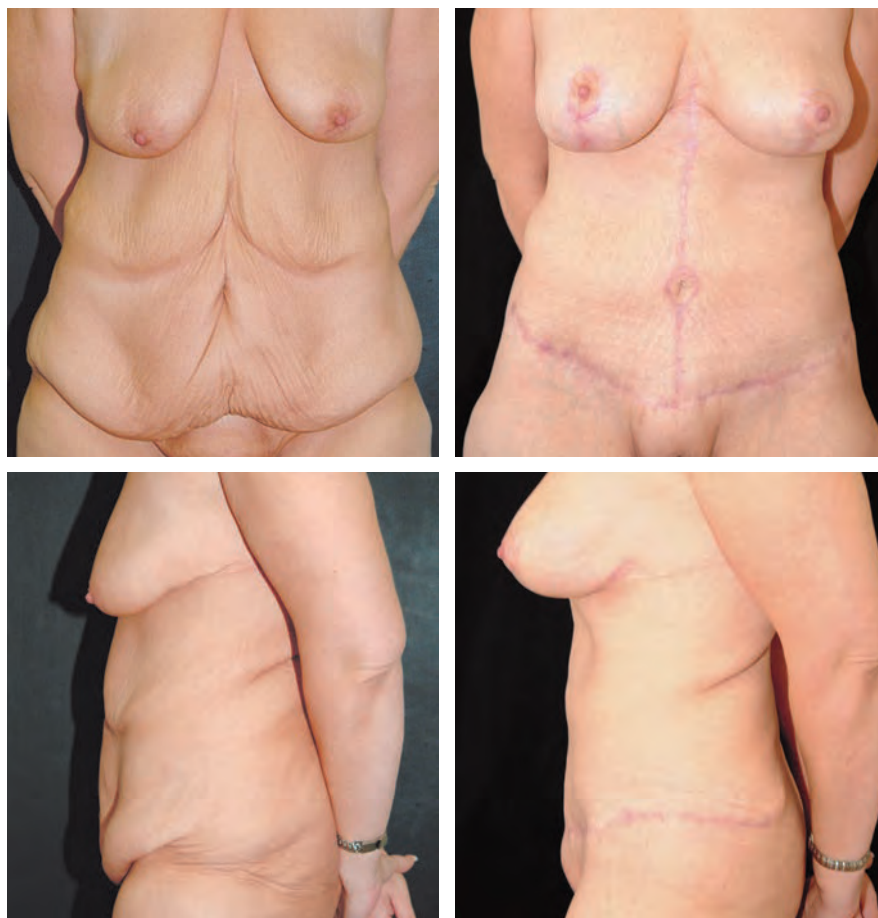


This 35-year-old nulliparous woman was seen after a gastric bypass and subsequent weight loss of 109 kg (240 pounds). She requested both abdominal and breast rejuvenation. As seen in her preoperative photographs, there was a significant amount of excess tissue in the vertical and horizontal dimensions, with cascading skin redundancy at the upper and lower abdomen.

This redundancy was present not only at the abdomen but also extended onto the chest, flanks, and back. She had an upper midline vertical scar; therefore a fleur-de-lis approach was designed. Because breast surgery was to be performed, a conservative reverse abdominoplasty was conducted. This entailed direct resection, without undermining, of the abdominal excess skin through the inframammary incisions. *Therefore the patient essentially underwent all three complementary procedures during one operative session.* The fleur-de-lis surgery was conducted before the breast augmentation/mastopexy to ensure the inset of the upper abdominal flap and the definition of a proper inframammary crease on which the breast could be built.



Her preoperative markings are shown.



The postoperative results at 8 months reveal the impressive, almost circumferential correction. The scar is once again low centrally and hidden throughout. The improvement at the upper chest, back folds, thighs, and waist is evident.



Concluding Thoughts

A well-conceived and well-executed high-tension abdominoplasty, with the addition of the fleur-de-lis or reverse principles, defines a truly comprehensive abdominoplasty, which is a surgical antidote to the shortfalls of more traditional approaches. In essence, comprehensive abdominoplasty is a more complete treatment of the anterior trunk aesthetic unit from the submammary and lateral chest area to the pubic, thigh, and buttock zones, with a greater overall aesthetic result and margin of vascular safety.

Clinical Caveats

Key Principles of the High Lateral Tension Abdominoplasty

The HLTA is driven by the concerted effort to treat not only the tissues above the incision but also those below. This treatment is as much excision of redundancy as it is a far-reaching body lift through a relatively anterior incision. The pubis and anteromedial thighs as well as the hips, anterolateral thighs, and even buttocks can be aesthetically improved by this technique.

This procedure is fundamentally and philosophically different in that the skin is considered more redundant at the lateral trunk than in the midline. Therefore the anterolateral thigh can be more effectively treated. In addition, the redundant upper abdominal skin emanates more from the chest and demonstrates more of a horizontal laxity compared with the vertical laxity of the lower pannus. Thus the relatively oblique pull of the HLTA can more effectively treat this epigastric excess.

This approach, in contradistinction to the traditional abdominoplasty, is not driven by the usually mandatory excision of all the skin between the pubis and umbilicus. Therefore the pubic/median portion of the incision can be naturally lower and more hidden and the closure can be under less tension, improving the chances for healing by first intention and a more natural looking result.

The HLTA often mandates that the incision be longer laterally. However, it is also true that the longer the lateral incision, the better the result. This approach allows the excision of a greater extent of skin, and what is more important, affords an impressive body lift of the surrounding tissues. This balance between scar length and result must be negotiated with the patient.

As a corollary, if there is not a significantly redundant skin envelope at the lateral thigh, the HLTA should be “tempered,” and the scar can and should be shorter.

This technique, although often more effective at treating the upper abdominal skin excess, should be supplemented by a second-stage reverse abdominoplasty procedure when necessary or even “converted” to a fleur-de-lis initially.

The HLTA is predicated on preservation of the flap blood supply first and foremost. As part of this philosophy, for a patient with a medium to high BMI the surgeon should seriously consider a staged liposuction of the central and superior abdominal flap instead of either liposuction or direct excision. Only then can a zero tolerance for skin necrosis truly be honored.

The entire anterior trunk should be considered as one aesthetic unit. Thus not just the traditional lower abdominal pannus is treated but all of the areas surrounding this deformity as well.

Fleur-de-Lis Abdominoplasty

The excess skin (particularly when first applying this technique) should be tailor-tacked in the vertical and horizontal directions to more safely conduct the skin excisions.

Tacking should always be started at the inverted-T junction to ensure that enough skin is preserved for the suprapubic closure.

Surgery beyond the xiphisternum should be avoided to avoid the scar’s riding up between the breasts.

The surgeon should imagine the excision as a fleur-de-lis skin template, never undermining the skin flaps.

Reverse Abdominoplasty

All patients undergoing significant routine abdominoplasties (especially weight-loss patients considering possible breast rejuvenation) should be informed that a reverse abdominoplasty might be desirable at a later time.

The position of the future crease should be accurately determined with the patient in the upright position on the operating table.

The abdominal flap should always be doubly secured to the defined inframammary crease to create a platform on which the breast can rest and the abdominal flap can hang.

The relative mobility of the umbilicus and the extent of excision must be assessed to help determine how much umbilical displacement may occur. The tissue above the umbilicus should be left undissected in an effort to block excessive superior movement.

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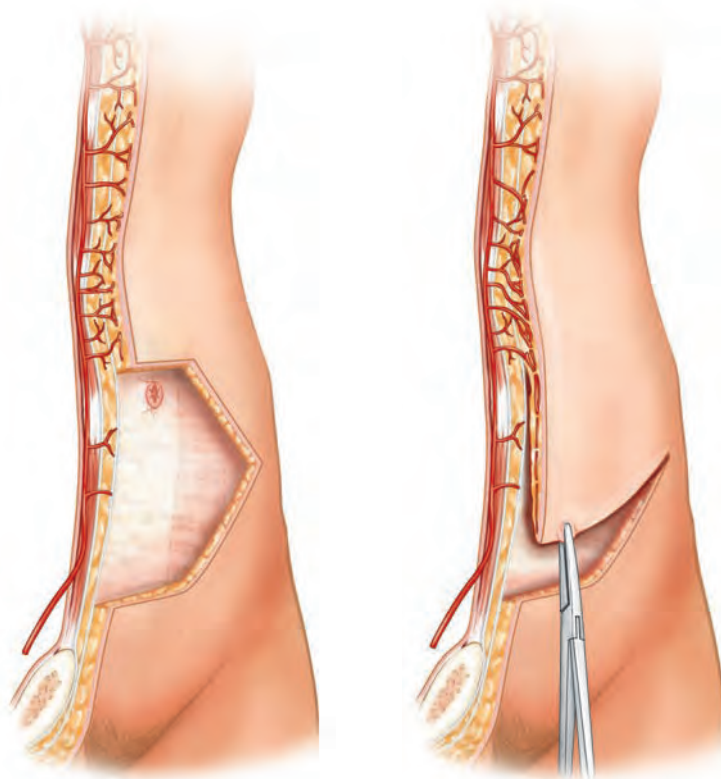
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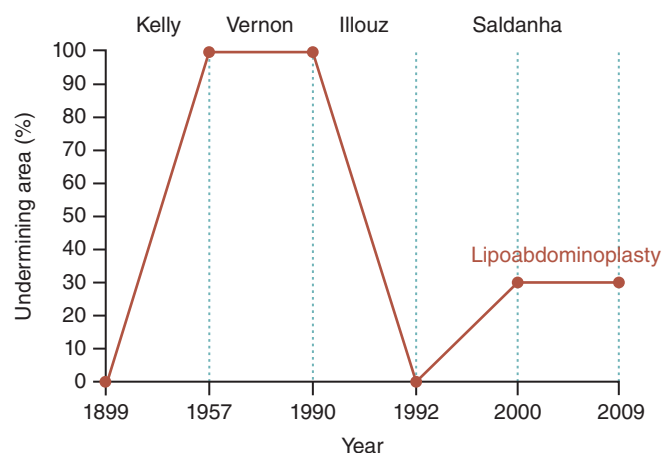
CHAPTER 84



Lipoabdominoplasty

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The abdomen is one of the regions of the body that is most susceptible to aesthetic and functional deformity as a result of genetic characteristics or because of acquired problems associated with obesity, weight loss, pregnancy, or other causes. Abdominal deformity may present as cutaneous flaccidity, localized fat accumulation, or diastasis of the abdominal rectus muscle. Such deformity has long had a negative psychological and physiologic impact on patients who seek a more aesthetic abdominal appearance. Lipoabdominoplasty has proved an excellent procedure for solving this problem and providing patients with the cosmetic contouring they desire.



Lipoabdominoplasty combines two traditional techniques—liposuction and abdominoplasty. This new, conservative concept is based on preservation of the abdominal perforating vessels (subcutaneous pedicle), which are branches of the deep epigastric vessels. As stated previously, this preserves about 80% of the blood supply of abdominal flap compared with traditional abdominoplasty. The nerves and lymph nodes are also preserved, maintaining the flap's cutaneous sensibility to superficial pain and superficial touch by temperature, vibration, and pressure—also an improvement on traditional abdominoplasty.

Evolution of Technique

Traditional plastic surgery of the abdomen results in a high rate of morbidity, because the perforating vessels must be sectioned during undermining of the large flaps. As demonstrated by Munhoz in a postoperative Doppler ultrasound study, these perforators represent 80% of the blood supply of the abdominal wall. Consequently, the vascularity of the remaining flap is supplied only by the intercostal, subcostal and lumbar perforating branches situated in the back and flank regions. Multiple in-

investigators have noted the incidence of ischemia, with tissue necrosis and suture dehiscence, associated with abdominoplasty with liposuction, so surgeons have been reluctant to perform this procedure.

Techniques for undermining the abdominal wall evolved from 1899 to 1957, when Vernon published a standardized technique for extensive undermining of the abdominal wall to facilitate umbilical transplantation.

In previous decades surgeons developed innovative techniques to reduce the surgical morbidity associated with abdominoplasty, obtain a faster recovery, provide a more aesthetic body contour, and produce lower rates of abdominal wall necrosis. The introduction of liposuction by Illouz in 1980 led to the development of techniques that reduced the need for abdominal undermining.

The mini-lipoabdominoplasty described by Hakme in 1985 involved liposuction of the entire abdomen and flanks, with an elliptical resection of the suprapubic skin, plication of the supraumbilical and infraumbilical rectus muscles, without relocating the umbilicus. The complications associated with combined liposuction and abdominoplasty methods are vascular related and were presented by Matarasso in 1991 and 1995. He considered the back and flanks safe areas for liposuction. He did not regard the lateral region of the abdomen as safe, and he cautioned that no liposuction should be done in the central region of the abdomen.

In the 1990s Illouz decreased the extent of undermining and the rate of complications (seroma, hematoma, and most of all, necrosis), reaching zero undermining in 1992 with an article on “abdominoplasty mesh undermining.” The trend toward “abdominolipoplasty,” with or without a small amount of undermining, continued until 1999, when Shestak and Avelar presented the partial abdominolipoplasty method, with no undermining. In 1995 Lockwood reported using Scarpa’s fascia to decrease the tension of the skin closure.

Superficial liposuction, introduced by de Souza Pinto in 1996, became the first fundamental principle of lipoabdominoplasty, because this technique allows more mobility of the abdominal flap so that it can slide down easily and reach the suprapubic region. The second principle is the preservation of abdominal perforator vessels (see p. 3035).

Lipoabdominoplasty was developed by Saldanha and published for the first time in 2001 as a safe option to correct both functional and aesthetic abdominal deformity while achieving better aesthetic results with technical simplicity for surgeons. Saldanha outlined a standardized method for selective undermining between the internal borders of the rectus abdominis muscles.

Indications and Contraindications

Lipoabdominoplasty can be used for any patient with flaccid abdominal skin, adiposity, and diastasis of the rectus muscles. It can be used in smokers and in overweight and postbariatric patients.

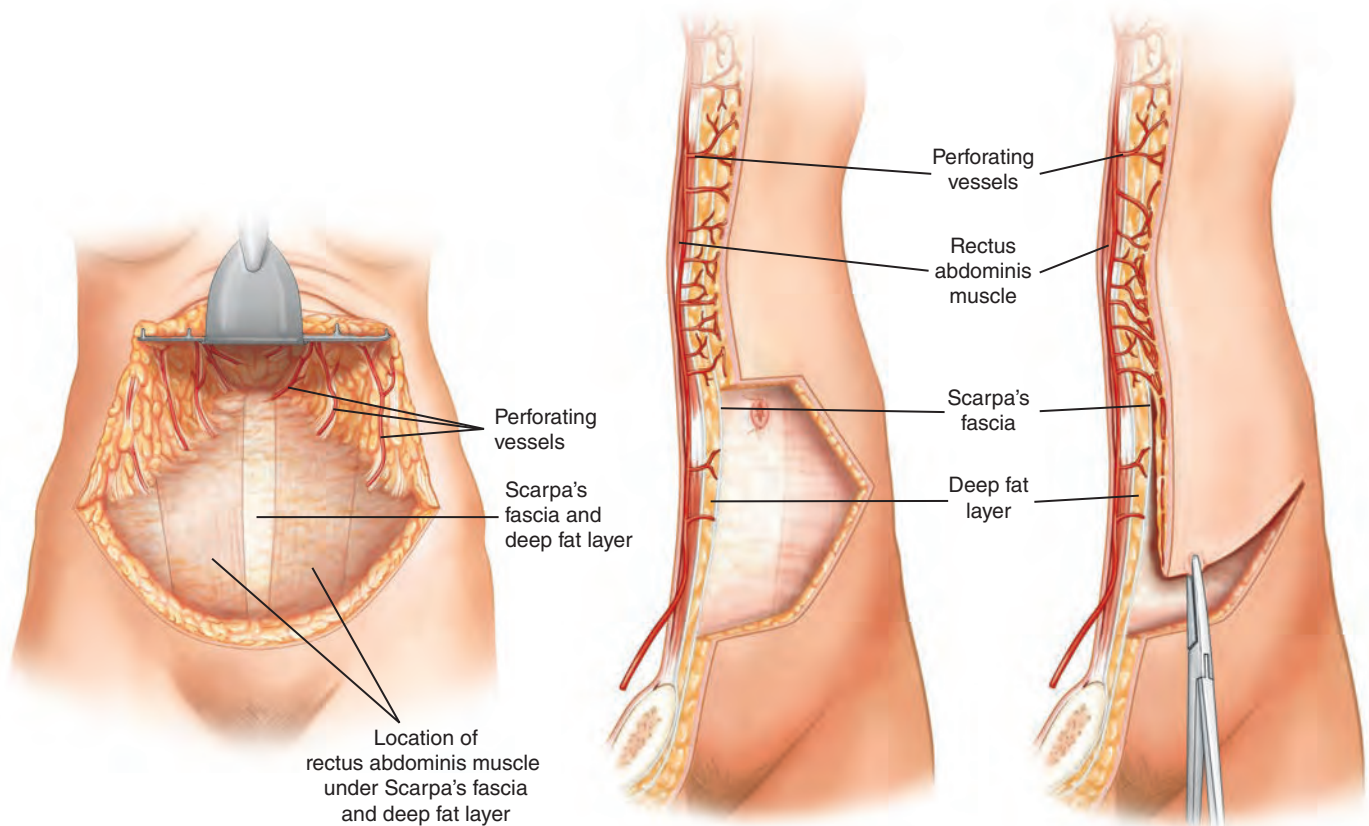
Pertinent Anatomy

The abdominal wall skin comprises two elements: the epidermis and the dermis. Beyond the dermis is the subcutaneous cellular tissue, which is made up of two layers of fat separated by the superficial fascia. The deeper fat layer is intimately related to the muscles of the anterior abdominal wall through which the vascular, lymphatic and nervous systems penetrate.

The abdominal muscles are the rectus abdominis, external oblique, internal oblique, transverse, and pyramidal.

Lipoabdominoplasty is based on the vascular anatomy of the abdominal wall, especially of the perforating vessels of the rectus abdominis muscles. The main arteries of each part of the abdominal wall are two superior arteries, the superior epigastric artery and the musculophrenic artery (branches of the internal thoracic artery); and two inferior arteries, the inferior epigastric artery and the deep circumflex artery of the ilium (branches of the external iliac). Branches of the lumbar and intercostal arteries also help to supply the abdominal wall. The veins follow the arteries' paths and nomenclature.

Lymphatic drainage flows caudally to the umbilicus toward the superficial inguinal nodes and cranially to the axillary nodes. Innervation is by the thoracoabdominal, iliohypogastric, and ilioinguinal nerves.



Scarpa's fascia and part of the deep fat layer are preserved to achieve a complete reconstruction of the abdominal wall in the entire lower abdomen—between the umbilicus scar and pubis. Reconstruction is completed when the superior flap is brought down to the pubis.

The upper abdomen is undermined exactly between the internal borders of the rectus muscles that correspond to the area of diastasis, preserving the perforating arteries, veins, lymphatics, and nerves. Munhoz's postoperative Doppler ultrasound study demonstrated that 81.21% of the perforating vessels mapped in the preoperative period were preserved. This validates the hypothesis that this technique results in a lower percentage of complications from flap ischemia.

De Frene et al showed that it is possible to raise perforator flaps after liposuction of the donor sites; they performed breast reconstruction using perforator flaps in patients who had previously undergone abdomen liposuction.

The skin and rectus abdominis muscle are innervated by the anterior branches of the sixth to the twelfth intercostal nerves, which run along the abdominal perforating vessels. Many studies have shown that the loss of sensitivity is significant after classic abdominoplasty.

Preoperative Assessment

The surgeon evaluates the amount of excess abdominal skin and its flaccidity, noting the presence of any striae and their extent.

The thickness and volume of subcutaneous fat are estimated.

The rectus abdominis muscles are evaluated for diastasis.

The surgeon palpates for ventral, lumbar, or femoral hernias. Abdominal wall ultrasound is essential.

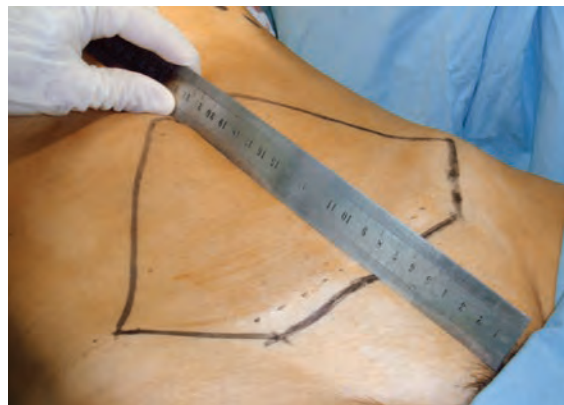
The presence of any scarring is recorded, as is a history of previous endoscopic procedures because of the risk of weakness in the abdominal aponeurosis.

A history of previous liposuction should raise a warning flag because of the likelihood of decreased flap mobility.

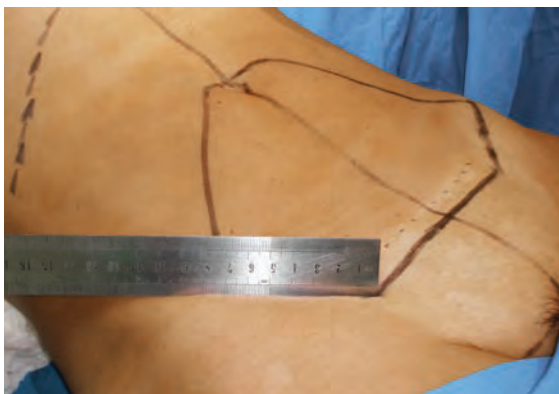
The surgeon should begin with a high suprapubic incision if there is any question whether a mini-lipoabdominoplasty or full lipoabdominoplasty is indicated.

Preoperative Planning

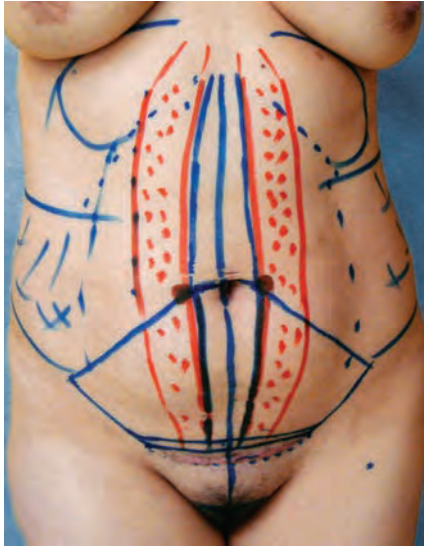
Marking



The abdomen is marked with the “bicycle handlebar” shape described by Baroudi and Ferreira. The horizontal suprapubic line is 12 to 14 cm long and 6 to 7 cm from the vulvar furcula.



Two oblique lines 6 to 8 cm long are drawn in the direction of the iliac crest to complete the incisional line. The areas that will be liposuctioned and from which the abdominal flap will be raised are marked. When appropriate, the dorsal region is also marked for liposuction.



For better orientation at the beginning of tunnel undermining, the rectus abdominis muscle diastasis is marked (shown here in another patient).

Surgical Steps in Lipoabdominoplasty

- | | |
|-------------------------------------|---|
| 1. Marking | 7. Removal of the infraumbilical strip |
| 2. Infiltration | 8. Plication of the rectus muscle |
| 3. Liposuction of the upper abdomen | 9. Omphaloplasty: star-shaped technique |
| 4. Liposuction of the lower abdomen | 10. Suturing of the layers |
| 5. Preservation of Scarpa's fascia | 11. Placement of drains |
| 6. Selective undermining | 12. Dressings |

Operative Technique

Infiltration



We use the tumescent technique, infiltrating the abdominal region with 1 to 1.5 L of saline solution with 1:500,000 of epinephrine.



84-1
Lipoabdominoplasty
with selective
undermining

Upper Abdomen Liposuction



So that liposuction can be performed safely, the patient is placed in a hyperextended position on the operating table. Liposuction begins on the supraumbilical region with a 3 or 4 mm cannula; the fat of the deep and superficial layers is removed, extending to the flank and reaching the submammary fold. The thickness of the fat is maintained at about 2.5 cm to avoid vascular impairment and contour deformities as in traditional liposuction.

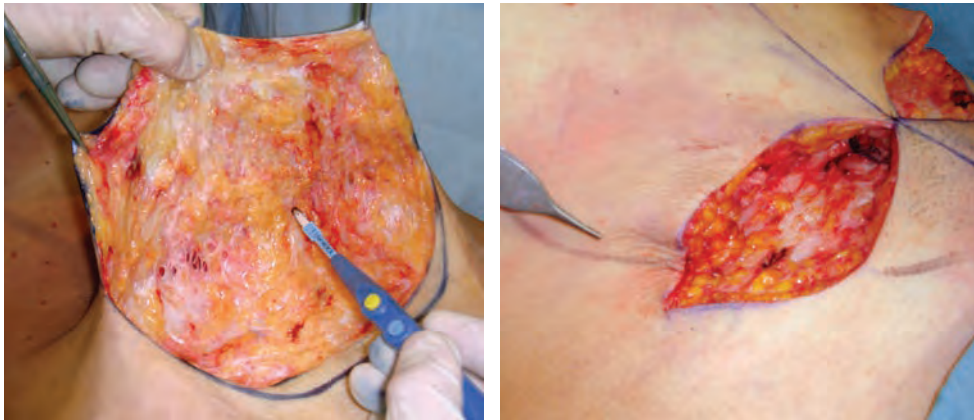
Lower Abdomen Liposuction



Scarpa's fascia is an important anatomic structure of the abdomen and should be preserved in the lipoabdominoplasty. So that the fascia can be seen and preserved, all of the superficial fat layer and part of the deep layer in the lower abdomen should be aspirated with a 6 mm cannula. After the surgeon evaluates the flap descent, the

umbilicus is isolated and the infraumbilical skin resected as in traditional abdominoplasty. If necessary, complementary open liposuction can be performed to remove fat above and below the Scarpa's fascia and create a homogeneous surface to accommodate the superior flap, which becomes thinner in its descent.

Preservation of Scarpa's Fascia



Preservation of Scarpa's fascia is important for a number of reasons: to reduce bleeding because the inferior perforating vessels are spared; to provide homogeneous support for the upper flap, which becomes thinner in its descent; it causes the contention of scars laterally offering better adherence between the flap and the deep layers.

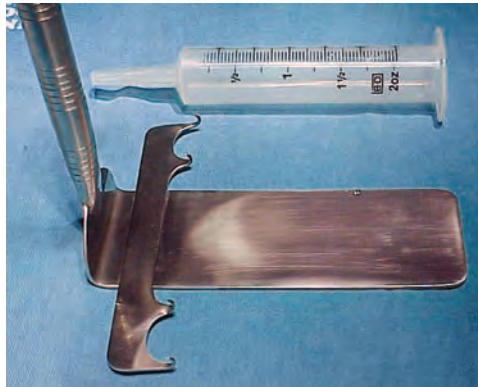
Selective Undermining

The preservation of the abdominal perforating vessels and nerves during the procedure is the second principle of lipoabdominoplasty.



Selective undermining is performed in the median line of the upper abdomen between the internal edges of the rectus abdominis muscles. Undermining laterally beyond this area may damage the perforating vessels, increasing the potential for morbidity and abdominal flap necrosis.

Tunnel undermining may reach the xyphoid process, depending on the need for rectus muscle plication. The tunnel width may vary with the extent of diastasis, because the perforating vessels follow the muscle's separation. The wider the diastasis, the wider the tunnel. The perforating vessels are not damaged if undermining does not extend laterally beyond the internal edges of the rectus abdominis muscles.



The Saldanha retractor can be used to enlarge the surgical site, thus improving visualization of the anatomic structures, which facilitates muscle plication and helps to prevent trauma to the edge of the flap.

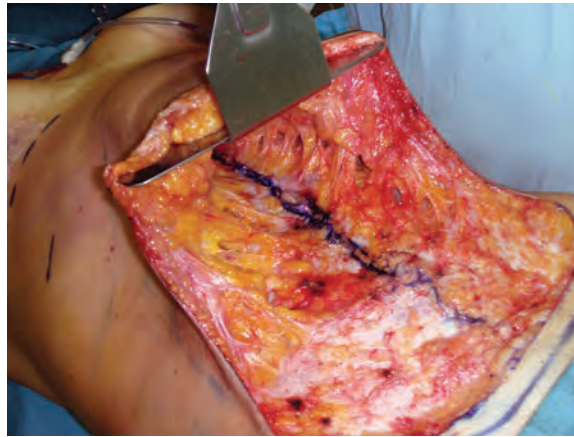
The dislocation caused by the liposuction cannula facilitates descent of the flap. Release of the trabecular ligament (as described by de Souza Pinto) in the upper abdomen should be performed to extend the transposition of the abdominal flap to the pubic region, preventing excessive tension on the suture.

Removal of the Infraumbilical Strip



In the median infraumbilical line, a vertical strip that contains Scarpa's fascia and adipose tissue should be removed to expose the internal edges of the rectus abdominis muscles and to facilitate plication from the xyphoid process to the pubis.

Resection of Excess Skin



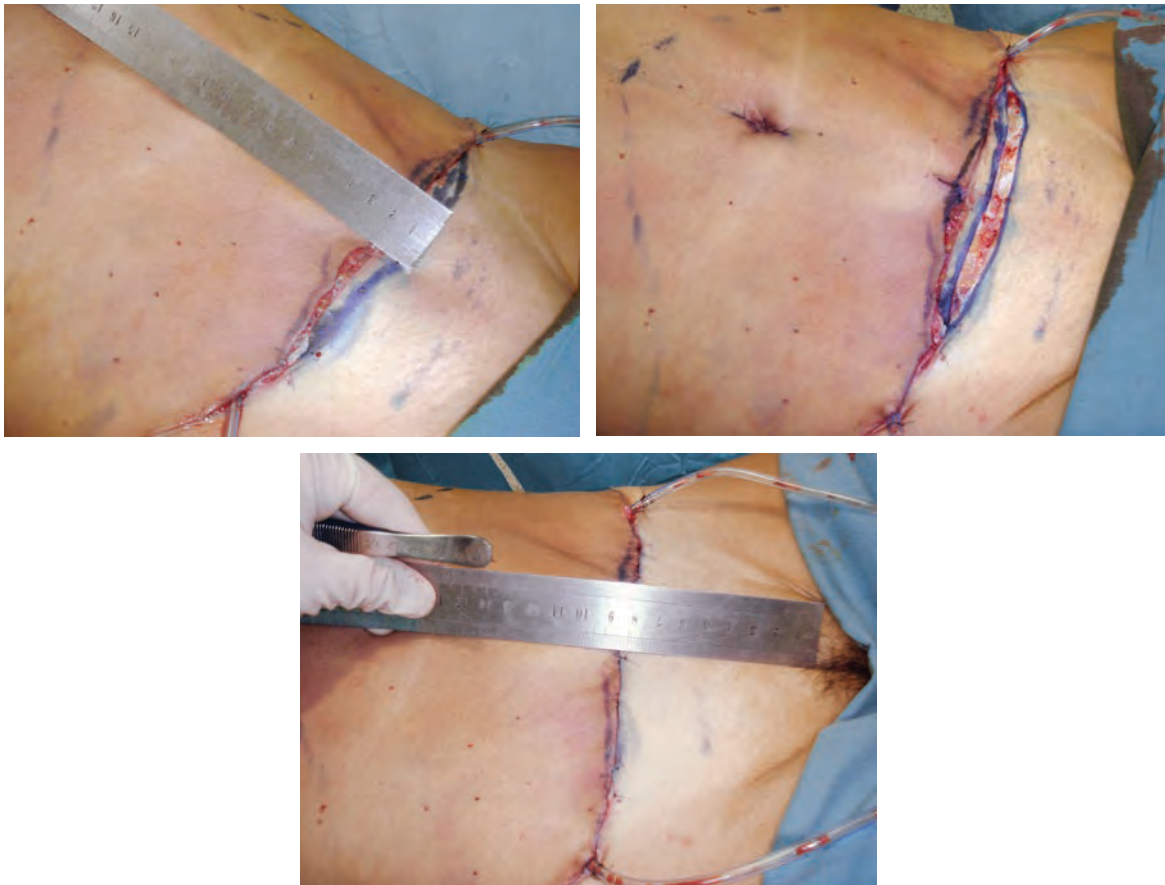
All excess skin of the lower abdomen should be removed after making certain that the flap easily transposes to the pubic symphysis.

Omphaloplasty



The star-shaped omphaloplasty design is marked on the abdominal wall and a lozenge shape is created on the umbilical pedicle. The cardinal points of the umbilical pedicle are sutured to the cardinal points of the cruciform incision of the abdominal wall. The scar results in a continuous Z-plasty that offers little possibility of retraction.

Suture of the Layers



The surgical site is sutured in two layers, with 3-0 Monocryl on the deep layer and 4-0 Monocryl on the subdermis. The skin is sutured with 5-0 mononylon separate stitches. At this point, the scar can be lowered by resecting a cutaneous strip (1 to 2 cm) without risk of harming the flap or causing too much tension on the sutures.



A continuous-aspiration drain is placed for 1 or 2 days.

Dressing

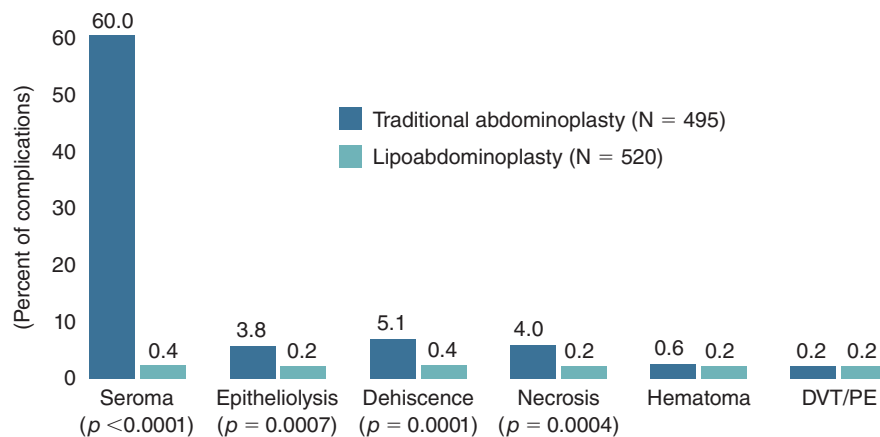
The wound is covered with Micropore surgical tape, and the dressing is placed while the patient is still on the operating table.

Postoperative Care

The aspiration drain is removed 1 or 2 days after surgery. The dressing is changed on the third and eighth postoperative days when the horizontal sutures are removed. The sutures on the umbilicus are removed on the twelfth postoperative day. A medium compression belt is used until the twentieth postoperative day.

The recovery time for patients who undergo lipoabdominoplasty is midway between that of abdominoplasty and liposuction because it is less invasive, causes little vascular and nerve injury, and presents a discrete dead space. Preserving Scarpa's fascia decreases the dead space, reducing the possibility of seroma formation. These factors result in lower morbidity and enable the patient to return quickly to social and professional activities.

Problems and Complications



DVT, Deep venous thrombosis; PE, pulmonary embolism.

If the surgical steps described are followed systematically, the potential for complications is reduced. The graph above provides data on our 9-year experience with lipoabdominoplasty with selective undermining, comparing the complication rate with that of the traditional abdominoplasties performed. The reduced incidence of seroma, epitheliolysis, dehiscence, and necrosis is statistically significant. Although the reduced incidence of hematoma and deep venous thrombosis/pulmonary embolism remained the same, we cannot consider them statistically because of the small number of cases in which these complications occurred.

The percentage of surgical revisions decreased from 20% to 10% when we began to perform lipoabdominoplasty-only procedures, remaining so for 8 years. The table shows the percentage of surgical revisions required in this lipoabdominoplasty series. The cases of surgical revision required because of complementary liposuction and postoperative skin flaccidity (3.2%) correspond to patients who had undergone previous bariatric surgery and had a great amount of flaccidity. There was a need for scar revision in 6%, which represents 63% of surgical revisions.

Surgical Revision in Lipoabdominoplasty

	2000	2001	2002	2003	2004	2005	2006	2007	2008
Primary Cases (N = 520)	15	45	55	64	62	65	68	71	75
Scars	3	5	4	3	4	3	3	4	2
Skin flaccidity	—	—	1	2	1	1	1	2	—
Insufficient liposuction	—	—	1	2	2	1	1	1	1
Excessive liposuction	—	—	—	—	—	—	—	—	—
Infection	—	—	—	—	—	—	—	—	—
Other causes	—	—	—	—	1	—	—	—	—
TOTAL	3	5	6	7	8	5	5	7	3
Percentage	20	11	11	11	13	8	7	10	4

Pitfalls

Initially, the surgery requires more than 30 minutes.

The procedure should not be performed on patients with a large hernia or even-tration.

A short learning curve is required to assimilate the new procedure.

Outcomes

The learning curve for this technique is short, because the plastic surgeon performs both liposuction and abdominoplasty. As the surgeon gains familiarity with this technique, he or she can produce a harmonious body contour with a shorter postoperative recovery time. A safe liposuction technique in abdominal and costal areas leads to excellent results in almost all cases. In lipoabdominoplasty, preserving Scarpa's fascia reduces the length of the suprapubic scar, compared with the initial marking, in 30% of the cases. This occurs because Scarpa's fascia has a direct relationship with the skin. This can be observed when it is reapproximated, after the removal of the vertical infraumbilical strip. Complication rates are decreased, the aesthetic results are satisfactory, there is less postoperative morbidity, and the need for late surgical revision is reduced.

Results

The combination of liposuction and abdominoplasty at the same surgical setting improves the results, providing greater reduction in abdominal volume and better body contour. In addition, patients' satisfaction with their abdominal rejuvenation results in a decreased need for surgical revisions—and an increased demand for such procedures as they share news of their experience with others.

The table compares the incidence of complications in traditional abdominoplasty to that of lipoabdominoplasty in the 1015 patients in our series who underwent abdominal surgery and were followed by the senior author (O.R.S.) from 1979 to 2008.

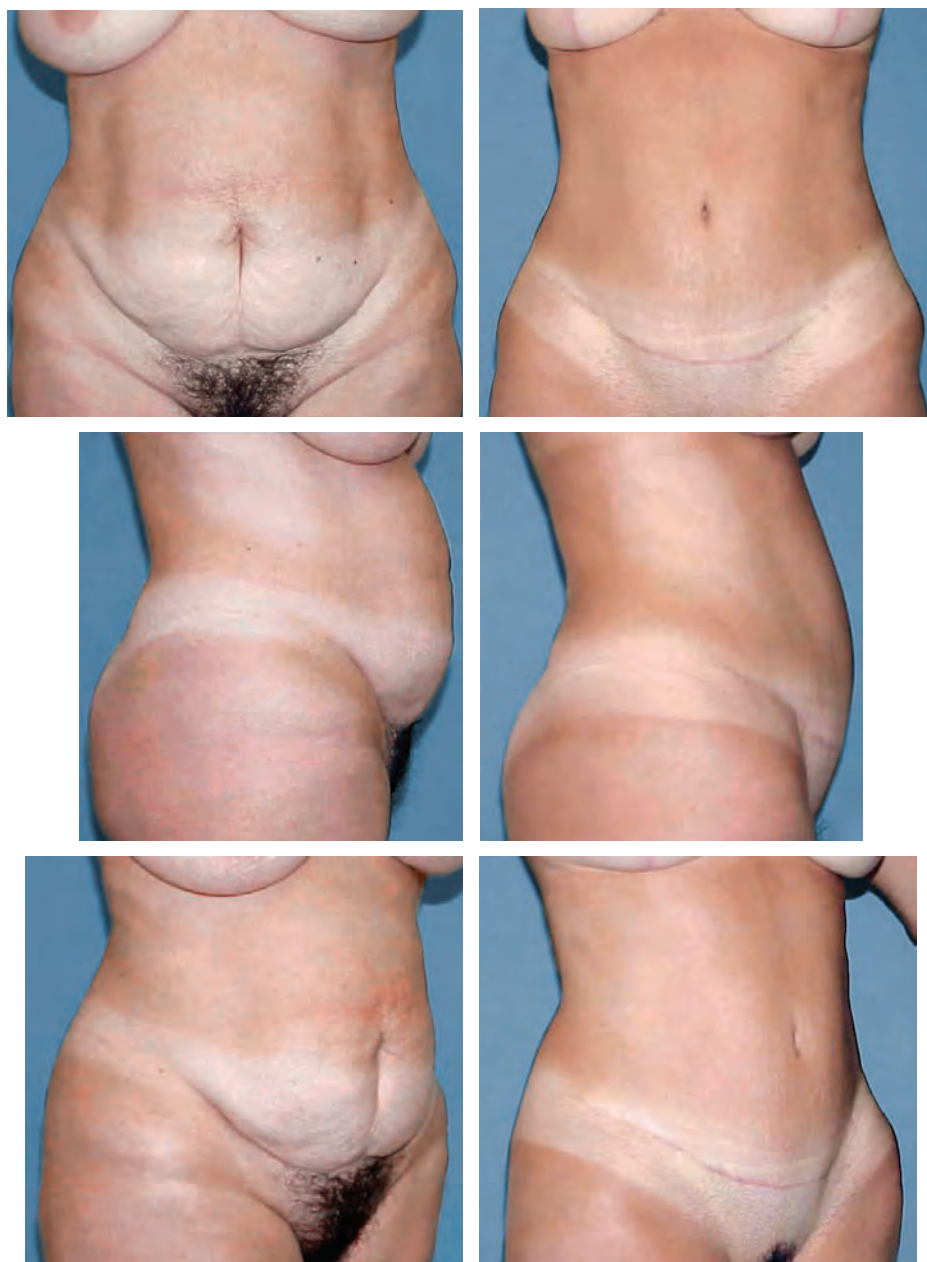
Total Abdominal Surgeries, 1979-2008

	1979- 1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	TOTAL
Traditional abdominoplasty	469	25	—	—	—	—	—	—	1	—	495
Lipoabdominoplasty	—	15	45	55	64	62	65	68	71	75	520
TOTAL											1015

From 1979 to 2000 the senior author performed 494 traditional abdominoplasties. In 2007 one traditional abdominoplasty was performed in a case of skin excess in a postbariatric patient, bringing the total to 495 traditional abdominoplasties. In 2000 the senior author began to develop lipoabdominoplasty, performing 520 procedures through 2008. In the first 9 years of implementing this technique, there was a 100% increase in abdominal surgeries by the senior author (before 2000, the average was 35 patients per year; from 2004 to 2008, the average was 75 patients per year). There was a 50% reduction in the need for surgical revisions during the same period.

We observed a decrease in final scar extension when compared with the initial marking in 30% of patients. The initial line always measured 28 cm in length: 12 cm horizontal and 8 cm oblique on each side. In the 520 patients, 156 had a final scar of 25 to 27 cm, with an average reduction of 2 cm from the initial marking. This is a result of the traction of Scarpa's fascia on the skin.

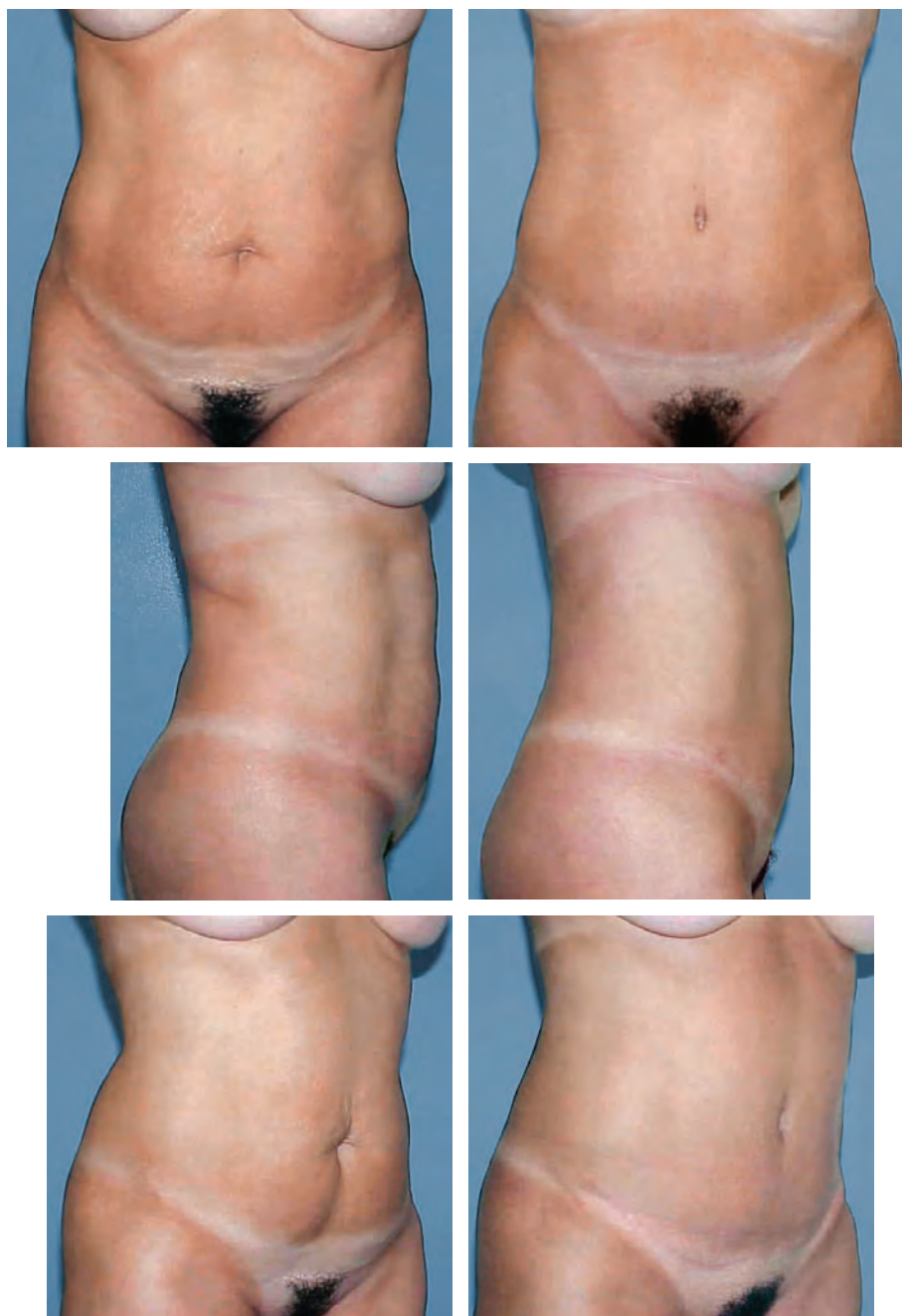
The graceful shape of the umbilical scar has been deemed good to excellent by the team and the patients.



This 42-year-old patient, who had two children, was slightly overweight, with redundant abdominal skin, an abdominal bulge, and stretch marks. She is shown 6 months postoperatively with a lower abdominal scar and a much better contour as a result of liposuction.



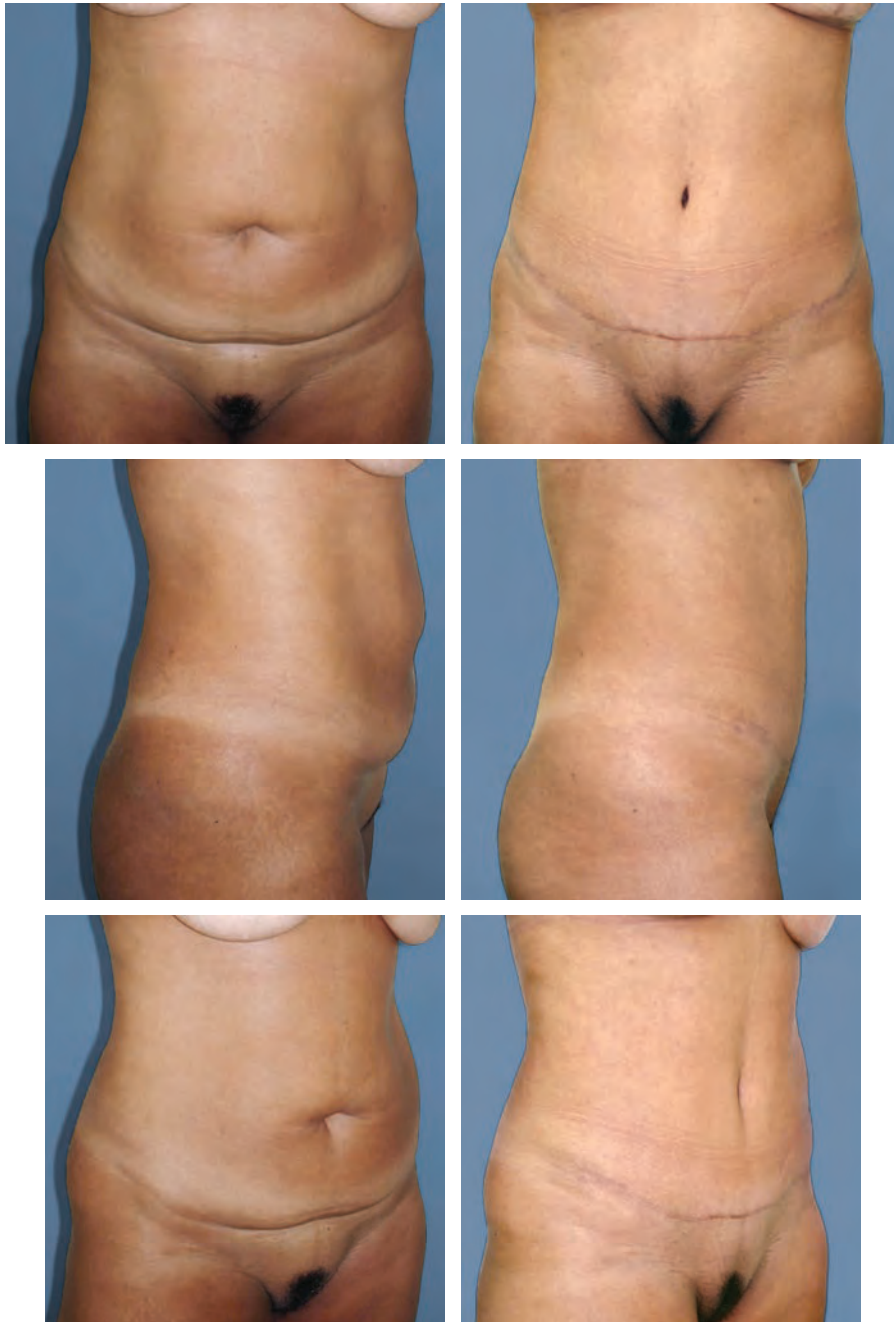
This 39-year-old woman, who had one child, had flaccid skin and moderate lipodystrophy, which made her appear older. The rejuvenating effect of lipoabdominoplasty, seen 12 months postoperatively, has provided a contour more appropriate to her age.



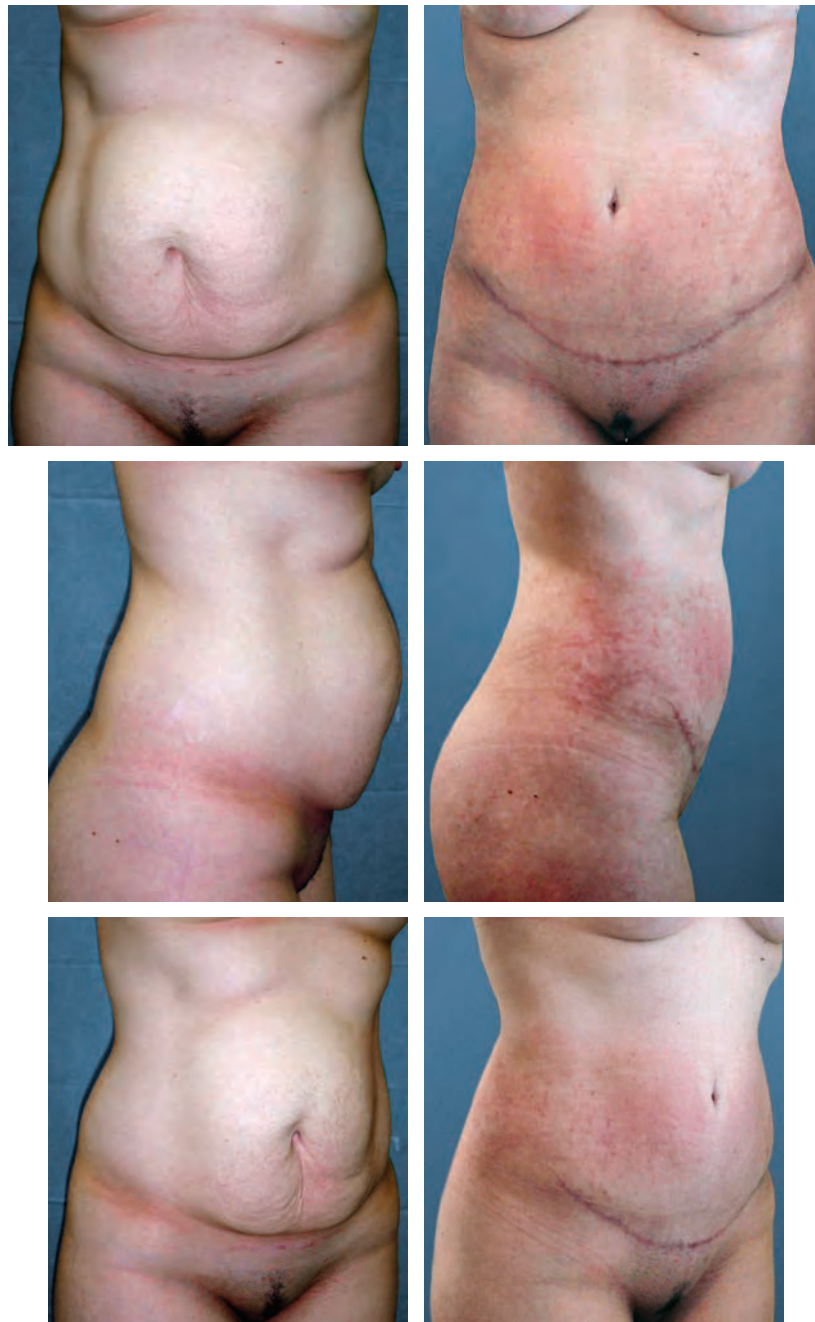
This 30-year-old patient had one child. Despite her relative youth, she had a very disharmonious abdominal shape. She is seen 10 months postoperatively; lipoabdominoplasty has produced a more harmonious contour with a natural-looking profile and umbilical scar.



Similar to the previous patient, this 28-year-old woman, with one child, presented with an unattractive abdominal contour. Six months postoperatively, the improved contour is evident. The lower scar accommodated the patient's desire to wear bikinis.



This 50-year-old woman, who had two children, desired a more harmonious body contour. She had redundant abdominal skin and a horizontal umbilical shape that bothered her. Her postoperative photos, 10 months after the procedure, reveal a much-improved shape with a uniform profile that pleases the patient.



This 29-year-old patient, after having two children, requested a better abdominal contour. She had abdominal lipodystrophy, stretch marks, a significant diastasis, protrusion, and a noticeable umbilical diversion. Three months postoperatively, the excellent rejuvenative effects of the procedure are already evident, including a new, higher, centered position of the navel.

Concluding Thoughts

The initial objective of lipoabdominoplasty was to reduce the complication rates in abdominoplasty patients. As the technique evolved, other advantages became apparent. Aesthetic results were improved, because reduced abdominal measures provided better abdominal contour. Recovery of suprapubic sensitivity was faster, because the nerves were preserved. This technique represents an important advance in plastic surgery, improving patient safety. The adoption of lipoabdominoplasty is easy for surgeons who are accustomed to performing both liposuction and abdominoplasty. Patient satisfaction increases, and the need for surgical revisions decreases, leading to a greater demand for the technique.

Clinical Caveats

With lipoabdominoplasty, a better body contour is achieved because liposuction decreases the abdominal measurement.

Morbidity is decreased because the perforating vessels are preserved and there is no dead space.

The incidence of complications is lower with this procedure.

Lipoabdominoplasty is easy to perform because surgeons are already accustomed to liposuction and classic abdominoplasty.

The abdomen is rejuvenated with a more natural profile.

Suprapubic sensitivity is preserved.

Postoperative recovery is faster, and the scar is shorter.

Vibroliposuction or ultrasound liposuction can be used.

The procedure is safe for smokers, obese patients, and postbariatric patients or those who have undergone reversal abdominoplasty.

Surgeons should perform their first lipoabdominoplasties in patients with excess skin flaccidity and extensive fat volume.

Ultrasonography of the abdominal wall should always be performed to identify any asymptomatic hernias and to prevent abdominal perforation by the cannula.

This technique should not be performed in patients with large hernias and eventrations, because bleeding can increase liposuction time. Patients who have had previous laparoscopic procedures also have this risk.

Extra care must be taken in patients who have had previous liposuction and in patients with abdominal scars that suggest previous surgeries.

A high suprapubic incision is recommended if there is any question whether a mini-lipoabdominoplasty or full lipoabdominoplasty is indicated.

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In this paper the author describes superficial liposuction and explains the benefits of this technique, including flap mobilization in lipoabdominoplasty.

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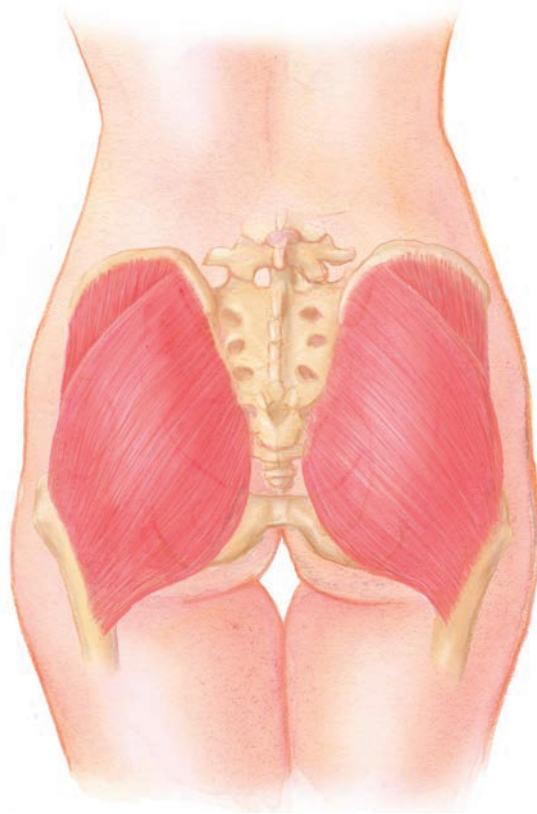
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CHAPTER 85



Gluteal Augmentation

CONSTANTINO G. MENDIETA

The ability to augment the buttock has existed since 1969, when Bartels et al first described the reconstruction of a unilateral gluteal agenesis by placing a Cronin breast silicone implant above the gluteus muscle. Over subsequent years, other authors described similar reconstructive procedures for the treatment of asymmetry and gluteal depressions. However, it was not until 1973 that the first successful augmentation for cosmetic purposes was published by Cocke and Ricketson from Nashville, Tennessee.

Despite its U.S. origins, gluteal augmentation did not develop a following in the United States, and it was the Latin-American plastic surgeons who popularized and refined the technique as a cosmetic procedure. In 1981 González-Ulloa developed an interest in gluteal augmentation and placed gluteal implants above the muscle through bilateral infragluteal crease incisions (at the bottom of the buttock). He was among the first to develop an implant line that was specifically designed for the buttock, marking the birth of the almond-shaped gluteal implant. Until then, breast implants had been used for buttock augmentation. González-Ulloa published his 10-year experience in 1991 describing his technique as well as a new incision approach, the bilateral intergluteal incision (moving the incision from the bottom of the buttock to the inside of the midline gluteal crease).

Until that time, only subcutaneous buttock augmentation had been described, but in 1984 Robles et al of Argentina published a landmark article in which they described the intramuscular technique through a central single intergluteal incision. Robles also introduced his own line of round gluteal implants, making the choices for gluteal implants more intriguing.

Unfortunately, gluteal augmentation as a procedure lay dormant for the next 10 years, with very few advancements or publications until 1994, when Vergara published his experience with an anatomic implant that he developed for the intramuscular plane. Then in 2000 de la Peña published his work describing a new surgical plane and described the new implant he designed specifically for the subfascial plane.

Gluteal augmentation was now developing apace: we had different incision locations, different implants to choose from, and different planes of placement. However, despite its 30-year history, the procedure remained in its infancy and had not flourished as other procedures had, such as breast augmentation, face lifts, and body contouring, about which many articles had been written. Physicians' interest remained low, since they remained unfamiliar with the anatomy, they perceived a high complication rate, and there were few articles in the literature.

This all began to change in the early 2000s as public interest began to peak with the appearance of Jennifer Lopez, Serena Williams, and other personalities who accentuated and flaunted their curves. As patients began to inquire what could be done to give them more-curvaceous buttocks, physicians' interest began to increase—yet the vast majority remained hesitant because the operative techniques were not well un-

derstood. Patient selection remained a mystery, and no evaluation system existed to universalize the approach. Consequently, surgeons continued to avoid performing procedures on this area of the anatomy.

In 2003 I published my experience with intramuscular implants in which patients described a tremendously high satisfaction rate, but clinically there was a 30% wound dehiscence rate. Up to this point, no article had addressed complications, complication rates, patient selection, implant selection, plane selection, and so on. My focus turned from simply trying to master the technique to trying to decrease the complication rates and make the procedure safer and more appealing to surgeons.

The procedure has evolved significantly over the past 8 years. In this chapter I will focus on how to augment the buttocks safely with implants or with fat. It includes guidelines for patient selection, implant selection, incision location, and surgical plane selection. In addition, information is provided on identifying patients who are at a greater risk for developing complications. Mastery of this procedure requires both knowledge of relevant clinical anatomy and familiarity with the properties of the various implants available to the surgeon.

Patient Profiles: Who Is a Candidate for Gluteal Augmentation?

Gluteal augmentation is not just about making the buttock bigger, but rather accentuating, contouring, and reshaping. The focus becomes volume redistribution, shifting volume from an unattractive zone to a more desirable curvaceous position.



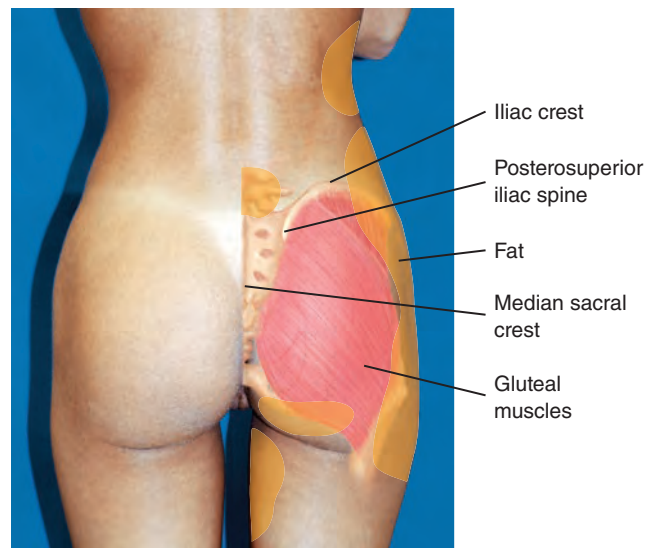
Preoperative and 5-month postoperative views after 1100 cc of fat grafting to the buttocks

With this perspective, even a full-figured woman becomes a candidate, because on closer examination, the large buttock has poorly distributed fat with deficient volume in pertinent aesthetic zones. Liposuction was also performed on this patient's back, waist, and abdomen.

The question is no longer who is a candidate for buttock surgery, but rather what augmentation procedure is best for a particular patient. Liposuction is used for reshaping, and fat grafting is used for fat redistribution, but which augmentation method should be selected becomes our first challenge.

Pertinent Anatomy

A thorough grounding in anatomy and aesthetics is essential for body contouring. We can all recognize a pretty buttock, but translating this aesthetic into surgical results becomes a challenge. Millard emphasized in his principles that to be successful in our surgical design, approach, and ultimate results, we must first understand the beautiful and ideal normal. This is particularly true when dealing with a massive-weight-loss patient, where normal anatomy and proportions may have become grossly distorted.

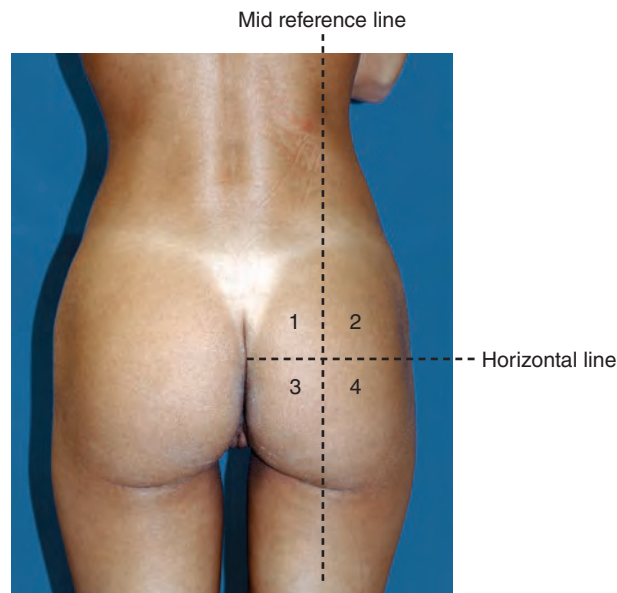


The gluteus maximus muscle originates primarily along the lateral margin of the sacrum and, to a lesser extent, from the coccyx and sacrotuberous ligament. It continues in an upward curvilinear direction to the posterior iliac spine (identified as bilateral dimples in the parasacral zone). Traditional teachings tell us that the muscle attaches all along the crest, but in reality it only follows the crest for a quarter to a third of its distance—up to the posterior superior iliac spine. From this point it follows a ridge inferior to the crest. The distance from this ridge attachment to the palpable superior crest is variable among patients. The gluteus maximus inserts into the iliotibial tract, and, to a lesser degree, the greater trochanter. The gluteus medius originates along a ridge in the posterior superior iliac crest and attaches in a manner similar to the gluteus maximus.

The superior aspect of the origin of the gluteus maximus plays an important role in defining the ideal buttock. However, buttock aesthetics are not solely dependent on the gluteal muscles. The overall shape of the buttocks is also influenced by bony pelvic anatomy, fat distribution, and, to a lesser degree, skin, if there is laxity or overhang, as is the case in massive-weight-loss patients. Without a doubt, the most significant contributor to shape is fat. Excess fat in the sacrum, upper buttock, flank, and outer legs will distort shape and contour.

The Ideal Buttock

To evaluate the buttock, it is helpful to divide it into quadrants by drawing an imaginary line down the center of the buttock. The ideal buttock has equal volumes on either side of this line and has the shape of a football, but with a slightly wider base.

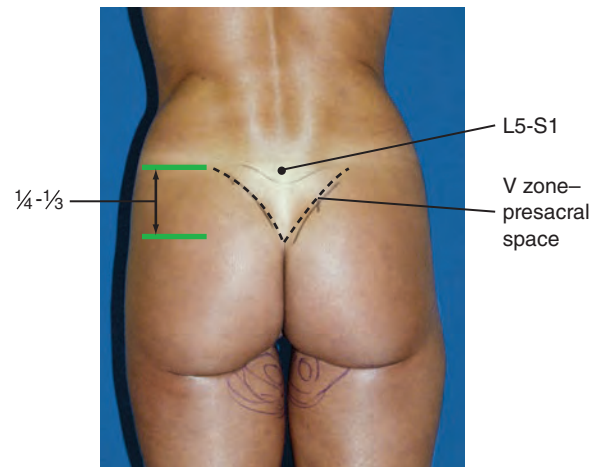


To assess volume distribution, a horizontal midbuttock line is added to divide the buttocks into four quadrants. The ideal buttock also has equal volumes above and below this horizontal line. In determining the best procedure for a particular patient, the surgeon evaluates all four quadrants as either sufficient or deficient.

There are three other zones surrounding the buttock that are important in this evaluation: the upper inner gluteal–sacral junction, the lower inner gluteal fold–leg junction, and the midlateral gluteal–hip junction.

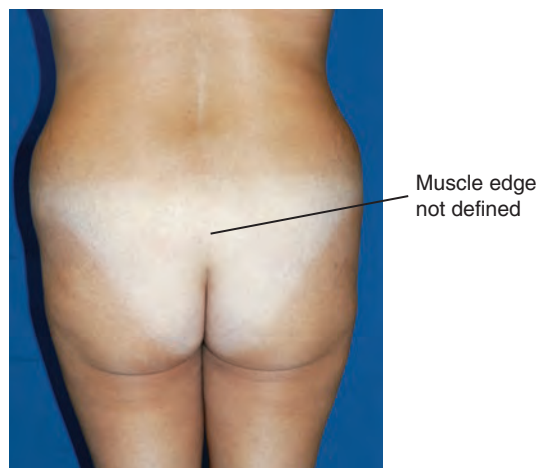
Upper Inner Gluteal–Sacral Junction: Ideal Presacral Space Shape

The inner gluteal–sacral space should be well defined so that a V shape is apparent; this lower presacral space is appropriately called the *V zone*. As the V zone becomes more visible, the buttock has greater aesthetic appeal.



Solid line marks end of intergluteal crease line; dashed line marks end of upper muscle edge; notice V zone with visible muscle fullness

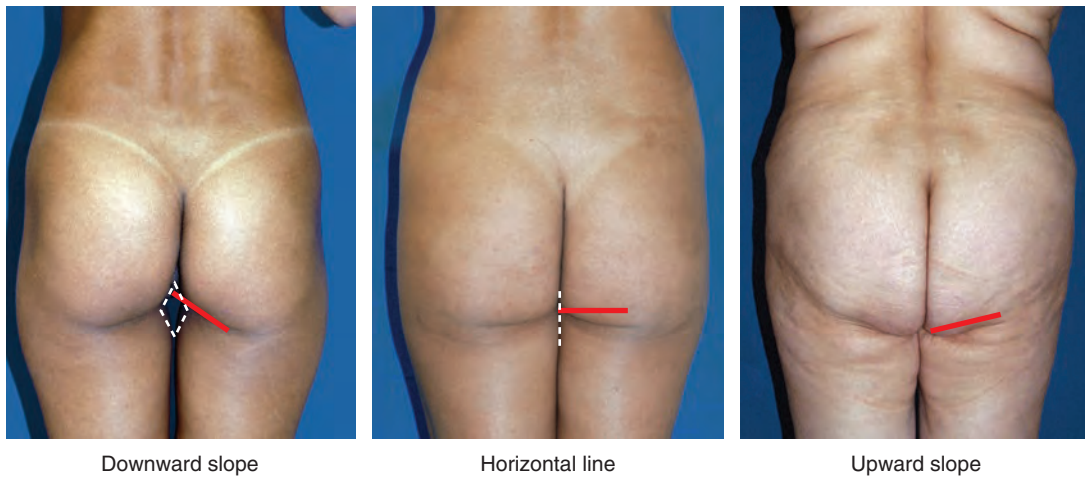
In the ideal buttock, the edge of the gluteal muscles should be well defined and have a semicircular upward turn. The superior edge should culminate a quarter to a third above the intergluteal crease line.



If this space is not well defined because of lack of muscle volume and excess fat in the V zone, the buttock becomes blunt and appears flat, especially on lateral view.

Lower Inner Gluteal Fold–Leg Junction

To describe this relationship, the intergluteal crease will be referred to as the *midline*. The upper aspect of the crease is easily identified; however, the inferior aspect is defined at the point where the buttock begins to separate from this midline.



In the images above, the red lines indicate how the fullness increases at the lower inner gluteal fold. Notice how the diamond-shaped zone turns from a 45-degree angle into a straight line.

In the ideal buttock, this point of separation from the midline occurs at about the bottom two thirds to three fourths of the muscle. The separation widens until it meets the inner leg junction. At this point the lower gluteal fold has a 45-degree takeoff from the center intergluteal crease line and the inner gluteal fold–leg junction should create a diamond-shaped space. This is a key point in gluteal aesthetics. As the lower inner gluteal fold and inner leg become fuller, the 45-degree sloping line is changed to a more horizontal position, which causes the diamond-shaped space to turn into a straight line, losing its aesthetic appeal. As the fullness increases, it develops an inverse relationship, creating an upward slope (negative angle). Thus the slant of the inner gluteal fold has three possible orientations: a downward 45-degree slope with the inferior gluteal fold ending at the midbuttock or slightly beyond (as seen in the ideal buttock), a horizontal line, or an upward inverse slope.



Improvement of this zone will depend on the severity of the fullness.

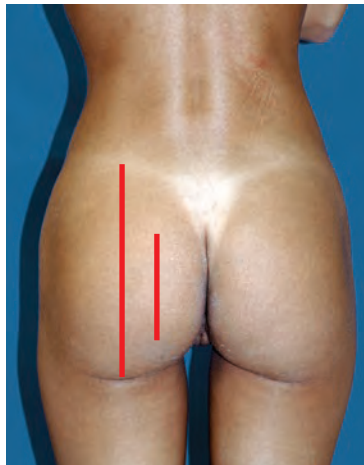
Lateral Midbuttock–Hip Contour



In the aesthetic buttock, the lateral midbuttock has no depression. In actuality, this zone may exhibit varying degrees of depression, ranging from no depression to mild and moderate degrees of depression to severe depression.

With volume well established and these three zones evaluated, the next questions become: Is there an ideal gluteal crease length? How important is this to gluteal aesthetics? And what relationship does this have to the gluteus muscle or any of the surrounding areas?

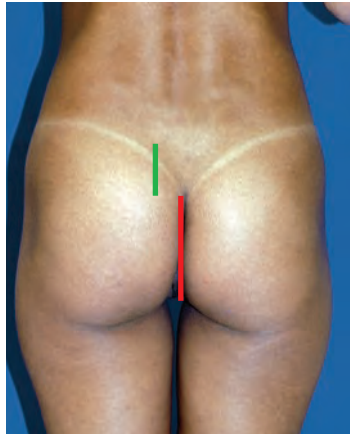
Ideal Interogluteal Crease Length



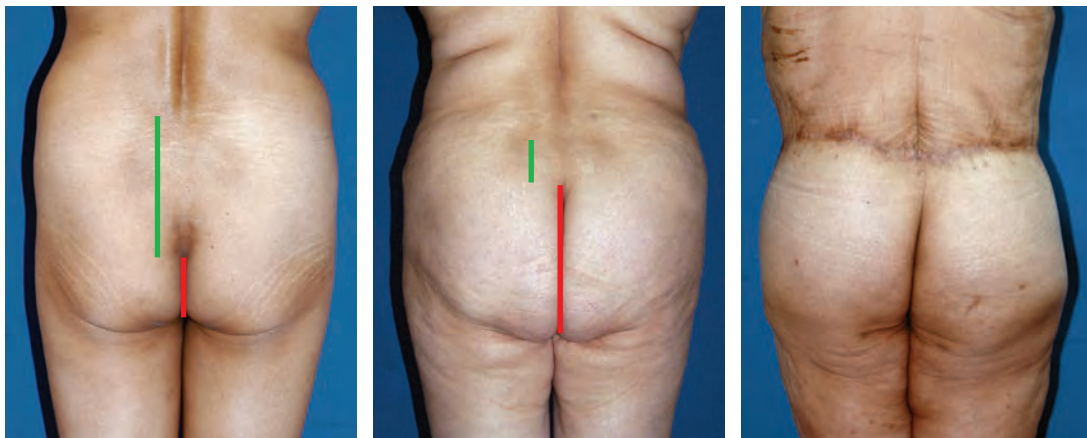
The interogluteal crease length is usually half the length of the gluteal muscle, but it is centered on the gluteus so that a quarter to a third of the gluteal volume is above the highest crease point and a quarter to a third below the termination point—the takeoff point where the lower inner gluteal fold deviates from the interogluteal crease line.

Ideal Presacral to Intergluteal Crease Length Relationship

The presacral space extends from the midline dimple of the lower back (L5/sacral junction) to the superior aspect of the intergluteal crease. It plays an important role in gluteal aesthetics.

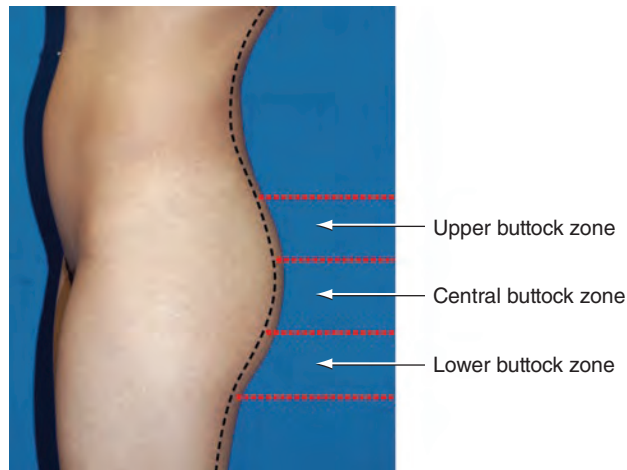


The length of the entire presacral space (*green line*) should be shorter than the intergluteal crease length (*red line*). Ideally, the presacral space should be a half to a quarter the length of the intergluteal crease.

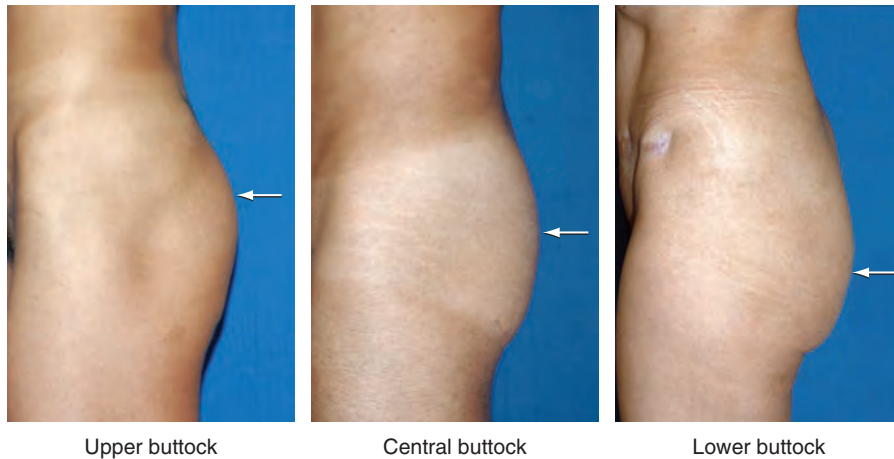


If the presacral space is twice as long as the intergluteal crease length (2:1) (*left*), the crease appears extremely short, giving the illusion of a truncated, flat, underdeveloped buttock. If the presacral space length is less than a quarter of the intergluteal crease length and there is excess fullness in the lower inner gluteal zone, this gives the crease an excessively long, alien appearance (*center*). However, even with this relationship, if the buttocks have adequate volume, especially in the lower third, the overall appearance may be adequate (*right*).

Lateral View Aesthetics

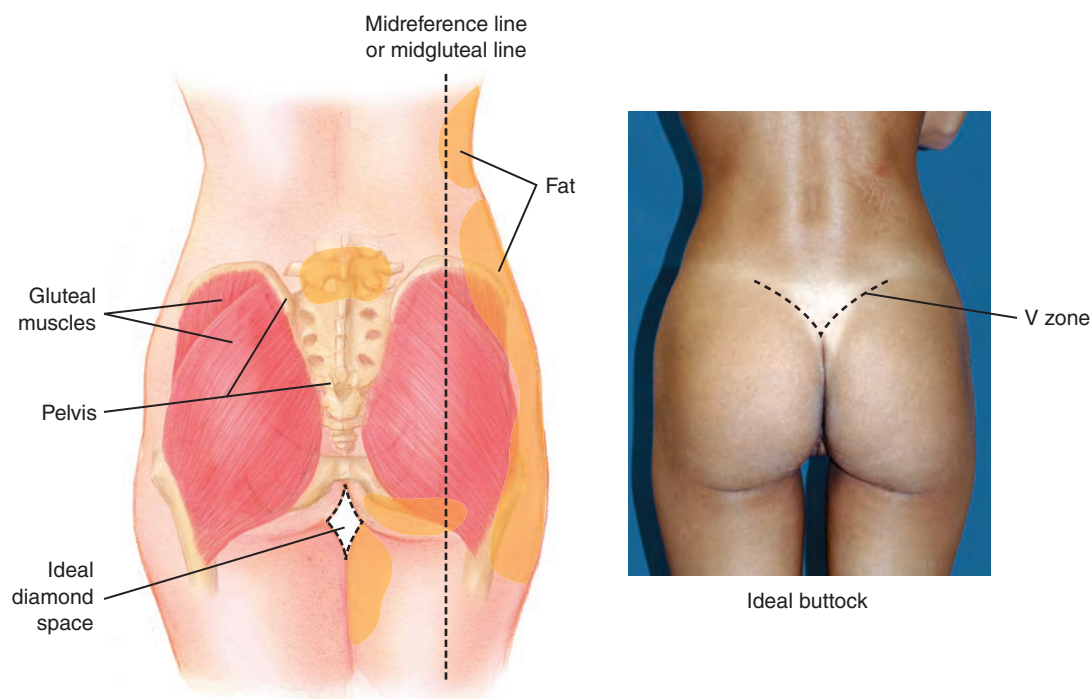


On lateral view, the presacral area should have a nice sweeping curve that has a lazy-S shape (from the back to the bottom of the gluteus). Most of the gluteal volume is central and has equal distribution in the upper and lower gluteal zones, providing a nice C-shaped curve. It has been suggested that the peak of the central mound should be at the level of the pubic bone.



Determining where most of the volume lies (upper, central, or lower buttock) is important in selecting the best procedure for buttock augmentation.

Summary of Key Anatomic and Aesthetic Concepts

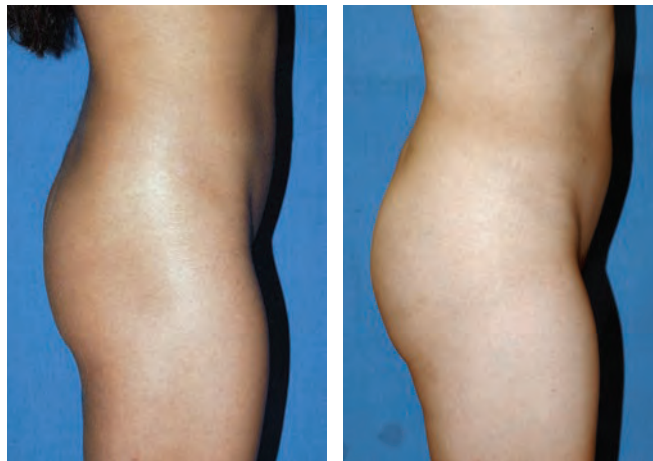


One can now easily see that the upper aesthetic unit of the gluteus follows its origin, beginning at the midsacral line, continuing as a semicircular line that connects to the posterior iliac spine (identified as bilateral divots in the parasacral zone), and peaking at 2 to 3 cm above this point. The ideal crease is centered on the gluteus muscle and is half the length of the muscle. The length of the presacral space should be shorter than the intergluteal crease length. In a well-developed buttock with very little lower presacral fat, a visible V zone is apparent that further accentuates the upper inner muscle anatomy; the muscle has a football shape, with equal volumes in all four quadrants. The gluteal unit is marked superiorly by its attachment to the iliac ridge (easily palpated) and inferiorly by the inferior gluteal crease. If incisions are created that fall below the superior insertion point or mark, the shape is distorted. Without a doubt, the most important contributor to gluteal aesthetics is the volume of distribution in all four quadrants. When this volume is adequate, all other aesthetic points can be overlooked and still produce an attractive buttock.

The other key contributor to gluteal aesthetics is the inner gluteal–leg junction. Inferior gluteal aesthetics is defined by a diamond shape at the intergluteal/leg junction. The medial buttock cheeks have a 45-degree takeoff from the intergluteal line and flow into the inferior gluteal crease, which terminates at or just beyond the mid-buttock line. On lateral view there is an S-sweep curve from the lower back as it flows into the buttock, and most of the gluteal volume is located in the central zone.

Clinical Decision-Making: Implants Versus Fat

As I noted earlier, my initial implant complication rates for buttock augmentation were published in 2003 in which I had identified a wound dehiscence rate of 30%, with an implant exposure and infection rate of 2% to 3%. However, in this series, by far the most frequent patient complaint was that the augmentation was “not big enough” (see below), and patients demanded larger volumes.



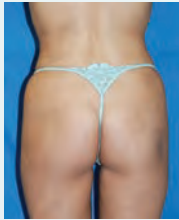
This patient is shown preoperatively and 2 years after intramuscular medium round implants were placed. The implant augmentation shows minimal difference.

In trying to fulfill patients' expectations, larger implants were used; however, complication rates soared, with wound dehiscence rates increasing to 40% to 50% and implant exposure rates rising as high as 30%. This was unacceptable, making it very clear that not everyone was a candidate for implant gluteal augmentation. But then, who was?

Through a new retrospective review of 150 intramuscular cases, we noted these factors: most of the dehiscence and implant exposures occurred in large patients or patients seeking large augmentations. While at face value this observation seems obvious, it must be remembered that no guidelines or parameters existed for gluteal augmentation. Therefore the question became more complex: What patient is too large? What implant is too big? What is the threshold? To help answer these questions, we evaluated patients based on body frame size and the degree of muscle tension at closure.

To assess body size, patients were divided into four groups: those with small, medium, large, and extra-large frames. Muscle tension was categorized as either having tension or no tension at closure. Implant exposure and wound dehiscence were compared. The results are shown in the table.

Wound Dehiscence and Implant Exposure by Body Frame in 150 Patients

Body Frame	Wound Dehiscence (%)	Implant Exposure Based on Muscle Tension at Closure (%)	
		No Tension	Tension
Small frame 	12*	1-2	12
Medium frame 	30†	3-4	12
Large frame 	40	10	30
Extra-large frame 	80	30	60

*Single midline intergluteal incision.

†Two separate parallel intergluteal incisions 2 cm apart.

Analysis of Implant and Fat Options

Before 2003, when patients presented for gluteal augmentation, implants were my preferred method; 90% of the augmentations were performed with implants and only 10% with fat injections. My preferred method of augmentation today is autologous fat grafting, because this method completely eliminates all the implant-related complications (wound dehiscence, implant exposure, capsular contracture, seroma, implant rotation, extrusion, and so on). Implants are used only in patients who do not have enough fat for a significant clinical augmentation (small-framed individuals) or borderline patients who cannot gain 4.5 to 9 kg (10 to 20 pounds) (some small- and medium-framed individuals). The complication rates in these patients, when using a double parallel intergluteal incision with a no tension on muscle closure, was only 2% to 3%. However, this means that the exact implant size to be used can only be determined intraoperatively with the use of sizers. If the patient desires a larger augmentation, we can perform simultaneous fat grafting to help enhance volume and shape, but the implant size depends on the patient's anatomy, meaning the degree of muscle and skin laxity.

Large- and extra-large-framed individuals are ideal for fat transfers, given that excess fat and implant complications are far too high in this group. The challenge therefore lies in medium-framed individuals, because they may or may not have an adequate amount of fat. It is in these patients that the surgeon's estimate of the fat that he or she feels can be extracted plays a crucial role. This estimated amount may vary significantly, depending on the surgeon's experience and comfort level. If the surgeon is in doubt, the patient can be asked to gain weight.

Thus the central question is: Just how much fat is needed to obtain a clinically significant buttock augmentation?

The Amount of Fat Needed for Augmentation

Every patient's desires and goals are different, and often the patient's anatomy may limit the amount of augmentation, depending on the laxity of the muscle and skin, but as a general rule gluteal augmentation with fat requires 400 to 1100 cc of good transferable fat per side. Obviously, the larger the patient, the larger the required volume; in a small-framed individual, 300 to 450 cc per side will be needed; in a medium-framed person, 450 to 850 cc per side; and in large- and the extra-large-framed patients, 750 to 1100 cc per side. The overall amount that can be placed will be influenced by the degree of muscle and skin laxity as well as the gluteal muscle dimensions.

The true amount of fat that will be available for transfer cannot be determined preoperatively; there are several variables that are only revealed during the surgical procedure. We must remember, not all of the aspirated fat is viable, and each patient has different fat characteristics: some fat is easily destroyed on suctioning, whereas other fat is very fibrous and resilient. Complicating the issue further, some patients have a bloodier aspirate, which can further limit the amount of fat we can extract safely. Other patients have such a strong propensity for leaving cannula track marks on the skin that it limits the aggressiveness of our suctioning, further limiting the amount of available fat. These variables cannot be predicted before surgery, which makes the quantity of transferable fat unpredictable. As a general rule, only half to a third of the total supernatant aspirate is acceptable for transfer, which means that 1000 to 4000 cc of total supernatant fat is needed to produce 600 to 2000 cc of good transferable fat. These volumes have been substantiated by others.

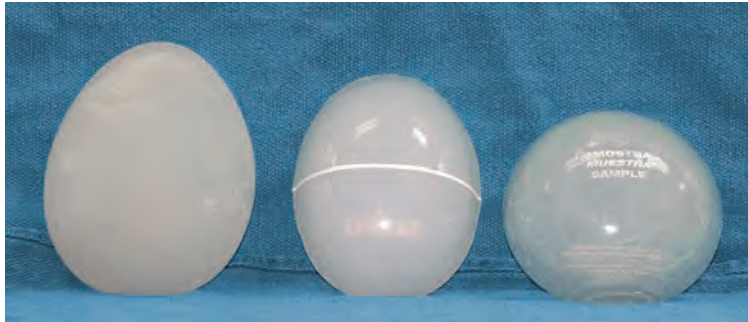
Clearly, some patients will not have that volume to spare. A small-framed individual, as stated before, is best augmented with implants or implants and fat. If in the surgeon's opinion a medium-framed individual does not have enough fat or the estimated volume is borderline, the patient is asked to gain 4.5 to 9 kg (10 to 20 pounds), depending on the surgeon's estimate of how much fat the patient will have available. Often the patient is brought back for a reevaluation after a 4.5 kg (10-pound) weight gain and is reassessed. If the available volume is still in doubt, the patient is asked to gain more weight. If the patients cannot gain the weight and the surgeon is still in doubt as to whether the needed volume will be available, there are three options:

1. The patient's buttocks can be augmented with whatever fat can be harvested, with the patient fully aware that the procedure may fall short of her expectations, and she may require a second procedure if she desires further augmentation. The second procedure can involve either more fat transfers after a second weight gain, or placement of implants.
2. The buttocks may be augmented with implants only, but the size of implant may be limited, depending on her muscle laxity. The goal is to place the largest implant that does not create muscle tension at closure. This cannot be determined until surgery, and this may limit the desired size.
3. Therefore a better option would be to use a combination of implants and fat, the implant size will be determined during surgery, and the fat will be used to further enhance shape and volume.

IMPLANT AUGMENTATION

There are three main issues that must be decided when selecting implants: shape, size, and texture. The implant content can be a solid silicone elastomer, or silicone cohesive gel. The gel implants are used outside the United States, whereas U.S. surgeons are limited to the use of elastomer implants.

Implant Shape Selection



The most common shapes are anatomic, oval, and round; the shape selected will depend greatly on which plane is chosen to augment the buttock, subfascial or intramuscular. Each plane has different tissue dynamics and responds very differently to augmentation.

Augmenting the Subfascial Plane

In this plane, tissues are more pliable, but they are thinner. If implants are improperly selected, they may become palpable with visible edges, and over time gluteal ptosis may develop.



This patient's subfascial round implants were placed too low and descended over time. This is particularly likely to occur if round or oval implants are used.

The best subfascial implant is the one designed by de la Peña; his implant is specifically designed for this plane, and he has spent a significant amount of time designing, engineering, and developing this particular technique. This plane offers a quicker recovery with much less postoperative pain. For surgeons outside the United States who can use silicone-gel implants, palpability is not a big issue. If the patient has good tissue coverage, with proper patient selection and the use of gel implants, a nice natural augmentation can be achieved.



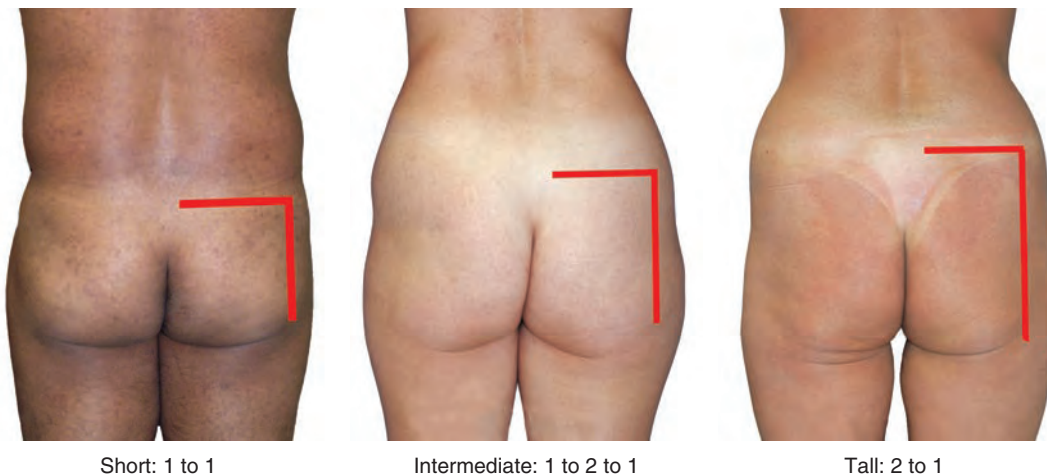
In the subfascial plane, the only decisions that remain are size selection and implant texture. De la Peña developed some excellent preoperative external templates (*above*) that guide the surgeon in size selection. In terms of implant texture, I prefer the smooth implants, because I have noticed a higher delayed seroma rate with the textured implants.

Intramuscular Plane

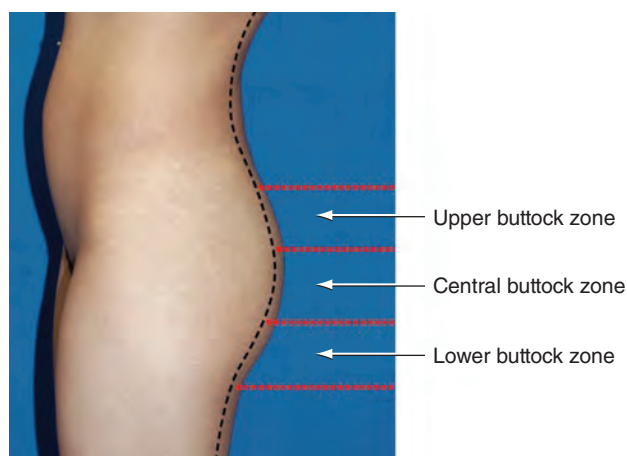
In the United States we are limited to the elastomer implants, and although they have become softer, these implants are firmer, more palpable, and have less give than gel implants; therefore obtaining tissue coverage is a priority. Placing the elastomer implants in the muscular plane will help camouflage the firmness of the implant, producing a more natural feel and appearance. Given the implant restrictions for U.S. surgeons, this plane becomes more appealing. The intramuscular implant selection process involves deciding on implant shape, size, and texture. Again, the smooth implant is preferred, because there seems to be a lower incidence of seroma formation.

The implant shape for the intramuscular plane requires evaluating two aspects: the muscle height-to-width relationship in the PA view, and the volume of distribution in the lateral view.

Muscle Height-to-Width Ratio



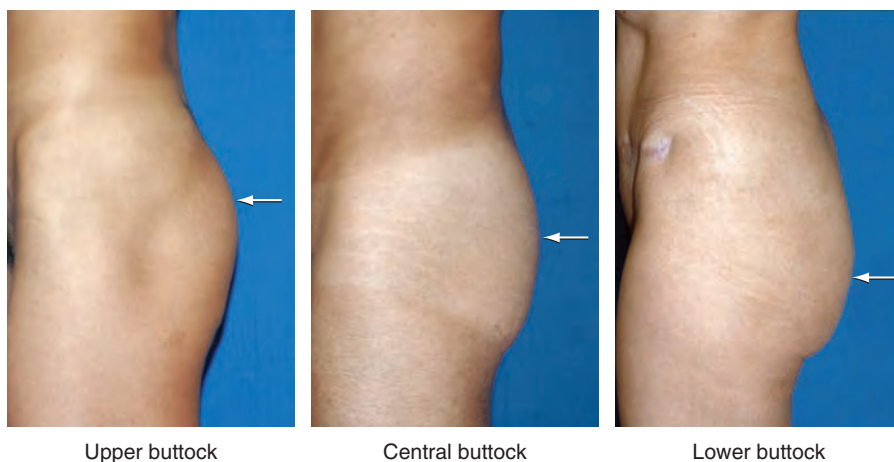
To find the muscle height-to-width ratio, the superior and inferior points of the gluteus muscle are identified, as well as the most medial and lateral points. At a glance, one can see a height-to-width relationship that will fall into one of three ratios: short muscle, 1 to 1; intermediate muscle, 1 to 2 to 1; or tall muscle, 2 to 1. The ideal buttock is intermediate but leans more toward a 2 to 1 relationship.



The gluteus is divided into three zones: upper, central, and lower

The short muscle is best augmented with round implants, because they have similar ratios (1 to 1); the tall muscle (2 to 1) is best augmented with an anatomic implant. The intermediate muscle has the most flexibility, because any of the three types could be used: round, anatomic, or oval. However, in these cases it is best to use the lateral view to make our final decision.

The Lateral View



The lateral view is used to evaluate where most of the bulk of the gluteal volume is located: upper, central (midbuttock), or lower buttock.

If the bulk is in the upper buttock, an anatomic implant will create the best result, because the anatomic shape adds most of its volume inferiorly. If in these cases a round implant is used, it will accentuate the already full upper buttock, which in turn will accentuate the lower gluteal deficiency, making the buttock look very disproportionate. If the bulk is central, the buttock is already well balanced, so any implant will produce an attractive result; I prefer the oval or round implants. If the bulk of the gluteal volume is in the lower buttock, a round implant will look best, because the round implant adds most of its projection in the upper and central zones, equalizing the volumes throughout the buttock.



This patient with a double-bubble deformity had round implants placed. Preoperatively most of the volume was in the superior quadrant; the implants accentuated the deformity in both cases.

Implant Size Selection

Selecting implant size requires a fine balance of trying to please the patient with her desired size and trying to prevent the complications of implant exposure and wound dehiscence. Often these goals conflict: the tissues will not allow as large an augmentation as the patient desires. In these cases, fat grafting can be combined to further increase volume.

Decreasing Implant Exposure

In attempts to decrease implant exposure, I spoke with my mentor in gluteoplasty, Dr. Jorge Hidalgo, and revisited the operation. Once the implant is in place, the muscle edges should almost be opposing (“kissing” edges); this way, very little tension is placed on the muscle closure. Some patients have a very lax or loose muscle and can easily accommodate large implants, whereas others have very tight, fibrous attachments with dense muscle fibers that can barely tolerate medium-sized implants. Interestingly enough, the degree of athletic build or activity has nothing to do with the degree of muscle tension. I have seen body builders with lax muscles and sedentary patients with very dense, tight fibers. There seems to be a genetic and cultural predisposition with individuals of African descent having the tightest attachments.

Because each patient’s anatomy is unpredictably different and implant exposure rates rise as tension increases, implant size cannot be guaranteed or determined before surgery. Sizers are used intraoperatively to identify the largest implant the body will accommodate without creating excessive muscle tension at closure. If the patient desires a larger augmentation, in 3 to 6 months the surgeon can either place larger implants (the muscle having been stretched), or can perform fat transfers. Fat grafting can also be performed at the same time as the implant augmentation.

Intramuscular Surgical Procedure Technique

Preparation

Preoperatively dexamethasone (Decadron) 10 mg and clindamycin (Cleocin) 600 mg are administered intravenously. Pneumatic compression stockings are placed and functioning before anesthesia is induced. Because the surgical procedure takes only 1½ to 2 hours, placement of a Foley catheter is unnecessary.

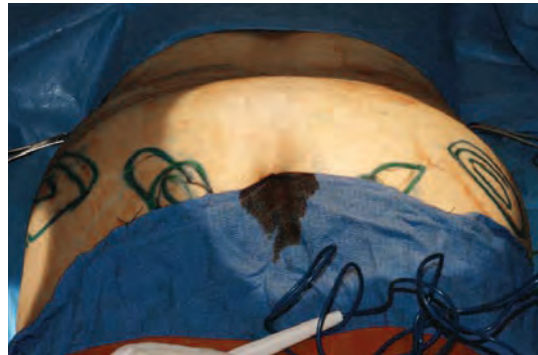
Anesthesia and Positioning

The procedure can be performed under general anesthesia, or with spinal or intravenous sedation. The patient is placed in the prone position with a pillow under the

pelvic bones to jackknife the pelvis and aid in muscle visualization and dissection. The elbows are flexed with the arms out to the sides at less than 80 degrees (the beach position), and all pressure points are padded. The pneumatic compression devices are rechecked.



If the procedure is to be done with the patient under general anesthesia, I suggest placing a draw sheet under the patient before induction. Once the airway is secured, with aid of the draw sheet, anesthesia in control of the airway, and staff assisting with arm positioning, the patient is rotated to the prone position. The arms are secured and the pillow placed under the pelvic bones. It is important to ensure that all pressure points are well padded and that the pneumatic compression devices are functioning.



Once satisfied with positioning, the buttocks and back are prepared and draped. The gluteal area is prepared from the knees to the upper back and as far laterally as possible. Draping should leave the entire gluteal zone and lower back exposed; a gauze soaked in povidone-iodine (Betadine) solution is placed over the anus and secured with 2-0 silk to avoid contamination (*left*). A sterile towel is placed over the gauze to cover the anus and the inner gluteal zone (*right*). This towel is secured to the skin with 2-0 silk so that there is no space between the towel and skin. All gloves and gowns are changed.

Markings

Preoperatively the areas to have liposuction or fat transfers are marked with the patient in the standing position. The intraoperative markings are minimal, identifying only the tip of the coccyx and infragluteal crease (this helps to identify the drain exit points). Most of our markings relate to incision placement.

Incision Design/Selection

In 1969 Crocket used a unilateral infragluteal incision for reconstructive purposes. González-Ulloa used a bilateral infragluteal approach for his subcutaneous technique, but given the visibility of these scars, they were never in favor. Robles placed the implants in the submuscular position through a hidden single intergluteal incision. This became the incision of choice because of its inconspicuous nature.

Performing gluteal augmentation with implants has been very humbling, because complication rates have remained high, although we have explored many avenues to decrease wound dehiscence and implant exposure: fibrin glue; platelet gels; quilting sutures; drains; variations of the central intergluteal incision; scalpel dissection versus cautery dissection; immobilization; a variety of postoperative care techniques, including fewer office visits (to decrease wound irritation); changes in antibiotics; a variety of garments, and more. No matter how our preoperative, intraoperative, and postoperative care was manipulated, we saw no improvement. Other investigators published articles, and I saw that they did not share my high wound dehiscence rates or issues. However, it became clear that the single midsacral incision was not the best approach in my series, so I began to use bilateral parasacral incisions, which I later learned had already been described by González-Ulloa. These incisions avoid the sacral midline, with its poor circulation. In my last 12 cases, no dehiscence has occurred.

These incisions are designed as follows: with the patient in the prone position, the tip of the coccyx is palpated and marked; staying exactly in the sacral midline the central intergluteal crease is drawn from the tip of the coccyx 8 cm cephalad. The future incisions are marked 1 cm from this midline so that both incisions are 2 cm apart in the inferior and middle portions. If these lower distances are not respected, central skin necrosis may occur. As the incision reaches the upper buttock, it follows the upper gluteal curvature (this occurs at about the 6 cm mark from the coccyx). This design produces two 8 cm incisions that parallel the midline from the tip of the coccyx and extend cephalad following the upper gluteal curvature.



The incisions at their inferior and middle portions have a 2 cm separation; in their upper portion, a 4 to 5 cm separation. The eventual scars remain hidden in the gluteal cleft. Although the upper incision may be seen in some patients, it is hidden in bikinis.

Skin Flap Dissection

The incision sites are infiltrated with 10 ml of 1% lidocaine with epinephrine 1:100,000. Tumescient fluid is injected into the intramuscular and subcutaneous tissues, as well as the areas to be suctioned. With the surgeon approaching one side at a time while standing on the opposite side of the gluteus to be worked on, the incision is made down to the gluteal fascia. The tissues are placed under upward traction with hooked retractors. The beginning of this dissection is tricky, because the muscle fascia comes up relatively quickly and takes an upward, sloping turn. Care must be exercised to avoid getting into the muscle and losing the plane. With the aid of deeper retractors, the dissection is continued, making certain to preserve the fascia on the muscle (a key point in this approach; if the fascia is not preserved on the muscle, there will not be enough good closing tissue for implant coverage). The dissection can be done with electrocautery or, for a less heated dissection, with a gauze pad wrapped around the thumb, digitally elevating the subcutaneous tissues with an upward, sweeping motion. The goal of the initial subcutaneous dissection will be to expose just enough of the muscle and fascia to allow implant placement (this usually means about 5 to 6 cm of subcutaneous dissection).

Muscle Dissection

Before beginning the dissection, it is important to understand the anatomy. The major muscles in this zone are the gluteus maximus, minimus, medius, and piriformis. The maximus has transversely oriented fibers and is one of the largest muscles in the

body; its superior half covers the medius, which has vertically oriented fibers. The plane between these muscles is more distinct in its superior portion (at the level of the posterior superior iliac crest). Moving caudally, the fibers integrate and become indistinguishable. Because our dissection is performed at the gluteal midlevel, there will not be clear identifiable planes, muscle groups, or layers. It is a blunt intramuscular procedure with components of direct visualization, the goal being to maintain a 2 to 3 cm muscle thickness of coverage for the implant. The gluteus muscle is about 4 to 6 cm thick, so maintaining a 3 cm intramuscular dissection allows the muscle to remain and still provide coverage over the crucial nerves and vessels.

Using the midsacral level as the reference point, the fascia is opened following the direction of the muscle fibers for a length of 5 cm.



The intramuscular dissection is started by using a long hemostat and spreading perpendicular to the muscle for a depth of 1 cm. At this point, the surgeon switches to a ring forceps and continues the perpendicular muscle spread for another 2 cm (a total of 3 cm coverage). During the forceps dissection, one can see glistening fascia fibers that are present at different levels of the dissection. If the 3 cm depth has not been reached, the fascia is incised and dissection continues until the 3 cm mark is reached. The forceps dissection creates only a small muscular opening that must be enlarged. With the use of cautery, the muscle incision is opened medially and laterally to its full fascial incision length. Once this depth is achieved, the Deaver retractors are introduced on both sides of the muscle and spread. Up to this point, the procedure has been relatively bloodless; the dissection now becomes blunt, and some blood loss (about 50 ml) will occur. Remember, this is an intramuscular procedure; there is no real areolar plain, as in breast augmentation. The closed ring forceps is used to bluntly push and create the muscle pocket; the muscle pocket should be kept 3 cm thick throughout. It is best to start the pocket dissection in the superior lateral direction. A key point to this portion of the dissection is to tilt the tip of the ring forceps down to about 45 degrees, because the surgeon's tendency will be to unconsciously tilt the forceps upward and pierce through the muscle. If this happens, one can dissect deeper or convert this part of the implant to a subcutaneous position (it is better to dissect

deeper). The dissection continues in a sweeping counterclockwise motion from a superolateral to superomedial direction by a back-and-forth pushing motion of the ring forceps. At this point, with a pocket somewhat created, under direct visualization and with the aid of retractors, the surgeon further defines the pocket with the Aiache gluteal muscle dissector, a serrated instrument. If this dissector is not available, the surgeon can use an index finger or a curved Van Buren sound to push the fibers. At this point little dissection will be done inferiorly. A lap pad is placed in the wound to clear out any blood.

Expander

To help define the pocket further, the surgeon places a breast implant expander and overinflates it until no further expansion can be obtained. The expander will stretch the muscle and help to indicate areas that require further dissection. It will also help define the inferior dissection. In the past, the inferior dissection was limited to an imaginary line that spanned from the tip of the coccyx to the greater trochanter of the femur; this limitation placed the implant in a very high and unattractive position. As surgeons have gained familiarity with this procedure, the inferior dissection has been refined so that the dissection extends 3 to 5 cm below the coccyx, placing the implant in a more anatomic location with improved aesthetic contour. To ensure safety, the inferior dissection is performed with the aid of the expander in place; blunt finger dissection is used to push muscle fibers away from the implant in an inferior direction. The majority of the inferior dissection is done using finger dissection to maintain the muscle thickness and avoid instrument injury to any structures. On occasion, the surgeon may encounter some very dense and tough fibers that cannot be broken with finger manipulation. In these cases, the expander is removed and under direct vision these fibers are freed using the Aiache or Van Buren dissectors or even cautery.

It should be kept in mind that the sciatic nerve is deeper than this dissection. An important landmark is the acetabulum of the femur, which is easily palpated and sometimes seen. If the acetabulum can be palpated, the nerve lies in a groove that is immediately lateral to this structure and is well protected. Occasionally one may encounter the inferior gluteal or superior gluteal arteries; rarely are these cauterized or ligated. However, if this is necessary, it will not create a problem, because the maximus is a type III muscle with excellent blood supply.

Sizers and Implant Size

Once the surgeon is satisfied with the dissection, a sizer is inserted to determine the appropriate implant to be used. When the implant is in place, the muscle edges should be in close proximity, with very little tension at closure (this is one of the key steps in the procedure). Every patient will exhibit different muscle thickness, tightness, and characteristics; this is not related to an athletic build or body size. It is difficult to

predict whose tissues will be lax or tight. Therefore it is often helpful to have a variety of sizes available in the operating room to help assess the largest implant that this particular patient's muscle will accommodate with minimal tension.

Drains

After the implant size has been determined, a Jackson-Pratt drain is introduced in the pocket and brought out through a separate stab incision in the infragluteal crease. Use of the drain has decreased the incidence of seroma. At this point the pain pump and catheters can be placed; these are brought out through the upper medial buttock.

Implant Placement/Closure

The implant pocket is irrigated with 10 ml of 1% lidocaine with epinephrine 1:100,000 mixed with 5 ml of bupivacaine (Marcaine) 0.5% plain. All gloves are changed, the implant is soaked in antibiotic solution, and the incision is thoroughly scrubbed with a scrub brush using Hibiclens. A new sterile towel is placed over the buttock; the implant is rolled into a cigar shape and introduced. A sterile sleeve may come with the implant; this is used to introduce the implant and help avoid implant contact with the skin—*the surgeon should be prepared to struggle*. Sometimes, if the muscle is tight, it will have to be incised at its insertion along the sacrum for about 0.5 cm to create more space. (The surgeon should try to avoid having to do this, because it does make it more difficult to close). Care is taken to leave a cuff of tissue so that it can be closed over the implant. Any irregularities are corrected with further pocket refinement utilizing a curved dissector. The drains are checked for any kinking to ensure that they are in a good position. The muscle is closed with 2-0 Vicryl. The subcutaneous wound is closed in layers with a final running 3-0 Vicryl. The opposite side is now completed in a similar fashion.

Postoperative Care

Activities

For the first 2 to 3 weeks the patient is instructed not to sit, to sleep on the stomach, and when relaxing (watching TV, visiting with friends, reading the paper), to be in the prone position or standing. The patient may conservatively ambulate around the house but is asked to limit activities to avoid wound friction and trauma. When traveling to the office, the patient is asked to lie prone in the back seat of the car.

Most wound dehiscence occurs about the fourteenth postoperative day; wounds are checked on this day. If the wound is intact, the patient is seen for follow-up a week later. At the third postoperative week, the patient is cleared for sitting and driving and is encouraged to start stretching exercises. If the wound is marginal,

the patient is followed closely but is not allowed to sit or drive for at least 2 more weeks until the wound appears stable, or, if the wound dehiscd, until granulation tissue has developed.

The patient can usually return to work 2 to 3 weeks postoperatively.

Return to the gym will depend on wound status. If all is well, the patient can resume exercise 6 weeks postoperatively. If the wound is compromised, it may be 2 to 3 months before workouts are appropriate.

After 3 months the patient is cleared for all types of activities (bungee jumping, motorcycle riding, or any other vigorous activity). At first, the implants will feel very firm (like sitting on rocks); it will take 3 months for them to “soften up.” After that time, they feel like a well-worked-out buttock.

Garments

If liposuction was performed, the patient wears a body garment for 4 to 6 weeks. If no liposuction was performed or the liposuction was limited to the waistline, an abdominal binder that wraps around the upper buttock and waist line is used for 2 weeks. This binder seems to give patients more comfort and less pain than not having any garment.

After the third week, if all is well, the patient is cleared to start sitting.

Bathroom

Privileges are given, but the patient is encouraged to urinate in the shower while in the standing position.

Since the patient is usually constipated (because of pain medications), bowel movements are not likely to be an issue until a week postoperatively.

Nevertheless, if the patient must defecate, it is permissible to sit, but with assistance. The patient is instructed to use baby wipes and to wipe in the standing position while leaning forward on a countertop, wiping once (repeating with a fresh towelette) from top to bottom until clean.

Postoperative Visits

To avoid excessive ambulation, the patient is seen on the third postoperative day for a wound and drain check. The drains are removed when there is less than 30 ml of drainage per 24 hours, usually about 1 week postoperatively. Oral cephalexin 500 mg three times a day is used until the drains are removed. If the amount of drainage remains high at 1 week after surgery, the surgeon must consider balancing the risk of infection from the prolonged presence of drains against possible seroma formation resulting from early drain removal. If drainage persists, tetracycline is placed through the drain and the tube is clamped for 3 hours. This sclerosing agent helps to decrease output. The patient is seen the following day and the process is repeated if necessary. If drainage persists after 10 days, the drains are removed regardless.

Postoperative follow-up visits are scheduled for the third, seventh, tenth, and fourteenth postoperative weeks. If the wound's condition is questionable, the patient is seen either daily or every other day between postoperative days 14 and 21. If the wound is intact by the third week, the patient is seen 1 month later, then 3 months postoperatively, and finally at 6 months. If the wound has dehisced, the patient is usually seen daily until the wound is stable (with granulation tissue forming), then weekly or every other week.

Problems and Complications

As the technique and procedure have evolved, implant complications have been decreased by attention to the following principles:

- Incisions are placed in the intergluteal fold, but as separate bilateral incisions, each placed 1 cm from the center midline.

- Using sizers, the correct implant size is determined based on muscle tightness. The muscle edges should be almost kissing when the implant is placed, before muscle closure.

Individuals with a large or extra-large frame seem to have a higher implant complication rate, because they usually require larger implants, which can lead to greater tension at closure and a greater potential for complications. In these individuals augmentation is best done with fat or dermal flaps. With these modifications, this procedure has worked well.

Wound Dehiscence

Most dehiscence will occur near the fourteenth postoperative day but can occur as late as 3 weeks postoperatively. In our original series, published in 2003, the rate of dehiscence was 30%. The central single sacral incision had the higher dehiscence once the bilateral intergluteal incisions were performed. One dehiscence occurred in 18 cases. Although the case number is small, the procedure shows tremendous promise.

If the wound does dehisce, it can be locally explored at the bedside to see whether the implant is exposed. If it is not exposed, traditional wound care and management are implemented. Closure may take 1 to 3 months. If the implant is exposed, secondary surgery is required using implant salvage techniques (posterior capsular flaps for coverage).

Implant Exposure

If no tension is placed during muscle closure, the incidence of exposure is low (about 2% to 3%). If an excessively large implant is placed or in patients with extremely tight muscle fibers with very little stretch, the incidence is higher. Patients are informed that implant size cannot be determined preoperatively, because the most significant variable to implant size is the patient's particular muscle tightness, which can only be determined intraoperatively. I attempt to place the largest implant the patient's buttock can accommodate. If a larger size is desired, an implant exchange can be performed 3 to 6 months later, and at this time a fairly large implant can be used, since the muscle has been expanded and stretched. Complication rates in such instances are very low, and recovery is extremely quick, with return to work in 5 to 7 days.

If the implant is exposed and secondary surgery is required, the wound is irrigated and the implant usually is exchanged. If the exposure is large, posterior capsular flaps can be used to aid in implant coverage. Patients are advised that these are implant salvage techniques and may be unsuccessful, requiring implant removal.

Infection

Postoperative infection is rare, with an incidence of 1% to 2%. If an infection does develop, removal of the implant may be required. Infections most commonly occur around the tenth to fourteenth day but have been seen as late as 3 months. However, implants have been salvaged through secondary surgery to exchange implants and the use of a closed antibiotic irrigation system. The pocket is irrigated for several days until the infection resolves. Again, patients are advised that these are salvage techniques and that implant removal may be necessary.

Seroma

The use of drains has decreased the incidence of immediate seroma. Late seroma has an incidence of 3% and is usually seen approximately 6 months postoperatively, although it can occur several years later. Late seroma has mainly been seen with the use of textured implants. Resolution has required surgery with implant exchange (substituting smooth implants), partial capsulectomy, and drainage.

Capsular Contracture

Capsular contracture has a 1% incidence; it is improved with implant exchange and partial capsulectomy. It may recur.

Neurapraxia

No sciatic nerve injuries have occurred in my patients. Patients will complain of sciatic-type discomfort in the first month after surgery because of swelling. In these patients symptoms are improved with stretching exercises and administration of vitamins B₁₂ and B₆, methylprednisolone (Medrol Dosepak), and oral gabapentin (Neurontin) 100 mg given twice daily. After 1 week, if symptoms have not improved, the dose of gabapentin is increased to 200 mg twice daily. Most of these symptoms will improve and disappear over the next 1 to 3 months.

Implant Rotation

Implant rotation is not an issue with round implants; however, there is a small (less than 1%) incidence of implant rotation with anatomic implants. This can be corrected by placing internal capsulorrhaphy sutures.

Chronic Pain

Chronic pain usually does not occur. When it does, possible causes include myositis, fasciitis, capsular contracture, nerve impingement, and scarring. Sometimes the implant may be too large and cause pain when the patient sits, because it forces itself onto the muscle attachment at the posterior iliac crest. In such a case, changing to a smaller implant may help; in a patient with an anatomic implant, changing to a round implant may help.

AUGMENTATION WITH FAT GRAFTING

There are three main components to be considered in fat grafting: fat harvesting, fat preparation, and fat injection. There are many different approaches to harvesting and preparation and physicians regularly debate which one is superior. To date, there is no scientific evidence that one approach is demonstrably better than another for fat survival. Although the debate continues as to the best harvesting method (machine versus syringe aspiration, syringe size, cannula size, and other factors) and the best fat preparation method (straining, centrifuge, decanting), there is little debate on the best injection technique. It has been clearly established that small amounts of fat need to be placed in layers using multiple repeated passes, as opposed to single globular-type injections. This basic layering technique is what makes fat grafting work. This technique has been well demonstrated for small-volume transfers and remains the cornerstone for large-volume transfers as well. However, large-volume augmentations are very different from small-volume augmentations. The primary difference is the recipient site. In large-volume placement, the surgeon is injecting into very large muscle groups with excellent blood supply as opposed to smaller, tighter,

less-vascularized spaces. This is where my technique to harvesting, preparing the fat, and choosing the infiltration syringe and cannula size differs from that of many of my colleagues. The layering principle remains the same.

Technique

The large-volume fat grafting technique is straightforward, cost effective, and time efficient. There is no need for expensive or fancy equipment. The simplicity and speed are related to three factors:

1. Fat harvesting is performed with a larger-bore cannula (4 mm and on occasion 5 mm for the deep layer).
2. The aspirate is separated into its components by the use of a very large metal strainer (600 microns).
3. The pure fat injections are done with large-volume syringes (10 and 60 cc syringes) and 2.4 to 3 mm cannulas.

Nearly all the procedures are performed with the patient under general or intravenous sedation in my office-based AAAASF-approved surgical center (only ASA 1 and 2 patients). The procedure takes 2½ to 3 hours to perform. The surgical team is very small, consisting of me, my surgical assistant, and a circulator; my assistant helps position, turn the patient, and prepare the fat.

Infiltration

The tumescent fluid is infiltrated through the access incisions; the exact locations for these are determined when the patient is on the operating room table. On average, 4 to 5 L of tumescent fluid is used per case.

Tumescent Mixture

The fluid consists of 1 L of prewarmed Ringer's lactate solution mixed with 1 ampule of 1:1000 epinephrine. The amount of lidocaine used will vary, depending on the type of anesthesia being used. If the patient is under general anesthesia, then 20 ml of 1% lidocaine with 1:100,000 epinephrine is used. If the patient is under intravenous sedation, 50 ml of 1% lidocaine with 1:100,000 epinephrine is used; 10 ml of bupivacaine (Marcaine) 0.25% is used as well.

Harvest

Liposuction is performed with the power-assisted machine using a 4 mm cannula with the fat being collected in 1500 ml glass bottles that work much like a large Lukens trap.



One connector tube goes from the handpiece into the glass bottle and another from the glass bottle to the liposuction machine. The liposuction machine is set at a suction power of 22 to 23 mm Hg.



Once the bottle is full, it is emptied into a regular strainer that has been sterilized. The strainer will separate all fluid (lactated Ringer's solution, blood, triglycerides, and emulsified fat) from the intact fat cells.



There is absolutely no fluid in the fat. The fat is then transferred to 60 cc syringes.

The well-established methods of centrifuging and decanting work well for facial fat grafting procedures, but the face requires small volumes that can easily be handled with these methods. For fat transfer in the buttocks, on the other hand, large volumes (4 to 6 L) are used, and while large centrifuge machines exist, they are very bulky, require additional personnel, and add a tremendous amount of time to the procedure. Decanting is not efficient with such volumes. The most efficient method for me has been straining. The straining process is remarkably easy. It requires a large metal strainer (which can be purchased at the local grocery store, Target, Wal-Mart, or kitchen accessory store for approximately \$6 to \$10), a wooden tongue blade to help swirl the aspirate, two or three sterile bowls (one to collect the strained fluid and the others to place the supernatant fat), and one large, nonsterile bowl for the discarded strained liquid. Critics of this open straining technique argue that the process is not closed and therefore exposes the cells to air, potentially increasing fat cell trauma and death. I have not noticed this to be an issue in assessing the results.

Passive straining takes far too much time; the dense fat will frequently clog the fine mesh holes, slowing the process further. To expedite this process, my assistant picks up the strainer and repeatedly shakes it back and forth, much like a chef would strain spaghetti. If this active straining technique is not working well and the fluid refuses to strain, a tongue blade is used to swirl the aspirate and let the fluid flow through. Care is taken not to forcefully scrape the tongue blade on the bottom or sides of the mesh to avoid destruction of fat cells. The swirling must be gentle and at midstrainer level, the idea being to avoid squeezing the fat cells. Once all the fluid is sieved, the supernatant fat is placed in a 1000 cc collecting metal bowl and covered with a sterile towel. The entire process is repeated until all currently available aspirates have been strained.



Once the bowl is full, 10 cc of antibiotic solution (clindamycin 600 mg mixed in 20 ml of saline solution) is added and the fat is swirled again.

If I am still harvesting, my assistant will proceed with syringe loading. Because we are working simultaneously, there is no down time between harvesting and preparing fat. This entire process moves smoothly and quickly, like a well-coordinated two-person orchestra.

The following reference values should be noted:

The amount of tumescent fluid injected is usually 5 L.

The amount of intraoperative fluids required is usually 4 to 5 L.

It takes 5 to 6 L of aspirate (fluid and fat) to obtain 2 to 3 L of supernatant fat.



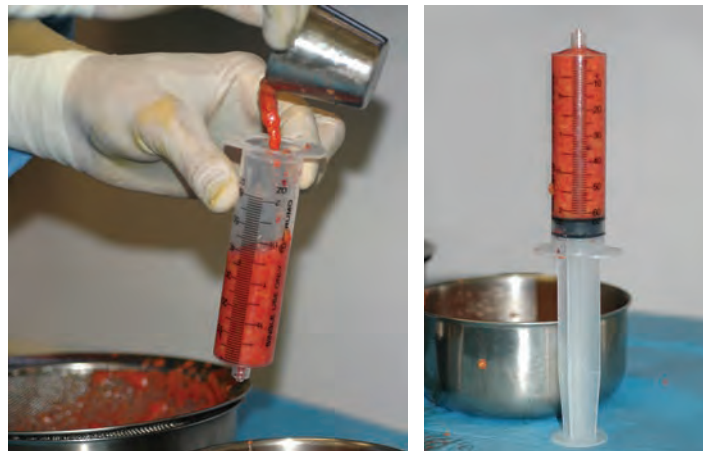
Syringe loading depends on fat density. My transfers are done using a 10 cc syringe connected to a Tulip Luer-Lok 2.4 by 20 cm cannula (for subcutaneous injections) and a 60 cc Luer-Lok syringe using a 3 by 15 cm Luer-Lok Byron cannula (for intramuscular injections). A cannula thinner than 2.4 mm is too flimsy and may bend during injections.



On rare occasions the fat is extremely fibrous and will not pass through the small syringe Luer-Lok opening. In these cases, the fat is transferred using a large-bore 60 cc Toomey syringe connected to a large-bore 4 mm harvesting Toomey cannula.

It is important to assess the quality of the fat as it is being strained. Occasionally it is difficult to tell whether the fat density will be an issue; in these cases, the Luer-Loks are loaded, and if an issue develops, the Luer-Lok syringe is emptied into the Toomey syringe, and for that syringe only, the Toomey system used. Rarely, the entire aspirate is fibrous in which case the entire injections are done with the Toomey system. I always have these syringe and cannula readily available since I never know when I might need them.

Loading



The 60 cc Luer-Lok syringes are loaded in the following manner: the syringe plunger is temporarily removed while the fat is poured using a small 50 cc metal cup.



All four 60 cc syringes are loaded while the 10 cc syringes are loaded quickly and easily using the transfer tool connected to the 60 cc syringe.

At this point I am still harvesting, so my assistant is on hold until the next batch of fat comes through. He or she will repeat the emptying and straining process, collecting the fat in the 1000 cc bowl and adding antibiotic solution to each new batch until we are done harvesting. If the bowl becomes full, we have a spare bowl waiting. The strained fluid is periodically poured into a large plastic nonsterile 3 or 4 L bowl and the fluid is discarded.

The advantage of this technique is that the total procedure time is about 3 hours, compared with following the small fat-transfer principles (harvesting with a smaller cannula, followed by centrifugation, then injection with 1 or 3 cc syringes), which would take about 6 to 8 hours.

The straining system I use is efficient, cost effective, easy to perform with retention rates equal to those published. My experience is clinically based and not scientific; however, it is my impression that I retain 70% to 80% of the fat injected.

The disadvantage to this technique is that I do lose about 10% of cells that are very tiny and sieve through the strainer. The quality of these very small fat cells is unknown; some hypothesize that those are the best cells (stem cell rich); others think that these are not great cells for transfer. In an effort to salvage some of these smaller cells, I have tried using a smaller strainer with 300-micron sizes but even so, I still do not manage to capture many more cells, because these cells are almost liquid in form.



The other disadvantage to my approach is that one needs to do some searching to obtain the necessary equipment. The glass bottle can be obtained through Wells Johnson (Tucson, AZ); it is the 1500 cc model with a rubber stopper. This glass bottle can be resterilized; its initial cost is about \$350. After about 30 cases a new rubber stopper must be ordered. The bottle is sterilized in a regular autoclave, and the rubber tubing by gas sterilization, to make it last longer. (If autoclaved, the rubber starts to break down and will last for only 10 to 15 cases.) Another option is to gas-sterilize the 1500 to 2000 cc plastic containers, which cost about \$2 or less. Some companies may have these already presterilized. Finally, the strainer can be obtained at any store (Target, Wal-Mart) and costs about \$6 to \$10; it is sterilized regularly.

There are many new disposable collection systems coming to the market that will further simplify and speed the process, but currently some of these systems are flawed because they retain too much fluid with the transferred fat-containing fluid, which will be reabsorbed, falsely elevating the absorption rate. With time these issues will be worked out, but in the meantime the system I am using has worked extremely well.

Postoperative Care

Care for patients after fat transfer is the same as that following circumferential abdominoplasties or buttock lifts. If no abdominal work has been performed, the patient is instructed to sleep on her stomach for 2 weeks. This means watching TV, reading, and relaxing in the prone position. For travel to the office, patients are asked to stay

in the back seat, lying on the stomach. Bathroom privileges are given, but patients are asked to urinate in the shower in the standing position. Bowel movements, although welcomed, usually do not occur for 1 week because of constipation from pain medications. If at 1 week the patient remains constipated, one bottle of magnesium citrate is recommended.

If an abdominal procedure has been performed, postoperative care is the same as that provided for abdominoplasty patients. Patients sleep on the back, not on the stomach. Although it may seem contradictory, it is better to tolerate some fat loss than to have to deal with abdominal skin pressure necrosis. A body garment is worn for 4 to 6 weeks, and the patient is able to return to work in 2 to 3 weeks and to the gym in 4 to 6 weeks. No ultrasonography of the buttock area is performed, because this can destroy fat cells. An antibiotic (such as cephalexin) is used until the drains are removed (when drainage is 30 ml or less in 24 hours). Patients may shower on the third postoperative day. The final results can be evaluated in 6 months.

Problems and Complications

Complications associated with fat transfer are rare.

Gluteal Asymmetry

Gluteal asymmetry is not a complication, but rather a preoperative anatomic fact. No two buttocks are the same; patients must be educated about this reality. One side is always larger and different from the other. This disparity was present preoperatively, and it will be present postoperatively.

Infection

The incidence of infection after gluteal augmentation is approximately 1% to 2%. This is usually seen by the seventh to the fourteenth postoperative day. It will present with increased gluteal pain, mild to severe swelling, and erythema that is mild to severe (rare). The usual presentation begins with the patient complaining of some discomfort and tenderness in the gluteal area. On physical examination the surgeon may not see much. Over the next few days the patient develops a fever and possibly

some mild erythema; however, redness may still be difficult to discern. Over the ensuing days a localized area or a gluteus that is more swollen becomes evident, and the patient complains of increasing tenderness, especially to the touch. If this is just cellulitis, it can be treated with antibiotics; however, if an abscess is present, it will need to be drained. Usually this does not require extensive incisions; sometimes needle aspiration will suffice, along with administration of antibiotics. In other cases, if the area is not that obvious, CT-guided drain placement may be needed. If the area is obvious, a small incision is made and a drain is placed. The area can be irrigated daily with an antibiotic solution.

If the diagnosis is uncertain, ultrasound examination or a CT scan is performed. Treatment of the infection will vary: in some patients, it can be managed on an outpatient basis; in others, it may require hospitalization. A word of caution: the scan may show areas of questionable fluid accumulation, but often this is just the transferred fat. Therefore the scan has to be correlated with the clinical picture. At the first sign of possible infection, or if there is any doubt, antibiotic therapy is instituted (covering for *Staphylococcus*, *Streptococcus*, *Bacteroides*, and *Escherichia coli*).

Other Potential Complications

There have been no incidents of sciatic nerve injury, seroma, or fat necrosis among my patients. Irregularities and lumpiness have also not been problems; the injections are deep to the muscle. Patients who are simultaneously undergoing a body lift and fat transfers must be educated on the postoperative need for ambulation. If they have poor pain tolerance and refuse to move during the postoperative period, they will sit on the dissected flaps and injected fat, creating ischemia to the areas and subsequent wound necrosis. I have instituted several steps to help minimize problems:

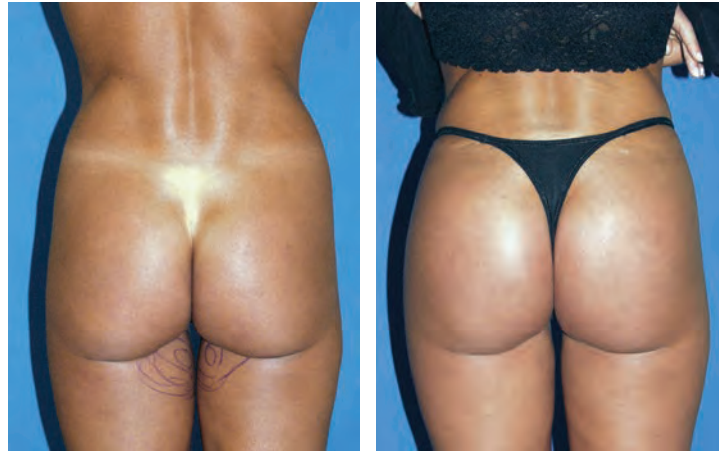
- A mini-bowel preparation solution is given the day before surgery, with a liquid diet after 12 noon.

- Patient ambulation starts the morning after surgery. A patient who refuses to ambulate is placed in the lateral decubitus position and turned regularly, if possible.

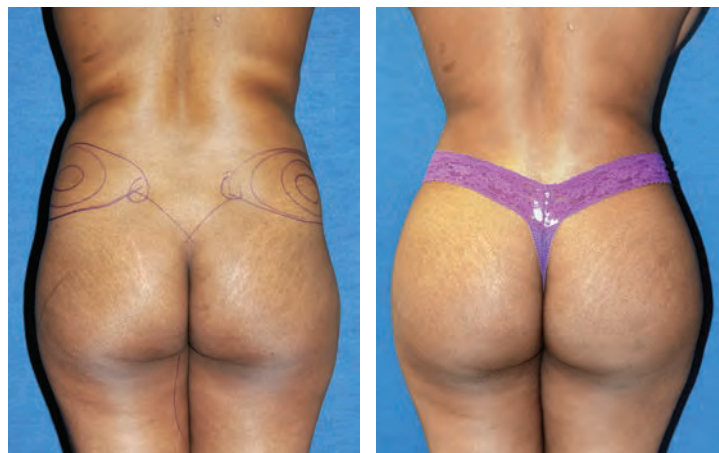
- No more than 600 cc of fat is placed in each buttock during the first procedure. More fat can be injected later.

- The patient is positioned in a lateral decubitus position on an eggcrate mattress or air mattress bed.

Results



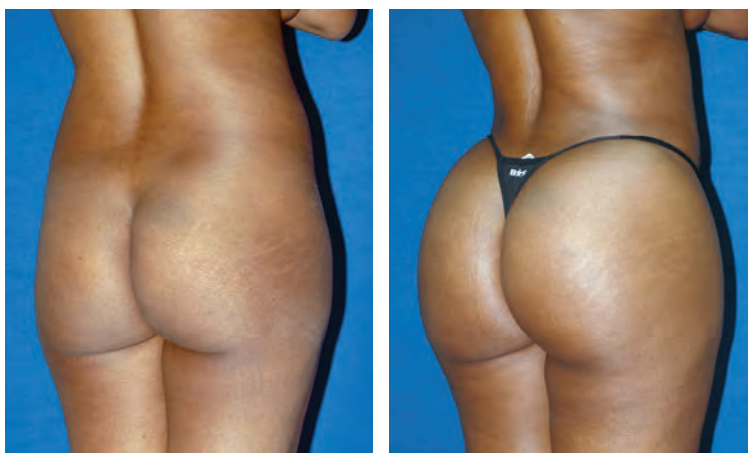
This 26-year-old nulliparous patient is 5 feet 5 inches tall and weighs 59 kg (130 pounds); she had round, smooth, solid silicone 290 cc implants placed intramuscularly. Liposuction of the inner legs and waist was also performed. She is shown 10 months postoperatively.



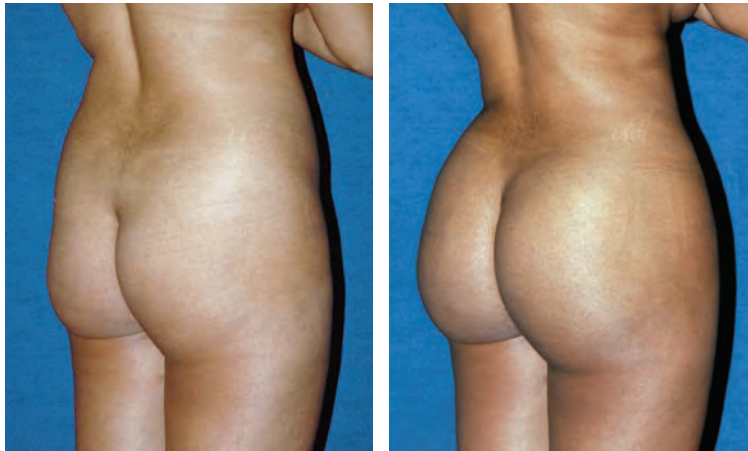
This 22-year-old nulliparous patient is 5 feet 6 inches tall and weighs 69 kg (152 pounds); she had liposuction of the abdomen, flank, back, and upper buttock. Five liters of tumescent fluid was infiltrated and 5400 cc was removed, containing tumescent fluid, blood, destroyed fat, and intact fat. Thirty percent was acceptable for transfer; 780 cc was placed in each buttock. She is shown 1 year postoperatively.



This 26-year-old patient is 5 feet 6 inches tall and weighs 64 kg (140 pounds). She has had one child. Liposuction was performed on her abdomen, flanks, back, and upper buttocks. Five liters of tumescent fluid was infiltrated and 5400 cc was removed. Fat grafting was performed in which 780 cc was placed in each buttock. She is shown 1½ years postoperatively.



This 36-year-old nulliparous patient is 5 feet 6 inches tall and weighs 70 kg (155 pounds); she had liposuction of the abdomen, inner legs, flanks, back, and upper buttocks. Five liters of tumescent fluid was infiltrated and 5400 cc was removed, containing tumescent fluid, blood, destroyed fat, and intact fat. Thirty percent was acceptable for transfer; 800 cc was placed in each buttock. She is shown 9 months postoperatively.



This 31-year-old nulliparous patient is 5 feet 6 inches tall and weighs 61 kg (135 pounds); she had liposuction of her abdomen, flanks, back, and upper buttocks. Five liters of tumescent fluid was infiltrated and 5400 cc was removed. Fat grafting was performed in which 780 cc was placed in each buttock.

Concluding Thoughts

In deciding whether to augment the gluteus with fat or implants, the surgeon first needs to determine how much fat is available for transfer. In some patients this question often cannot be answered preoperatively, because the quality and quantity is not apparent until liposuction is underway. To make a difference with fat transfers, 400 to 800 cc of fat per side should be used. The actual volume will depend on the patient's size, anatomy, and aesthetic goals. However, some generalizations can be made: small-framed individuals will require implants for gluteal augmentation; medium-framed patients present a dilemma, since they may not have enough donor fat and require implants; and patients that have a large or extra-large frame are best contoured and augmented through liposuction and fat transfers.

In intramuscular implant augmentation the size is determined intraoperatively with the aid of sizers so there will be no muscle tension at closure. Implant shape selection involves determining the muscle height-to-width ratio: a tall buttock (2 to 1 height-to-width ratio) is best augmented with an anatomic implant; a short buttock (1 to 1 ratio) is best augmented with a round implant; and an intermediate buttock (1 or 2 to 1 ratio) may require assessment of the lateral view to make the final determination.

Complications have been reduced tremendously by following three principles: the use of bilateral gluteal incisions, the use of sizers for proper implant size selection,

and proper patient selection through the use of body-frame classification to match the appropriate procedure. The implant gluteal augmentation operation has become safe, reproducible, and more acceptable to physicians but remains selective only for patients who do not have the fat to spare. The primary mode of augmentation is fat grafting, because this avoids all the possible complications that can occur with implants.

Clinical Caveats

The volume of distribution in all four quadrants of the buttock should be determined.

The V zone is evaluated for lack of muscle volume and excess fat in the presacral space.

The inner gluteal fold zone is assessed: does it have a downward 45-degree slope, a nearly horizontal character, or an upward slope?

The lateral midbuttock zone is evaluated to determine whether it is adequate, has excess tissue, or is deficient.

The presacral space–inner gluteal fold relationship is assessed to determine whether it is ideal, short, or long.

The inner gluteal crease length is measured.

On lateral view, one must determine where most of the gluteal volume lies: the upper, mid, or lower buttock.

Fat grafting is the least problematic form of gluteal augmentation.

The fat harvest should be limited to approximately 2 to 3 L.

Fat should be placed in all available layers, starting in the muscle and moving up, even in subcutaneous tissues.

Proper implant selection is important: oval, anatomic, or round.

Implant size is determined by the patient's muscle anatomy. This should be determined intraoperatively so there is no muscle tension on closure.

If the patient is still overweight, an implant is not the best form of augmentation.

Implant augmentation is best for very thin patients for whom augmentation with fat is not an option.

If possible, a bilateral paramedian incision should be used unless the patient already has a midsacral scar. In that case, the existing scar should be used.

Annotated Bibliography

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The author presents several cases that are follow-ups to the type of gluteoplasty described in the author's 1979 article in which he discusses torsoplasty and reconstruction and augmentation of the deformed gluteal region. It was found that there was considerable postoperative improvement for the patient and satisfaction for the surgeon.

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CHAPTER 86



Female Aesthetic Genital Surgery

GARY J. ALTER

The demand for female genital aesthetic surgery has increased as women and men have become more aware of genital appearance and as successful procedures have been developed to achieve patients' goals. The widespread proliferation of sexually explicit material in print and video, along with the popularity of genital hair removal, has led to women defining and seeking an aesthetic genital ideal. If a woman believes she has unattractive genitalia, she may avoid intimacy for fear of rejection or ridicule. The definition of a female genital ideal varies among individuals. Most consider the following traits as ideal:

1. Symmetrical labia minora (inner lips) that do not protrude past the labia majora (outer lips) when the woman is standing.
2. A clitoral hood that is short and nonprotruding, with few folds.
3. Full labia majora that are not overly fatty without excess hanging skin so that there is no bulge or protrusion when tight clothes are worn.
4. A mons pubis fat pad that does not protrude in clothing.

These improvements can be achieved in almost all cases. In addition to aesthetic concerns, the vast majority of women have some discomfort with clothes, exercise, or sex caused by enlarged labia minora (singular labium minus), labia majora (singular labium majus), and the clitoral hood. Hypertrophy can also interfere with hygiene.

Indications, Advantages, and Disadvantages

Enlargement of the labia minora is usually congenital. It may appear in childhood but becomes more obvious in adolescence. Occasionally, enlargement of the labia minora will increase as a result of pregnancy, birth control pills, aging, or exogenous hormones. Ideally, the labia minora should be thin, straight, light-colored, nonredundant, and symmetrical.

Labia minora reduction has traditionally been performed by trimming the protruding labia along the entire labial length. The trimming is performed using a scissor, knife, clamp, or laser. The labial edge is closed with either interrupted or running external sutures or a running subcuticular suture. This procedure has the advantages of a short operative time and of eliminating some of the dark pigmentation that is disliked by some women. However, the disadvantages are elimination of the natural labial edge, which is replaced by an incision line and often a wide, irregular, scalloped scar; difficulty creating symmetrical labia; an often unnatural transition between the labium, clitoral frenulum, and clitoral hood; the possibility of overresection

of the labia; and the potential for a higher incidence of postoperative and chronic discomfort from irritation of the scar line. Because of the disadvantages, the extended central wedge technique was developed, which may also include partial reduction of the clitoral hood.

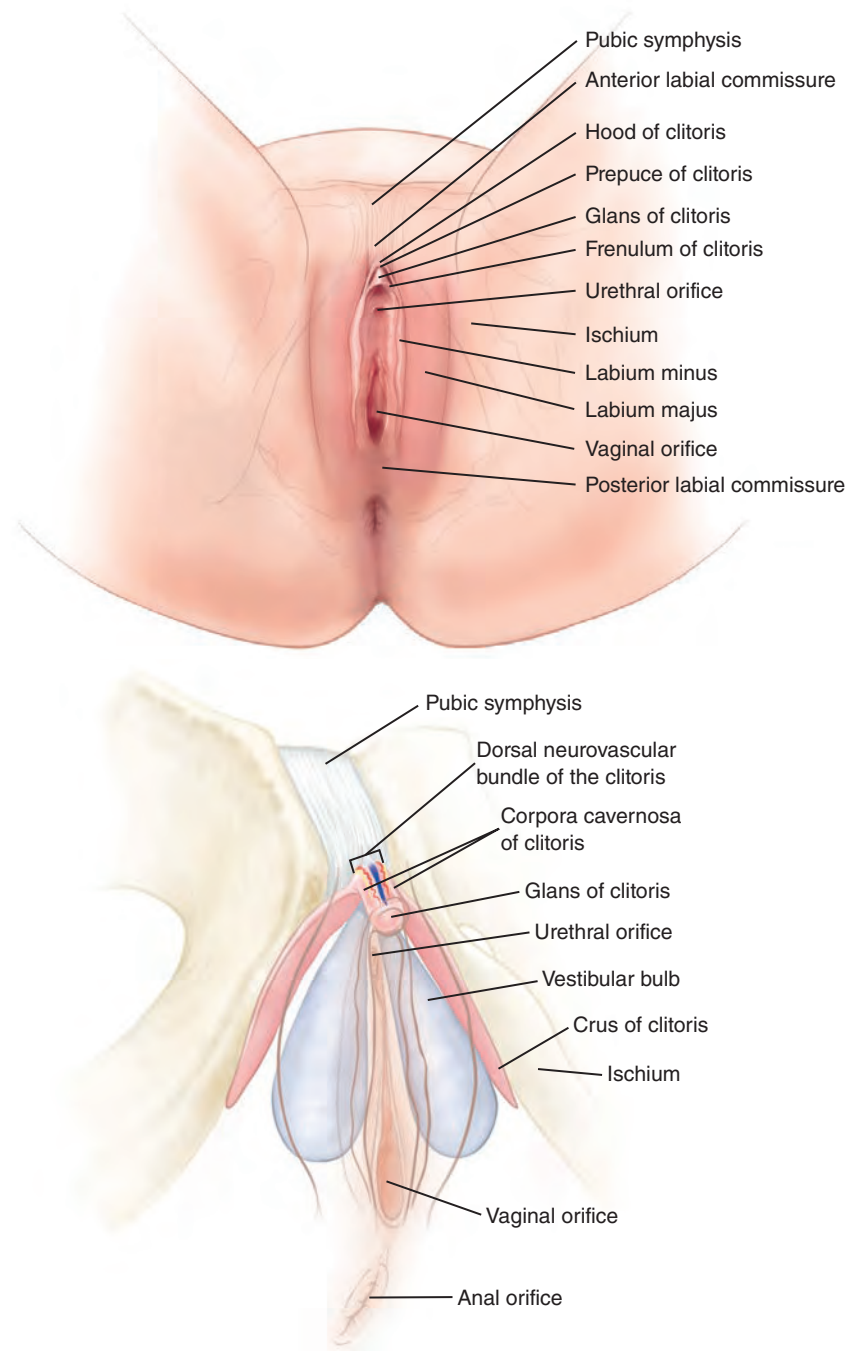
Youthful labia majora have fullness, but overabundant fat protuberance can be congenital or may occur with weight gain. Obesity causes labia majora fat and skin enlargement. After pregnancy or weight loss, or as a result of aging, the majora can lose fat but have excess skin and wrinkling. This causes the majora to hang lower, with more redundancy. The labia majora can be reduced, depending on the cause—excess fat or skin, or a combination of both. Before hair removal became the trend, physicians traditionally placed the incisions in the midlabium. However, those scars can be very visible if genital hair is removed, so the incision line should now be placed medially in a less noticeable location.

Pubic lipodystrophy is often seen as a congenital deformity, which will not resolve with weight loss alone. The woman may complain of an unsightly bulge or protrusion; the bulge may lead her to avoid wearing tight clothes or bathing suits, citing embarrassment and loss of self-esteem. If there is no excess skin or if a lift is not necessary, pubic liposuction can be used to eliminate the fat deposit. Usually the liposuction is performed through small stab incisions in the groin creases. The upper labia majora are usually also suctioned.

The epidemic of female obesity and the trend toward massive-weight-loss procedures have resulted in the common complaints of an excessive mons pubis fat deposit and descent of the escutcheon, introitus, and labia majora. A large mons pubis fat deposit is often associated with large, protuberant labia majora as a result of fat excess and stretched skin. Weight loss rarely eliminates these deformities, so surgical treatment is required.

Traditional reduction of an enlarged mons pubis fat pad with skin descent has been a horizontal skin excision and fat resection with a skin lift. This has often been combined with an abdominoplasty. However, a skin lift is usually not adequate, because the escutcheon often descends again. A second unsuccessful lift is often attempted, which can cause an unnatural shortening of the escutcheon. Surgeons have also performed a vertical excision of pubic skin, which can lead to an unsightly T scar in the mons. A pubic lift with fat removal and tacking sutures to the rectus fascia performed through a curvilinear incision below the panniculus line gives a natural, lasting correction to the mons pubis.

Pertinent Anatomy



A clear understanding of clitoral anatomy is mandatory to prevent injury. No change in sexual sensation should occur if the clitoris is uninjured. The glans clitoris is visible underneath an overlying extension of the clitoral hood, the prepuce. The body or corpora of the clitoris is attached to the pubic symphysis by the suspensory ligament of the clitoris. The corpora diverge inferiorly and laterally and are attached bilaterally to the ischium.

A fold of skin (frenulum) extends from the ventral glans bilaterally to meet with an extension of the clitoral hood to form a labium minus. The labia minora may meet at the posterior introitus or gradually taper down.

Injury will not occur if mons fat resection is performed superior to the pubic symphysis and if labia majora fat is excised lateral to the pubic symphysis and superficial to the ischium. The glans and body of the clitoris can be palpated and protected.

LABIA MINORA

Preoperative Assessment

Labioplasty can be performed on almost any woman with enlarged labia. Labial protrusion is evaluated with the patient standing. She then is asked to lie in the lithotomy position, and the labia are examined for thickness, symmetry, and both anterior and posterior length. The clitoral hood is examined to determine protrusion, symmetry, the location of hyperkeratotic, darkened skin, the presence of extra folds, and the clitoral glans size and exposure. The posterior introitus should be evaluated for a high posterior lip or an open introitus resulting from a previous episiotomy.

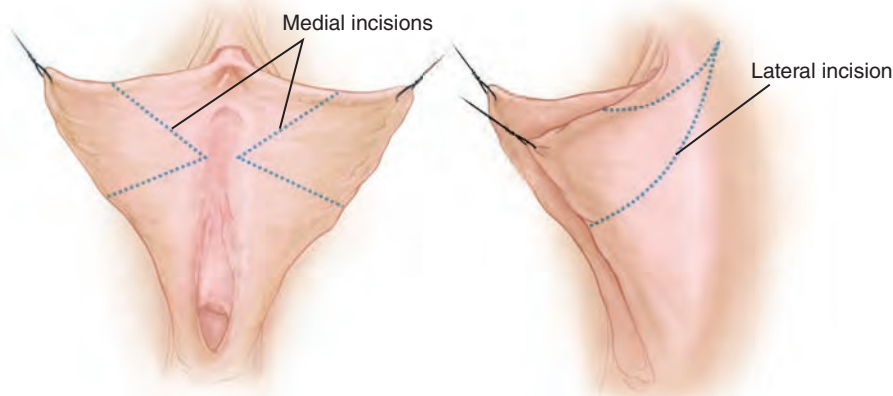
A wedge or V will be excised from the most protuberant portion of each labium. Because the labia are often asymmetrical, the amount of the wedge is varied to achieve symmetry. With the patient holding a mirror and lying in the lithotomy position, the surgeon holds the amount to be excised in each hand by bringing the anterior to the posterior portion of the V together.

There may be a color mismatch between the anterior and posterior labium at the anastomosis, but this is rarely an issue with the patient if she is told preoperatively, and the color difference usually lessens with time. The surgical plan and anticipated postoperative result must be explained to the patient to prevent any misconceptions or false expectations.

Preoperative Planning

Patient Positioning and Markings

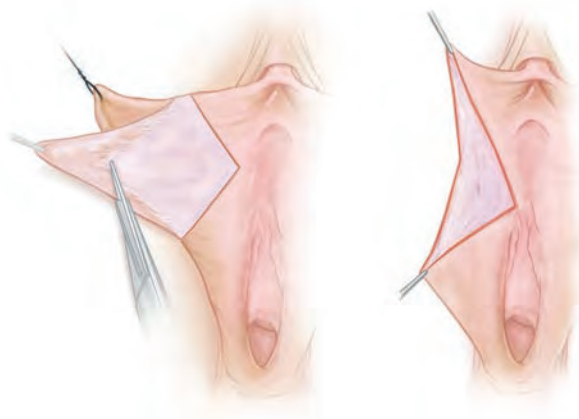
The patient is placed in the lithotomy position in the operating room; usually a general anesthetic is administered. The clitoral glans frenulum converges with the lower clitoral hood to form the labium minus; the nature of this convergence varies among women.



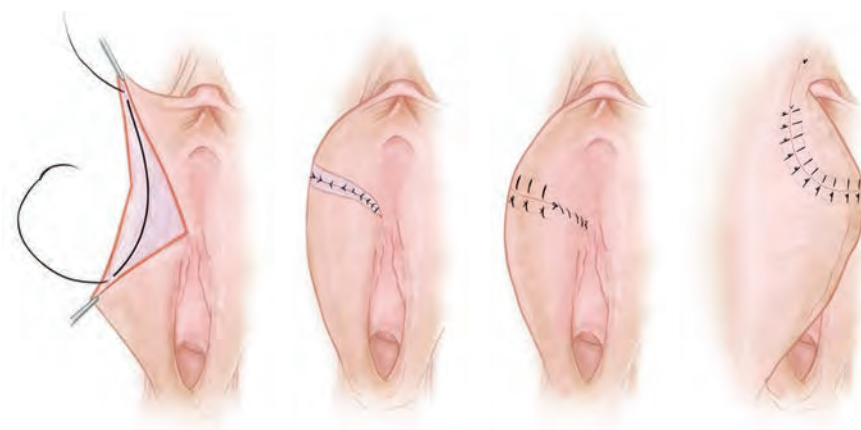
The anterior incision line is usually at or just posterior to this convergence. Forceps are used to determine the appropriate amount of excision in each labium to create a straight line without causing tension on the incision line or a tight introitus (which is uncommon). Markings on the opposite labium are made to achieve symmetry. The medial portion of the V extends internally to end distal to the hymeneal ring. The extended lateral markings are made in an anterior hockey-stick manner for excision of redundant lateral clitoral hood or lateral hood folds. Therefore the medial and lateral wedge excisions are asymmetrical. Usually the darkest labial skin is excised with the V. If there is extreme posterior labial asymmetry or enlargement, a second V may need to be excised from one or both sides to achieve symmetry or adequate reduction.

Operative Technique

After marking, the area is infiltrated with lidocaine and bupivacaine (Marcaine) with epinephrine. Loupe magnification is usually required to get an excellent closure and anastomosis.



The medial labium is approached first, and only the mucosa is removed. The underlying subcutaneous tissue should be preserved. The lateral skin is then excised, also removing only skin and no subcutaneous tissue.



The subcutaneous tissue is then approximated with 5-0 Monocryl on an atraumatic TF needle, in two layers whenever possible. A good subcutaneous closure helps prevent wound dehiscence or fistula formation. Any excess subcutaneous tissue is removed medially or laterally during the closure to eliminate dog-ears or an overly thick labium. The skin is then closed from distal to proximal with interrupted vertical mattress 5-0 Monocryl sutures. Running sutures can be used on the deepest portion of the medial incision line or occasionally on the lateral labium. The subcutaneous tissue of the clitoral hood is closed with a running 5-0 Monocryl suture, and the skin of the hood is closed with a running subcuticular 5-0 Monocryl suture. Minor defects may be closed with 6-0 Monocryl.



Once one side is completed, the markings on the opposite side are checked and possibly remarked for symmetry. The procedure is then repeated. In the very unusual situation in which a second wedge is required on one or both sides, this is performed after the bilateral anterior wedges are closed.



Extending the lateral labial V to the anterior hood can reduce redundant clitoral hood folds or excess lateral skin. However, if the excess folds or hypertrophic skin are more medial, the lateral V excision can stop at the lateral labium, and a vertical el-

lipse can be excised from one or both sides of the medial-lateral clitoral hood. (Excess perineal skin was also excised in this patient lateral to the posterior labia.) If there is asymmetry of the clitoral hood folds, these are adjusted accordingly. If no excess clitoral hood is present or if the patient does not want this excised, then the lateral V ends at the lateral labium or clitoral hood to prevent a dog-ear.

If the patient has redundant transverse folds of the clitoral hood, a small amount can be excised in a transverse ellipse on rare circumstances. Closure is done with interrupted vertical mattress 6-0 Monocryl. Care must be taken not to overly expose the glans, because patients can be hypersensitive or dislike the aesthetic appearance. More aggressive clitoral hood reduction requires clitoral repositioning (clitoropexy), which is beyond the scope of this chapter. Clitoral enlargement of the shaft and glans can be reduced, but this is also beyond the scope of this chapter.

The introitus should fit two fingers without significant tension to prevent overtightening. If there is a high posterior lip or overly tight introitus, a posterior midline incision may need to be made to prevent difficulty with intercourse. If the lip is incised, the vaginal mucosa is sutured to the perineal skin. This creates dog-ears bilaterally that need to be trimmed and aesthetically closed.

If a vaginal tightening procedure is performed at the same time as the labia reduction, the tightening procedure should be performed first. If the patient has very large labia requiring very large V excisions extending up to the hymen, the introitus and perineal closure distal to the hymen should not be completed until the labioplasty is finished. The large V excision can elevate the posterior lip and cause introital tightness. This is best adjusted at the time of distal vaginal and perineal closure.

Postoperative Care

The patient should use ice packs and antibiotic ointment for 2 days. Cephalosporin is given prophylactically for several days. The patient should avoid exercise for 3 weeks, but yoga and horseback and motorcycle riding should not be done for 8 weeks. Sexual intercourse is allowed at 6 weeks. Usually 80% of the swelling is resolved by 6 weeks, with all swelling and induration commonly gone in 4 months. The sutures start disappearing in 2 weeks and are usually gone by 6 weeks. The Monocryl sutures may cause itching and discomfort after several weeks; this can be alleviated with Vagisil or a very weak cortisone cream.

Problems and Complications

Complications are extremely uncommon if meticulous surgery is performed with the above sutures and techniques. Approximately 2% of patients will have a slight separation at the labial edge. Most of the visible small separations will resolve in 4 to 6 months and will not require revision. A fistula or major dehiscence occurs in less than 1% of cases. Surgical revisions may need to be performed for asymmetry of the labia minora or lateral clitoral hood, unsightly or stretched scars, separations or dehiscence of the labial edges, or fistulas. Revisions are delayed a minimum of 4 months after the initial surgery to allow healing and resolution of induration. Rarely, a patient will have some persistent discomfort lasting over several months. This is usually resolved with a several-week course of a potent cortisone cream such as clobetasol 0.05%.

Outcomes

A recent study in 407 patients revealed an average patient satisfaction rate of 9.2 on a scale of 10 (10 indicating most pleased). Patients reported improvement in self-esteem (93%), sex life (71%), and reduction of discomfort (95%), with a low significant complication rate (4%).

Results



This 23-year-old woman is shown before a labia minora reduction and lateral clitoral hood reduction.



The patient is shown 3 months after a labia minora reduction and lateral clitoral hood reduction. The appearance is very natural, with a slight color mismatch that is inconsequential.



This 50-year-old woman is shown before and 3 months after a labia minora reduction and lateral clitoral hood reduction. There is significant reduction of her labia and clitoral hood, with a natural appearance. The scars are almost invisible.

LABIA MAJORA

Women wish to recreate the youthful full labia majora. However, excessively protuberant or low-hanging labia majora can cause an unsightly bulge in clothes, often with a central crease from the introitus. The protuberance can be from either an overly fatty, full majora or a fat deficient, stretched majora with excess skin, or a combination. The woman should also be evaluated for significant mons pubic descent and pubic lipodystrophy, which could affect the approach for the majora surgery as well as results (see the next section). Labia minora and labia majora surgery can be performed in the same operation, with the minora performed first.

Preoperative Assessment

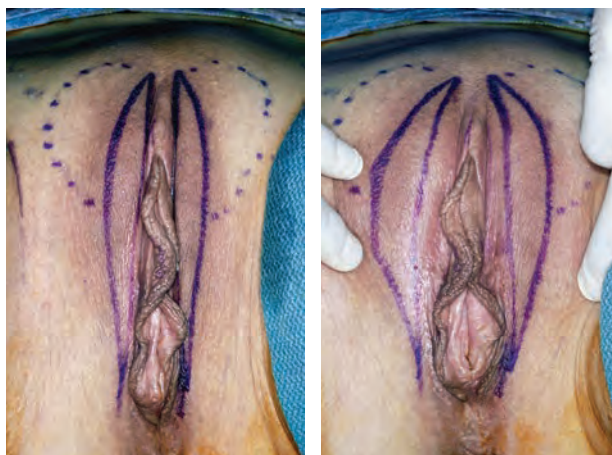
The patient's complaints are evaluated. It is helpful to have her shave on the morning before arriving for surgery, or it must be done at the time of marking. The majora are evaluated for symmetry with the patient standing and lying down in the lithotomy position. The patient uses a hand mirror to view herself during this process. Sometimes the excess may only be loose, redundant skin, whereas in others the excess may be fat. The skin or fat excess may be diffuse or more anterior or posterior.

Patient Education

The patient must be told that reduction of the majora can result in more prominence of the clitoral hood and labia minora. Occasionally, majora reduction may later lead to the patient's desire for a labia minora and/or clitoral hood reduction. She must also be told that the suture line may show a contrast between lighter and darker tissue or between coarse and fine skin. If these issues are described and shown preoperatively, the woman is usually not concerned.

Preoperative Planning

Markings



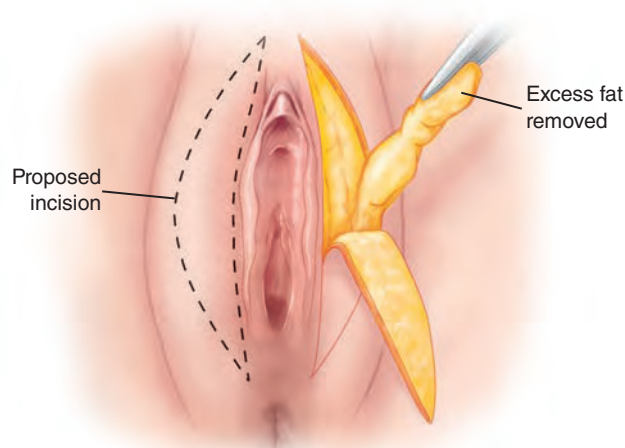
Landmarks are noted and marked, including the medial thigh creases and the lateral color differentiation of each labium. The skin excess is marked as a crescent excision from the medial labium extending from the anterior to the posterior labial commissures. The medial incision line is usually placed just lateral to the medial hairline of the labium. The amount of labial skin to be removed is determined by the amount of excision desired by each woman. However, it is usually mandatory to leave at least 2 cm of pigmented labium lateral to the lateral excision line. This usu-

ally ensures preservation of enough skin to prevent gaping of the introitus while the legs are fully abducted, which must be tested with a cotton swab pushing in the marked area. The surgeon should err on the conservative side. The crescent excision of each side is adjusted to achieve symmetry and to excise more anterior or posterior skin depending on the deformity. The medial anterior and posterior incision lines from each side do not meet in the midline but are moved laterally in a fusiform manner if necessary. Fat excision is performed in only a minority of cases. If fat is to be excised, the location and amount is noted on the markings. With fat removal, overresection must be avoided, because it gives an aged appearance.

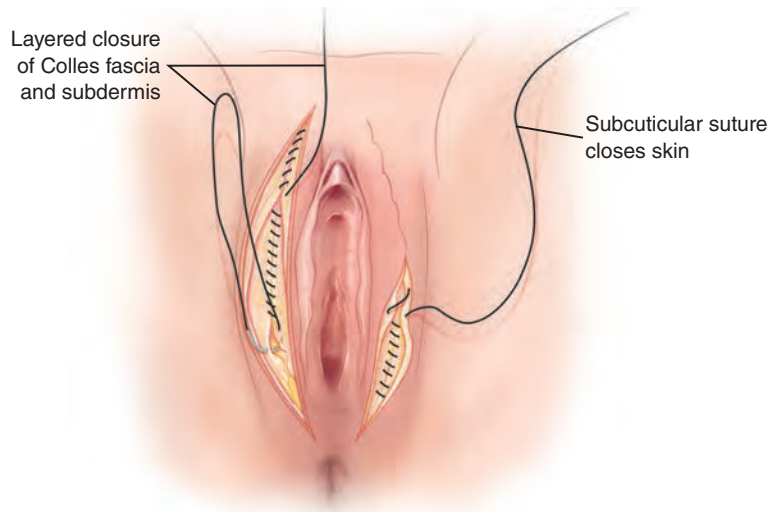


Once the markings are made, the woman stands and the location of the lateral markings are viewed for symmetry. Cotton swabs are used to push in the excess skin or fat to coapt the medial and lateral markings, which allows the surgeon and patient to view the expected postoperative labial size. It is not unusual to perform pubic liposuction during the operation.

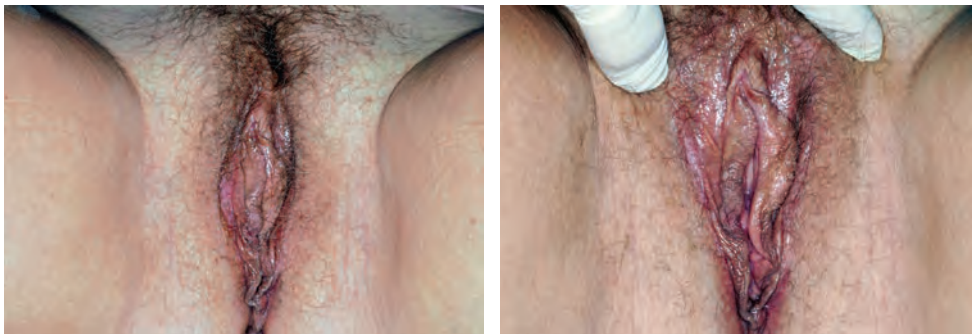
Operative Technique



The patient is placed in the lithotomy position. The areas of excision are infiltrated with lidocaine and bupivacaine with epinephrine. The crescent skin excisions are performed and checked for symmetry. If fat is excised in an area, the superficial Colles fascia is opened. The fat is conservatively removed with electrocautery. Meticulous hemostasis is maintained, or hematomas can occur. The skin on each side is temporarily stapled closed to check for symmetry. The wounds are then reopened.



If fat was excised, the superficial Colles fascia is closed with 4-0 or 5-0 Monocryl. The subdermal tissue is then closed with a running 5-0 Monocryl suture while including deeper Colles fascia to eliminate dead space. The skin is closed with a running subcuticular closure of 5-0 Monocryl. Drains are used only for major fat excisions.



The patient's labia majora are shown 5 months after surgery.

Postoperative Care

Steri-Strips are applied to the wound for a day or until they fall off. The remainder of the postoperative instructions are similar to those for the labia minora.

Problems and Complications

Complications are unusual. Hematomas can occur but are rare, unless a massive amount of fat is removed. The labia can swell considerably postoperatively, but this starts to resolve within a week. Significant discomfort is unusual. The most common complications are inadequate reduction or asymmetry of the skin or fat that may need to be revised in 6 months. Scars are rarely an issue if a subcuticular closure is

performed. Color contrast is not often an issue if this has been discussed with the patient preoperatively and incision placement is optimal. Persistent pain or sexual dysfunction is not likely to occur.

The worst potential complication is excessive skin excision, which can lead to a gaping introitus, causing vaginal dryness, discomfort in clothes, and an aesthetic deformity. This complication is more likely to occur if a medial thigh lift has been or will be performed, because the thigh lift Colles fascia tacking sutures can loosen, causing posterior migration of the thigh skin, thus pulling the majora and opening the introitus. If a medial thigh lift is contemplated or recent, skin excision should be even more conservative.

Outcomes

No series of labia majora reduction has been published. However, patients have expressed that they are extremely gratified with their result if their expectations were realistic preoperatively.

Results



This 55-year-old woman is shown preoperatively and at 5 months postoperatively (she is also shown on pp. 3108-3110). She underwent pubic liposuction and labia majora skin and fat reduction.

MONS PUBIS LIFT

A natural-appearing mons reduction and lift can be achieved with a horizontal skin excision; undermining of the mons fat pad; liposuction of the mons pubis, upper labia majora, and inguinal fat; and fat excision of the residual deforming fat pad. It is imperative that the fibrofatty tissue of the pubic skin flap be tacked to the rectus fascia to prevent recurrent pubic descent.

Preoperative Assessment



The amount of pubic fat and mons descent is evaluated first with the patient in the standing position. The enlargement and protrusion of the labia majora are also noted. If a panniculus is present, it is elevated to determine the amount of pubic skin that needs to be transversely excised. The anterior labial commissure should be at the pubic symphysis. The actual skin excision required is usually no more than several centimeters, because the pubic skin will modestly contract as the fat is removed. Overresection of skin can elevate the commissure too high and give an unnatural appearance. The skin incision is placed just below a pannus fold or at a previous abdominoplasty scar line. The skin crescent excision may remove a small amount of the upper pubic hair. The length of the incision is usually only long enough to eliminate the excess skin but can rarely extend to the anterior superior spines. The appearance of the labia majora with the elevation of the fat pad is also observed, and the amount of fat removal is estimated, if needed.

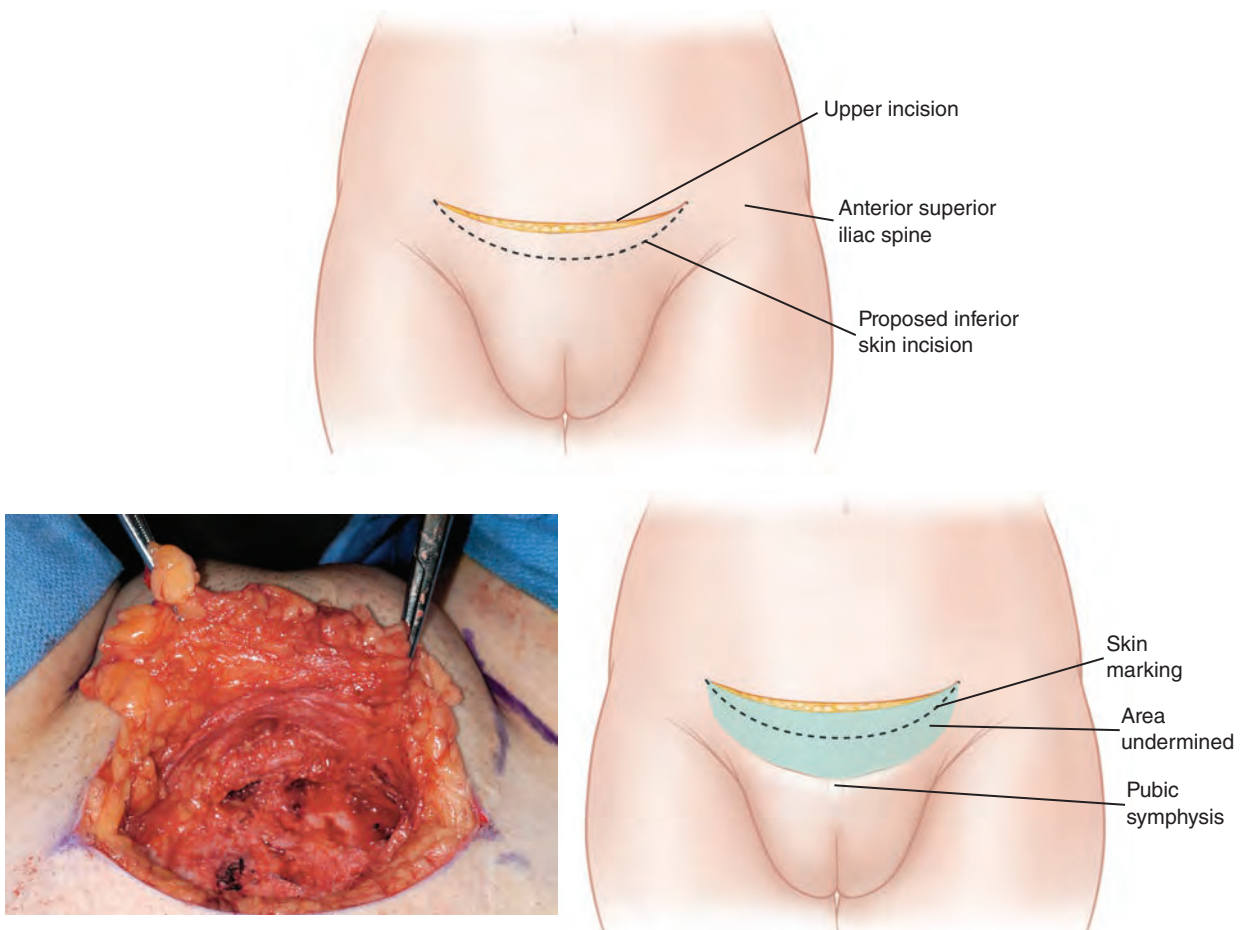
Preoperative Planning

Patient Position and Markings

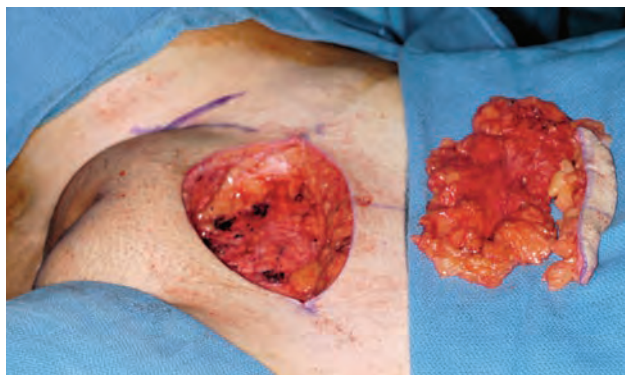
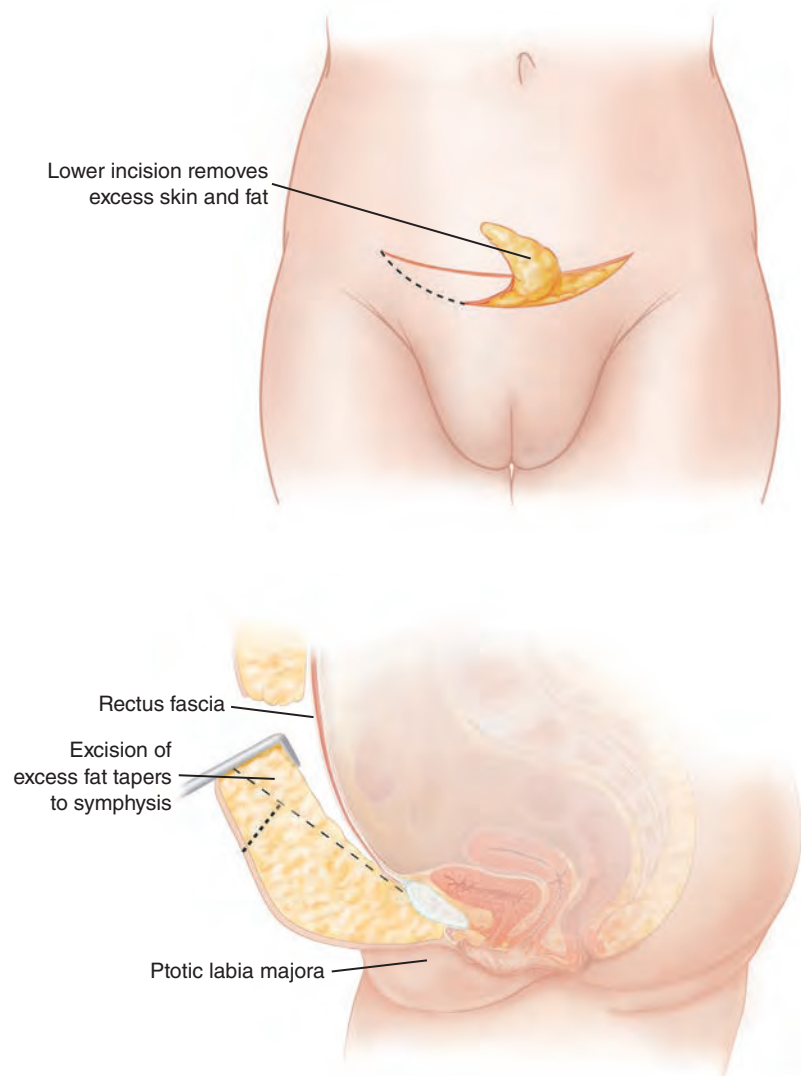
With the patient in the lithotomy position, the labia majora are evaluated for liposuction or marked for skin or fat excision if this is to be performed simultaneously. The procedure is the same as outlined previously.

The patient is placed in the supine position if only a pubic lift is performed. If labia majora skin or fat reduction is to be performed, she is placed in the lithotomy position, with the abdomen and genital region prepared.

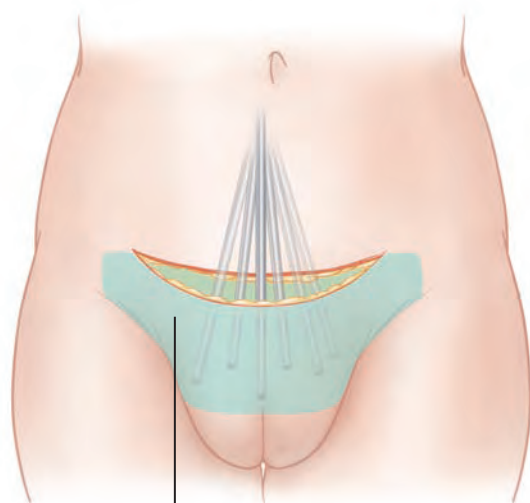
Operative Technique



The upper incision is made and carried down to the rectus fascia. The pubic flap is elevated to the pubic symphysis between the external inguinal rings. More extensive dissection is usually not necessary.

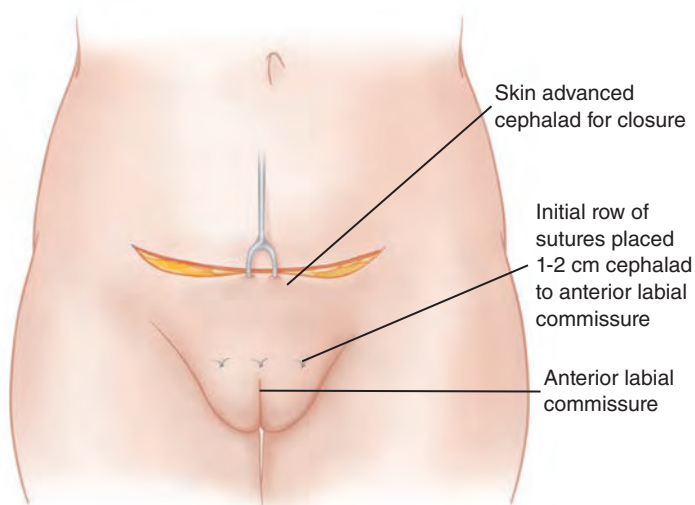
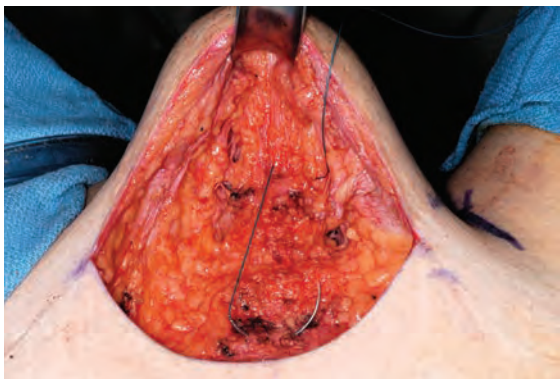


The inferior incision is then made, and a modest amount of pubic fat is excised. Infiltration of the mons, upper labia majora, and inguinal region is performed with tumescent fluid.

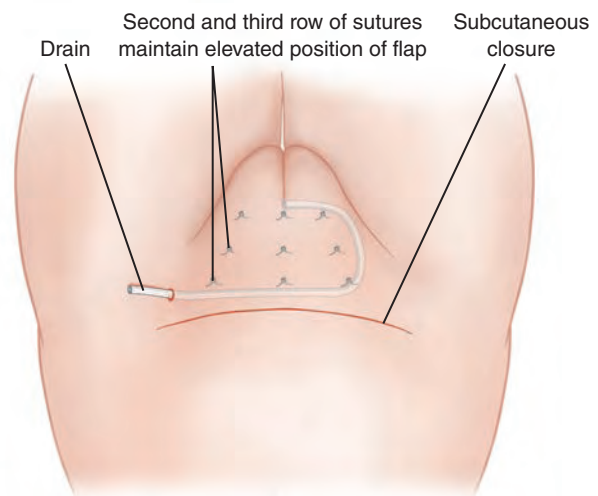
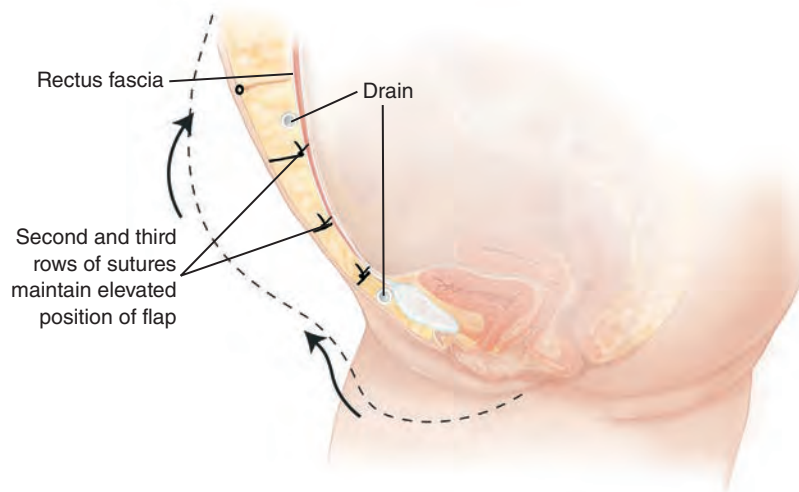
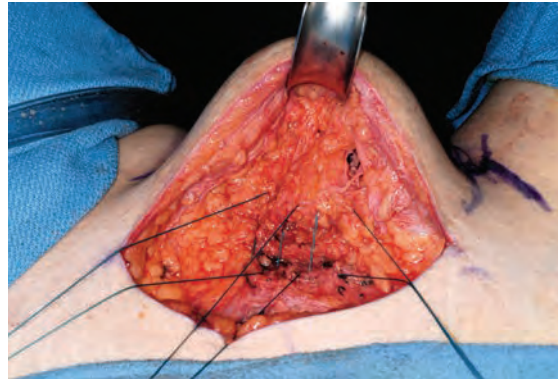


Liposuction of upper labia majora, pubis, and inguinal areas leaving 1-2 cm of fat on skin flap

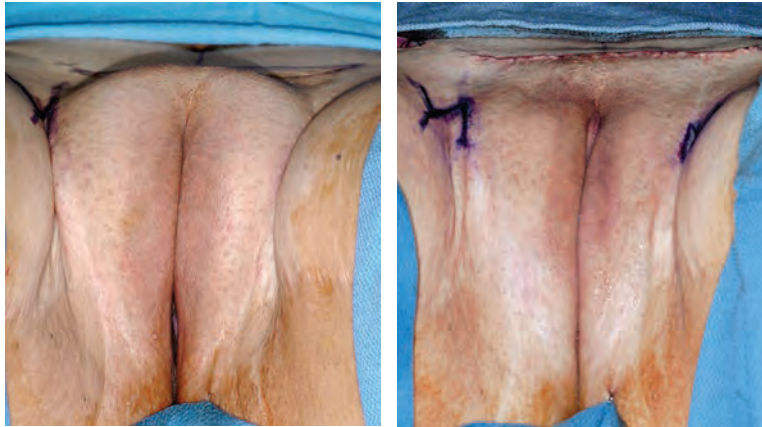
The pubic flap is liposuctioned to a thickness of 1 to 2 cm. The lateral areas are suctioned to prevent a concavity, and the upper labia majora are suctioned. Liposuction of the flap is preferable to open excision of the pubic fat, because it preserves the fibrofatty tissue used for tacking. If the labia majora fat is modestly increased, liposuction of the entire majora can be performed at this time. If labial fat is to be excised from above, open resection is done, followed by bilateral insertion of closed suction drains.



To maintain the lifted position of the mons pubis, rows of tacking sutures of 1 Ethibond on a CTX needle are placed from the fibrofatty subdermal tissue of the flap to the rectus fascia. The first row of three sutures is usually placed 1 to 2 cm cephalad to the anterior labial commissure to the rectus fascia just cephalad to the pubic symphysis and between the external inguinal rings. Mild dimpling can occur and is probably necessary to maintain the lift. These are the crucial sutures, and several attempts may be required to prevent an abnormal pulled appearance of the majora, to minimize dimpling, and to achieve symmetry.



Usually two more rows of three sutures are placed. A closed suction drain is placed from the pubic symphysis along the right lateral sutures, and then under the subcutaneous closure. The subcutaneous tissue and skin are closed. The thickness of the subcutaneous tissue on each side of the incision line should be equal, so liposuction of the lower portion of the abdominal skin flap may occasionally be needed. Rarely, excess abdominal skin may need to be resected to prevent it from overriding the pubic area.



This patient underwent a pubic lift, labia majora liposuction, and bilateral Z-plasties to eliminate restrictive medial thigh bands. She is shown preoperatively and immediately after labial liposuction and a mons lift. If the labia majora skin and fat are to be excised, this is performed at this time (see the labia majora section).

Postoperative Care

The patient's drains are removed when drainage is minimal. The patient is instructed to use ice packs on the majora for 2 days.

Problems and Complications

The patient should be told that there might be some concavity in the pubic area. However, liposuction of the pubic flap with conservative pubic fat resection along with lateral liposuction helps prevent that. Excess elevation of the pubic area can result in an unnatural anterior labial commissure and a short escutcheon. This is uncommon if skin resection is conservative.

If the patient has had a previous inner thigh lift, labia majora skin excision should probably not be performed at the same time as the pubic lift. Theoretically, the skin between the majora incision and the inner thigh may be at risk if the pubic resection is performed. Instead, labia majora liposuction or fat excision through the pubic wound can be done first, followed by a later procedure for additional excision of labia majora fat and skin, if necessary.

Outcomes

Patients are generally extremely happy with elimination of the pubic protrusion. It is uncommon to have an unhappy patient as long as the limitations and potential results are explained and shown to the patient preoperatively. The need for recurrent pubic lift surgery is very uncommon.

Results



This 23-year-old patient (also shown on p. 3112) is seen before surgery and 4 months postoperatively.



This 34-year-old woman had lost 91 kg (200 pounds), and an abdominoplasty with an attempt to decrease the pubic mons fat pad had been performed previously. The markings show the amount of pubic skin to be excised and the previous abdominoplasty scar. The lateral incision lines on the labia majora are checked for symmetry. The markings for the labia majora skin excisions are shown, which do not cross the midline. The pubic lift was completed, and the closure after labia majora skin excisions and pubic lift are shown.



The patient is shown preoperatively with a bulging pubic fat pad and hanging labia majora. Ten months postoperatively, an excellent result is seen. She could benefit from more pubic liposuction, but she is not concerned about this.

Concluding Thoughts

Aesthetic genital surgery can be very successful if the guidelines are followed meticulously. As more women become aware that safe, successful operations are available, the number of procedures performed will continue to increase.

Clinical Caveats

During preoperative assessment for all procedures, the patient should hold a mirror while she is shown the tissue to be excised and her expected postoperative result is discussed.

Labia Minora Reduction

The excision should not be closed with tension.

A good subcutaneous closure, usually in two layers through most of the length, is essential to prevent dehiscence. The labium is thus closed in four layers.

5-0 Monocryl on an atraumatic TF needle is ideal to prevent a tissue reaction and trauma that can lead to wound separation.

Vertical mattress sutures at the leading edge of the labium minus help to prevent wound separations.

The surgeon should confirm that two fingerbreadths can be inserted in the vagina.

The glans clitoris should not be overexposed if some of the clitoral hood is being excised vertically or horizontally. The glans exposure should remain the same as before surgery unless the patient requests otherwise.

Labia Majora Reduction

The eventual scar line should be as inconspicuous as possible, usually just lateral to the medial hairline.

The symmetry of the markings should be checked with the patient both standing and lying down; the appearance of the labia can be assessed by imbricating the marked areas with cotton swabs.

Overresection of the skin must be avoided, because this can cause a gaping introitus, especially if an inner thigh lift has been done or is contemplated.

A subcuticular closure should be used.

Continued

Clinical Caveats—cont'd

Mons Pubis Lift

The anterior labial commissure should not be overelevated.

Care must be exercised so that the escutcheon is not too narrow.

The pubic flap is primarily thinned by liposuction. An adequate amount of fibrofatty tissue should be left on the flap to prevent a concavity. The peripheral areas are liposuctioned for wound contouring.

Usually three horizontal rows of three symmetrical, strong tacking sutures are placed from the pubic flap to the rectus fascia.

The thickness of the two sides of the skin closure are matched and adjusted as needed.

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The author's first report on the wedge resection for labia minora reduction.

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CHAPTER 87



Evaluation and Treatment of Iatrogenic Deformities

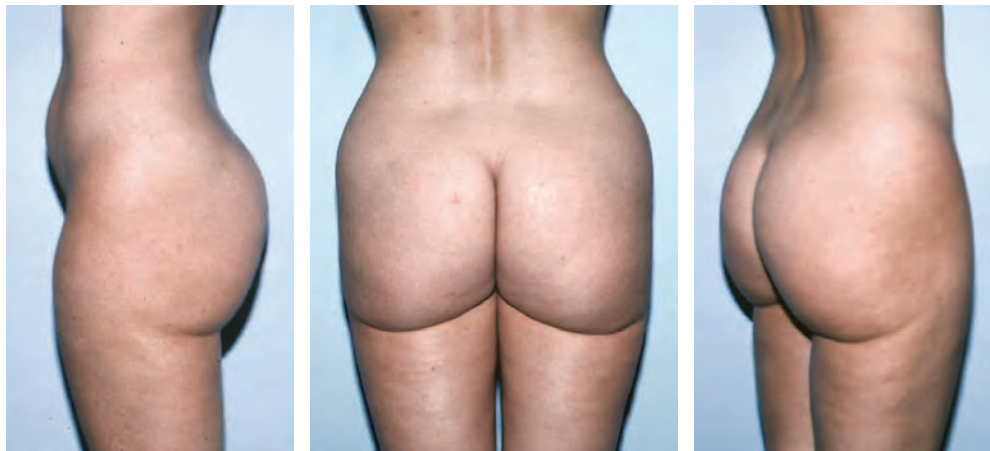
SYDNEY R. COLEMAN

Structural fat grafting is an essential tool for all aesthetic surgeons performing liposuction, because it provides a successful way to treat iatrogenic liposuction deformities. Patients with liposuction deformities were the first patients in my practice in whom I attempted fat grafting and therefore the patients with whom I have the longest experience. Unlike the use of fat to rejuvenate the hand, successful treatment of surface irregularities in the body requires a three-dimensional visualization of the problems and solutions.

Aesthetic Considerations

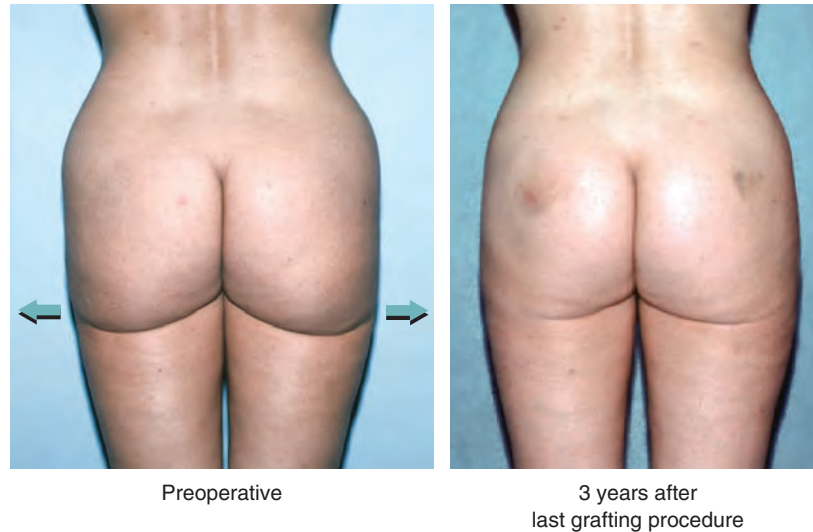
Any surgeon performing liposuction will undoubtedly experience the most common complication of liposuction—superficial surface irregularities. Some are exaggerations of preexisting irregularities, some consist of cellulite, and some are newly created. The thigh and abdomen are particularly prone to irregularities. Postliposuction iatrogenic deformities are not limited to surface irregularities. Changing the relationship between a woman's thighs, hips, and abdomen can result in unnatural and even bizarre proportions.

In 1987 I began treating iatrogenic liposuction deformities with fat grafting, primarily focusing on correction of surface irregularities. As I became more proficient at fat grafting, I began to address corporeal proportion to restore a more natural aesthetic symmetry after liposuction.



This 30-year-old woman presented 2 years after liposuction to her lateral thighs, buttocks, and love handles. She was distressed by the deepening of her buttock crease, which now wrapped around her thigh. She felt that her legs looked shorter and her buttocks bigger and more ptotic after the procedure. She also noticed that her body appeared boxy and less feminine. When she complained to the plastic surgeon about

the appearance of her buttocks, she discovered that he had purposely deepened her buttock crease to create a more aesthetic “smiling” crease.



The patient is shown 3 years after her second procedure, which restored a more normal appearance to her body. Additional fat was removed from her waist, upper hip, and lateral buttocks and placed into her buttock creases and lateral thighs to create a more feminine and natural relationship of the waist, hip, and thigh. By filling in the deepened buttock crease and slightly expanding the thighs, a more normal buttock-thigh interface was reestablished. By restoring the continuous flow of the buttock into the thigh, a more attractive, youthful line of the leg was restored.

Patient Selection

Patients who present with iatrogenic body deformities have usually had previous experiences with aesthetic surgeons, and they view these experiences as negative. Their perception of their bodies is colored by that experience, and it is often difficult to assess how realistic these patients are about their current appearance as well as the degree of satisfaction they will attain with treatment.

The aesthetic surgeon should not agree to perform a correction unless he or she has a reasonable expectation that a positive correction of the patient's deformity can be done without creating unacceptable new problems (such as donor-site deformities). Furthermore, the surgeon should believe that the positive correction will be demonstrable on photographs and that the patient will be able to appreciate the positive change. It should be clearly explained to the patient that new deformities might be created by harvesting fat to correct the current irregularities.

Patient Education

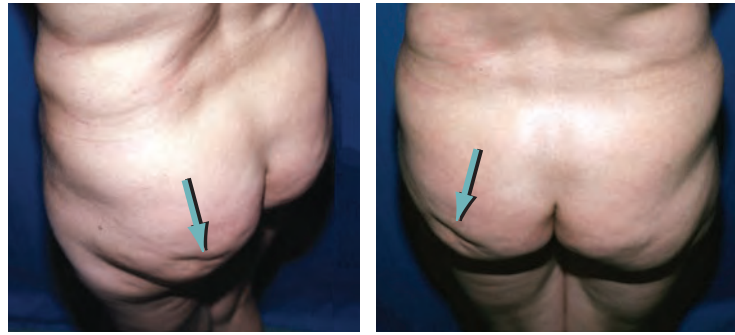
These patients need to be prepared for the result. For major deformities, I warn patients that it may take as many as four procedures to attain a result that they will find acceptable (although I have never performed more than three procedures on any one patient's body). I explain to the patient that the first procedure for a major defect is to restore volume; the second is to smooth out the area with "finishing touches." On an extremely rare occasion, a patient may desire a third procedure to smooth the area even more. For smaller irregularities, one procedure is often sufficient.

Patient Evaluation

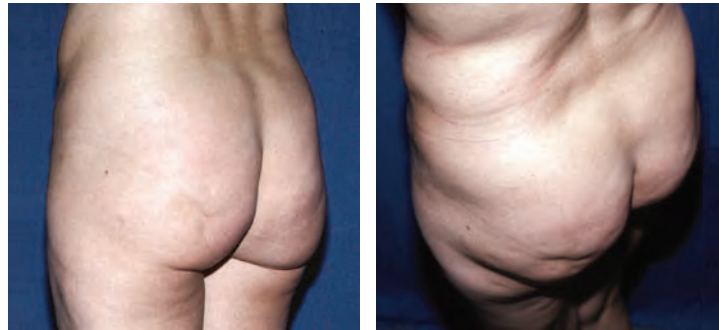
The most important step in correction of iatrogenic deformities is analysis of the defect. If the surgeon cannot adequately demonstrate a deformity on film, it will be almost impossible to show that the procedure has produced a positive change.

Photography for corporeal proportion is relatively standard, but photographic techniques to demonstrate surface irregularities are more challenging and require a different approach. When patients see their bodies in standard photographs, they often comment that the image does not accurately portray the full extent of the surface irregularities they see when they look at their unclothed bodies. I have come to realize that the primary reason for this discrepancy is that patients are most often looking down at their bodies with downlighting when they see these irregularities, whereas standard photographs are taken without this elevated perspective and with more diffuse light. Therefore it is difficult to appreciate patients' deformities with the standard views that plastic surgeons routinely obtain.

After much experimentation with lighting, I have finally developed a system of photography for analyzing corporeal defects to more accurately reflect what the patient sees and wants corrected. This system came about when one of my patients insisted that I take photographs of her body while I was standing on a stool so that the camera was a few feet above her. From this "bird's-eye" perspective, we were both much better able to appreciate the extent of her body surface irregularities than from any of the standard views.



With this bird's-eye view of a patient, the defect in her left buttock is clearly visible, in the same way that it is visible to her as she looks over her shoulder or in the mirror with downlighting.



Even large irregularities can be difficult to discern in the standard photograph taken of this patient compared with the bird's-eye view. I now stand on a stool and obtain approximately 10 views of a patient's body for almost any corporeal procedure that I perform. By shooting from a bird's-eye view, I can more effectively see the problem that the patient wants corrected.



After the patient is marked to demonstrate the areas of harvesting and placement of structural fat, I then photograph the patient standing with the marks. Before the procedure begins, I have the photographs printed to compare the marked and unmarked photographs, both with the patient standing. With the photographs placed next to each other, I can more accurately determine the relationship of the marks to the actual deformity while I am operating on the patient, who is in a supine or prone position.

Technique

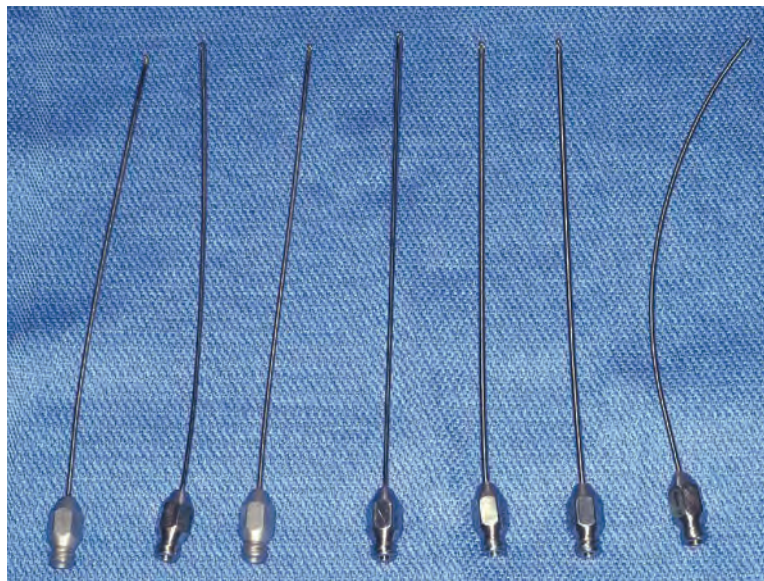
Anesthesia

Epidural and occasionally general anesthesia are most commonly used. No solution is placed into the areas to be infiltrated.

Incisions

When harvesting from the back, sacrum, or hip, the lateral sacral depressions are used as the main incisions. Incisions into this anatomic structure are much better tolerated than incisions anywhere else in this region.

Infiltration Cannulas



The syringes are connected to cannulas, which range from 18 to 16 gauge and vary in length from 7 to 15 cm. I prefer to use the shorter cannulas (usually 9 cm), but to avoid making too many incisions, I will often switch to a 15 cm cannula to extend placement from any one incision. When using the 15 cm cannulas, I prefer to use the thinner cannulas. I will switch to a 16-gauge cannula if there is much resistance. I alternate between straight and curved cannulas, depending on the curvature of the underlying structures.



The body is the only place that I use 3 cc Luer-Lok syringes for infiltration of fatty tissue. I fill the 3 cc syringes with 2.5 cc of refined fat to make them easier to manipulate. Unlike the 1 cc syringes, these syringes can be reused repeatedly without the plungers sticking. The technique of placement in the body differs from that described for the face and hands in that slightly larger amounts are placed with each pass, but no more than 0.25 cc is intentionally placed in a single withdrawal.

Level of Infiltration

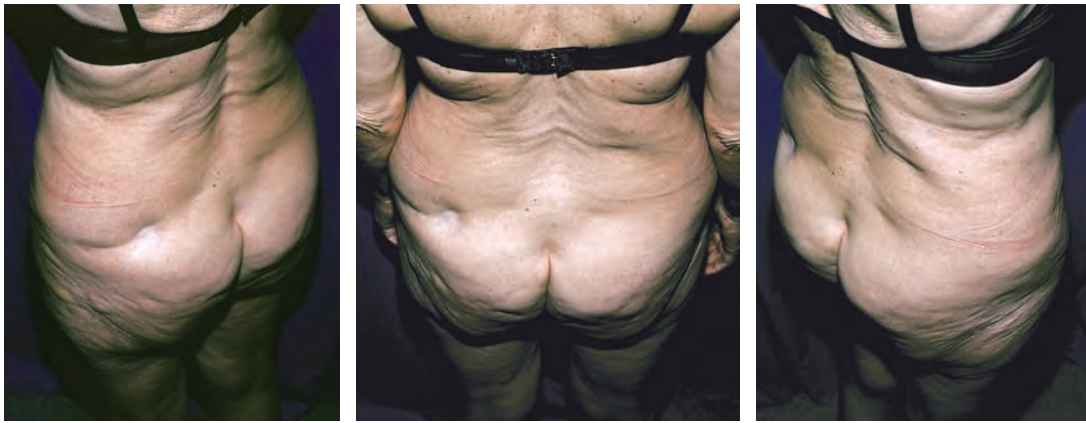
The level of infiltration depends on the desired outcome:

Fat is layered into the deep planes for large contour changes to the thighs or buttocks. In those deeper fat planes, especially if any tissue is placed into muscles, the thicker 16-gauge 15 cm style I cannulas are used. The blunt large cannulas minimize the possibility of damage to vessels and nerves in the muscles. More tissue is placed superficially to fill a specific groove or depression. Placement starts in the immediately subcutaneous plane and infiltrates layer by layer to a deeper plane, specifically feathering as the placement deepens.

Volume Ranges

Volumes for correction of corporeal deformities vary from 1 cc placements into minuscule irregularities to as much as 300 or 400 cc into a deficient thigh, buttock, or arm.

Procedure



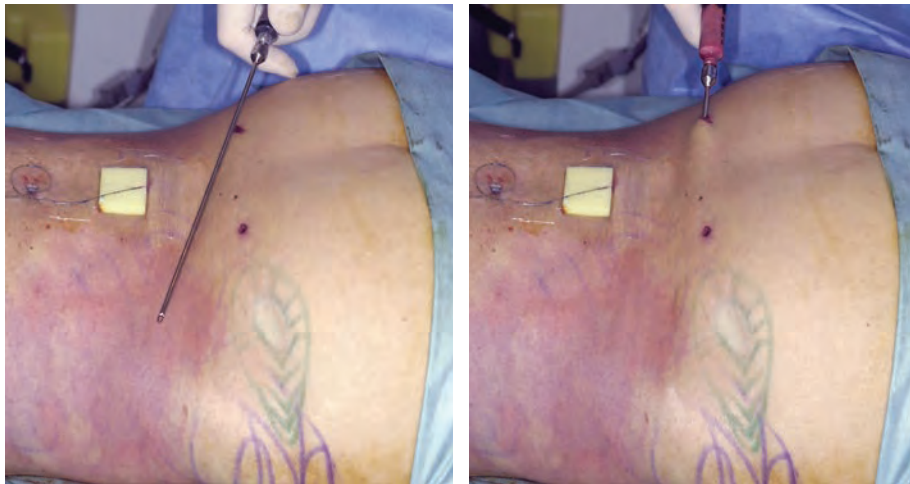
This 60-year-old patient presented with a depression that developed after she had multiple injections of steroids into her left hip. A significant defect is visible from the bird's-eye view, whereas I could barely see the problem in most of her conventional photographs.



The procedure is planned on tracings of the patient's body in many views. The plan devised for this patient was to remove tissue above the defect and refine it, and then place it into the depression.



The areas of planned removal were marked with a purple marker, the areas of planned placement of the refined fatty tissue with a green marker, and the planned incision sites with red markers.



This patient has already had tissue harvested from her right side and her upper love handle on the left. The first step in correcting the depression was to remove tissue above the defect to flatten the surface superior to the defect and provide additional harvested tissue to place into the defect. I began harvesting the portion nearest the contralateral incision using a 23 cm straight harvesting cannula with access through the contralateral sacral incision. I then switched to the ipsilateral incision and continued the removal of tissue laterally using either a 15 or 23 cm straight cannula.

To decrease the number of incisions that are needed to effectively remove subcutaneous tissue in the torso, I began using curved cannulas connected to my 10 cc syringes. A gently sloping curve on a cannula allows me to follow the natural curves of the body. For example, in this patient I could follow her body contours all the way to the far flank and hip from a sacral incision with a 23 cm curved cannula; 100 cc was removed from this patient's right love handle and 70 cc from the hip above the depression.



Placement into the defect begins with a style I blunt, 15 cm infiltration cannula through the ipsilateral sacral incision. This longer cannula allows placement from a slightly more distal incision. The placement begins deep and progresses in layers to a superficial level to create an integrated volume. The barrel of the cannula is firmly grasped between the fingers (middle, ring, and little) and the thumb while the cannula is inserted into the incision and advanced through the tissues. I use my index finger (or thumb in some situations) to push on the plunger while the cannula is withdrawn. *Fat is forced through the cannula into the donor site only as the cannula is removed, not while it is advanced.*

Numerous layers of fat are infiltrated in the deep tissues, gradually moving superficially to place a layer immediately subdermally. In the more superficial planes, the surgeon must pay special attention to avoiding linear placement or lumps. Placement in the immediate subdermal plane is especially important in patients with atrophy from steroids or other injections. I try to approach most areas for infiltration of fatty tissue in the body and face from at least two directions to provide more structural integrity to the placed tissue. In this instance I made an incision to allow placement perpendicular to the previously placed fat. After the incision with a No. 11 blade, I often open the depth of the incision with a small scissors or style III cannula. Placement continues, emphasizing the area of greatest deficiency in the central circle above, and feathering out into the surrounding areas.



The placement again begins deep against fascia and muscle through to the most superficial planes. An attempt should be made to disrupt an adhesion that causes surface dimpling or an isolated depression. This should be performed after most of the fat placement has been attempted to avoid creating unstable tissue planes in which the fat can migrate. I recommend disruption of subcutaneous adhesions or scars with a V-dissector. In the body, a 14- to 16-gauge cannula and a 15 cm cannula may be more useful and effective.

Posttreatment Care

One or two layers of Microfoam tape are placed over any areas into which fat has been grafted. Bulky dressings or foam rubber is never positioned over grafted areas. However, Reston foam can be placed over areas that are suctioned on the body to relieve pressure on grafted areas. Over the Microfoam tape and Reston foam, a girdle or abdominal binder can be placed to apply gentle pressure on the Reston foam and to secure the Microfoam tape.

If grafting is performed in the buttock crease or around the sacrum, the surgeon must consider positioning of the patient after the procedure. Because the ischium is weight bearing when the patient is sitting, he or she is instructed not to sit directly on the “sitz bones.” Rather, the patient should sit far forward or lean backward to distribute the weight while sitting so that the weight is not directed to the area of recent grafting. Because the sacrum is weight bearing when the patient is supine, the patient should be encouraged to lie on the opposite side, if possible, after grafting around the sacrum. Patients are also asked to wait at least 2 weeks before massaging the recipient sites to allow sufficient time for grafted tissues to become more stable.

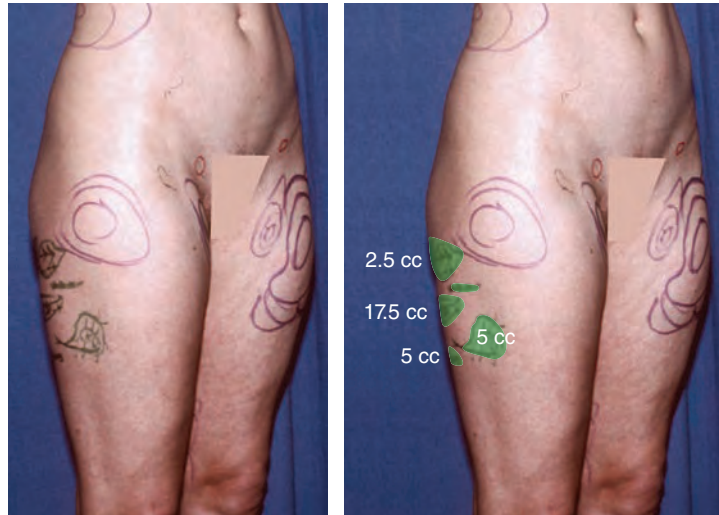
Complications

Undercorrection and overcorrection are the two most frequent complications after corporeal fat grafting. Friction from the many passes of the harvesting and infiltration cannulas can create incisional complications, such as hyperpigmentation and depressed scars. Use of the lipids decanted after centrifugation to lubricate the cannulas can significantly improve the appearance of the incisions. Paresthesia and transient anesthesia are also common in both the recipient and donor sites. Patients rarely complain about them for more than a few weeks.

Results



Many of the patients who are seen for correction have subtle surface irregularities requiring only smoothing without significant volume replacement. This 35-year-old patient presented 3 years after lateral thigh liposuction complaining of minor irregularities.



Because she had almost no viable donor sites, it was possible to harvest only minimal amounts of tissue. Therefore only 30 cc was placed into her right lateral thigh irregularities in the areas demonstrated above.



The patient returned at 2 years and 3 months after the only procedure. The modest amounts of structural fat grafting resulted in significant improvement and great patient satisfaction.

Clinical Caveats

The most important step in correction of corporeal deformities is analysis of the defect. A photograph from a bird's-eye view is invaluable for accomplishing this purpose.

To lessen any potential donor defect, the surgeon should minimize the amount of fat suctioned in any one area.

Use of the oils decanted after centrifugation to lubricate the cannulas can significantly improve the appearance of the incisions.

Annotated Bibliography

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The authors discuss correction of supratrochanteric depressions, trochanteric bulges, scars, contour irregularities, perineal bands, and flat buttocks.

Suggested Readings

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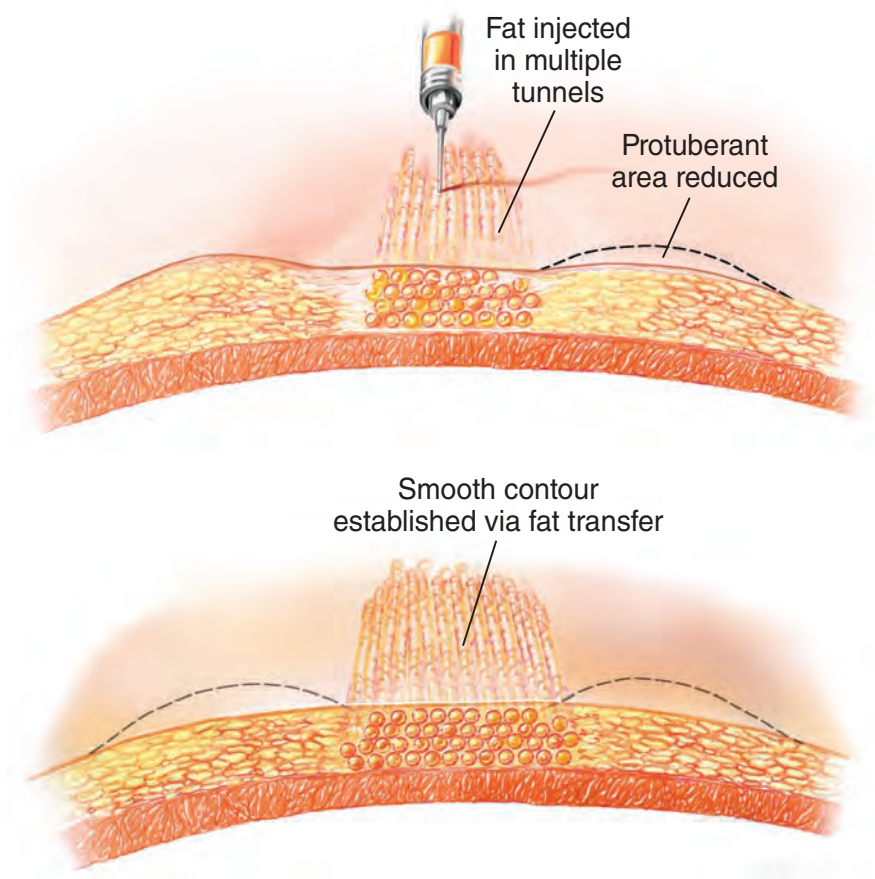
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CHAPTER 88



Correction of Contour Deformities After Liposuction

KRISTOFFER NING CHANG

With the introduction and popularization of *suction-assisted lipectomy* (SAL) in the 1980s, the concept of body contour surgery was dramatically transformed, offering surgeons a new tool to improve outcomes and reduce morbidity. Since that time, subsequent refinements and developments, including the use of wetting solution, large-volume liposuction, *ultrasound-assisted liposuction* (UAL), and *power-assisted liposuction* (PAL), have further enhanced our ability to contour the body. Today, liposuction's popularity and appeal have made it one of the most frequently performed aesthetic operations in the United States. Despite the excellent results often obtained with liposuction, this procedure is not trouble free and may produce aesthetically unsatisfactory results. Aesthetic problems resulting from liposuction can be grouped into four general categories:

1. Skin problems
2. Surface or contour irregularities
3. Disproportions
4. Skin excess

Skin problems include pigmentation changes, discoloration, loss of smoothness and sheen, textural changes, atrophy, wrinkling, and scarring. Surface or contour irregularities include visually distinct depressions, grooves, waves, dents, divots, dimples, ridges, and protuberances. Aesthetic disproportion is characterized by altered proportion in various parts of the body, rendering a disharmonious, displeasing look. For example, excessive removal of fat of a woman's thighs may result in an emaciated or a masculinized appearance. Excessive skin results from a discrepancy between the overlying skin envelope and the underlying subcutaneous tissue and fat. The junction of the lower buttock and upper posterior thigh is an area prone to this type of problem.

These changes are referred to as *postliposuction contour irregularities* or *iatrogenic deformities*, and they are familiar to any surgeon who performs liposuction. This chapter presents postliposuction deformities and strategies for their prevention and treatment.

Avoiding Deformities From Liposuction Procedures

A number of variables influence the outcome after liposuction and should be carefully considered when planning liposuction. These variables include the patient's age and skin condition, the composition and extractability of the fat, the equipment to be used (SAL, UAL, or PAL), the infiltration of wetting solution, artistic planning and surgical execution, and postoperative care. Careful planning is the key to preventing postliposuction deformities. The surgeon must understand the potential pit-

falls to be avoided and must individualize treatment to take into consideration the particular anatomic situation for each patient. Major factors that contribute to poor aesthetic results include overresection, underresection, removal of fat from the wrong location or from the incorrect depth of the subcutaneous layer, excessive fibrosis, scarring, loss of tissue elasticity and support, and skin excess.

Factors That Contribute to Poor Aesthetic Results

Overresection

Although we have strategies for correcting problems related to liposuction, it is always best to avoid them. Understanding the causes of these problems will help prevent them. Contour irregularities are among the most common deformities after liposuction. A common cause of these deformities is overresection of adipose tissue, which may result from employing a cannula that is too large or by making too many passes with the cannula in the same location. In some patients, especially fair, thin-skinned women, the adipose tissue may be loose and prone to overresection. The use of wetting solution containing epinephrine and lidocaine promotes hemostasis, provides analgesia, and makes the fat more easily removable. When an excessive amount of wetting solution is used in an area where the fat is loose and nonfibrous (for example, the buttocks or lateral thighs), fat extraction can easily exceed what is needed to achieve the desired result. Excessive infiltration of wetting solution, combined with the use of the cannula in the subdermal layer, may result in diffuse, multicentric contour irregularities. To ensure a good surgical outcome, there must be a smooth, unscarred layer of adipose tissue remaining beneath the skin and dermis.

In some patients, the aesthetic limit of fat extraction may be exceeded. Too much fat removal from the thighs may transform a desirable female shape into a more masculine appearance. The midsection of the medial thigh is particularly susceptible in this regard. Overresection may occur when the underlying bony prominence causes the surgeon to erroneously assess the remaining amount of adipose tissue to be removed. The medial condyle of the femur can mask overresection while the patient is in a supine position with the knee extended. This soft tissue deficiency becomes evident when the patient assumes a sitting position.

Uneven Resection

Uneven resection may occur where more fibrous adipose tissue is juxtaposed with looser adipose tissue. For example, in the periumbilical area, dense subcutaneous tissue around the umbilical stalk changes into the softer adipose tissue of the lower abdomen. Similarly, a preexisting abdominal surgical scar may cause interference with smooth fat extraction near the scar. Careful patient examination and planning for these anatomic variants can help prevent potential problems in these areas.

Incision Placement

Suboptimal incision placement may also yield unsatisfactory results. Ideally, an incision should permit easy access for execution of a series of unhindered, smooth, and radiating cannula movements appropriate for the three-dimensional configuration of the adipose tissue to be modified. When the cannula is torqued, forced to go around a curved surface, or its movement is impeded, the results may be suboptimal. To ensure smooth coverage of the area to be aspirated, two incisions may be placed 90 degrees from each other to allow the surgeon to make crisscrossing patterns. In circumferential liposuction or liposuction of extensive body surfaces, grid-pattern markings of variable sizes can be drawn on the skin surface intraoperatively to assist with placement of incisions and to facilitate unimpeded cannula movement.

The Level of Subcutaneous Tissue

Removal of adipose tissue from an inappropriate subcutaneous level may contribute to unsatisfactory results. For example, when fat is removed from the deep subcutaneous layer of the lower buttock and the upper posterior thigh region, support is lost and the buttock becomes ptotic. Improvement of the upper posterior thigh (subgluteal region) and the anterosuperior knee is accomplished by removal of more superficial fat.

Markings

The body's contour changes as the patient moves from a standing to a recumbent position, or when wetting solution is infiltrated. These changes must be considered when markings are being made preoperatively. The appropriate surgical markings guide the surgeon to prevent compromise of the extraction of fat. Lack of proper feathering at the periphery of the liposuction site may lead to a visible demarcation between the treated and untreated areas.

Use of Ultrasound-Assisted Liposuction

When UAL is being used, care must be taken to carefully regulate the amount of ultrasound energy applied. Excessive ultrasound energy may result in overresection, prolonged edema, and tissue damage from mechanical impact or the thermal effect.

Compression

Appropriate application of postoperative compression is important to prevent deformities. Uneven compression may lead to temporary or permanent deformation of the skin and subcutaneous tissue. Prolonged and tight postoperative compression may accentuate tissue ischemia associated with the use of epinephrine and tissue trauma from fat extraction, thereby resulting in more fibrosis and scarring.

Liposuction is a very effective tool for body contouring. Its successful execution is highly dependent on sound surgical judgment based on careful patient evaluation, meticulous preoperative planning, an understanding of anatomic landmarks, and knowledge of one's own surgical skills.

Secondary Procedures for Treating Postliposuction Deformities

Secondary procedures are performed after liposuction to remove residual fat excess and contour irregularities. Residual fat excess with a smooth, normal-appearing contour is amenable to additional liposuction. Protuberances in contour that appear visually distinct and do not blend into the surrounding surface contour require additional liposuction. Minor contour irregularities can be treated by limited additional liposuction, which is often performed under local anesthesia. The more severe and complex cases of postliposuction contour irregularities require a systematic approach that includes combinations of the following:

1. Liposuction of areas of protuberance
2. Liposuction around the areas of depression
3. Simultaneous fat grafting
4. Dermolipectomy for redundant skin

The technique of corrective liposuction and fat grafting has been available since the late 1980s. It has the advantage of being simple and safe. Fat collection, processing, and injection require commonly available supplies and instruments. Most patients have ample amount of fat available for harvesting to further modify and improve the contour.

Indications and Contraindications

Autologous fat grafting is indicated for the replacement of volume deficiencies and for filling postliposuction irregularities and indentations in the thighs, abdomen, hips, waist, buttocks, chest, and arms.

Patient Profiles



Liposuction of this 54-year-old woman's thighs and abdomen resulted in indentations in her anterolateral thighs, distal medial thighs, left groin, and lower abdomen. She is a good candidate for corrective liposuction and fat grafting because she has the following characteristics: (1) abundant subcutaneous fatty tissue around areas of depression, (2) gentle slopes in areas of indentation, (3) preservation of good skin quality in the areas of indentation, and (4) an absence of dense subcutaneous scarring.



Some patients develop extensive skin changes and subcutaneous fibrosis with multiple diffuse indentations. These problems are less responsive to corrective liposuction and are better treated with fat grafting.



Dermolipectomy is indicated for patients with redundant skin or extensively affected skin. This 45-year-old woman is a candidate for dermolipectomy. She developed loose skin in the medial thighs with uneven contours in the medial and anterior thighs after liposuction.

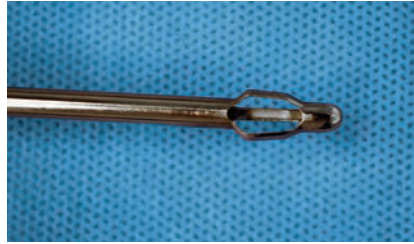
She was first treated with corrective liposuction and fat grafting, which was followed by medial thigh dermolipectomy after 1 year and 8 months. Postoperative results show a smooth contour and less flaccid skin 10 months later.



The same patient also developed an extra crease in the left upper posterior thigh and buttock junction after her original liposuction. This deformity was improved with posterior thigh dermolipectomy, which was an extension from and continuous with the medial thigh dermolipectomy.

The location of redundant skin determines where dermolipectomy is indicated. Dermolipectomy procedures include but are not limited to medial thigh lift, transverse flank-thigh-buttock lift, lower abdominal dermolipectomy, abdominoplasty, upper abdominal dermolipectomy, and brachioplasty.

In 2001 Saylan described *liposhifting* as a technique for the treatment of postlipoplasty irregularities. More recently, Wall has advanced the technique he refers to as *separation and fat equalization* and applied its use to both secondary and primary lipoplasty. In this technique, the fat is separated with a cannula that has an expanded, basket-shaped tip.



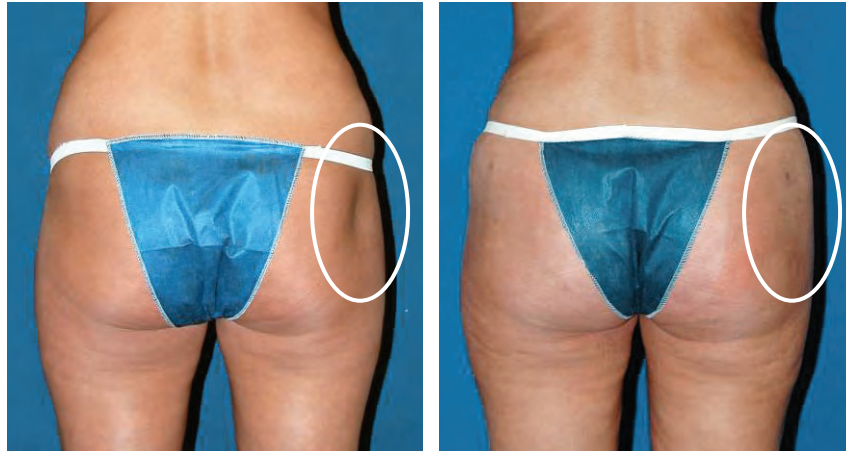
The fat is shifted and redistributed by manual massage and back-and-forth cannula movements without suction. Thus the fat is redistributed and equalized between areas of relative excess and deficiency. Wall's technique uses a power-assisted device. The fat transfer is internal, without leaving the body.

Liposhifting complements the “external” fat transfer technique. It does not replace external transfer of fat from a distant site if there is a significant deficiency of fatty tissue. In some cases in which the deformity is irregular, multicentric, and complex in shape, or if there is tight and localized subcutaneous scarring, liposhifting may have some unique advantages. Certainly liposhifting and fat grafting by an external route can be combined for synergistic effect.



Case courtesy Simeon Wall, Jr., MD

This 30-year-old woman had a history of prior liposuction of her circumferential thighs, with a contour deformity in the mid-buttock extending into the right lateral thigh. *SAFELipo* of the circumferential trunk and thighs was performed, with uniform foam compression postoperatively to maintain a smooth contour. She is seen 1 year postoperatively.

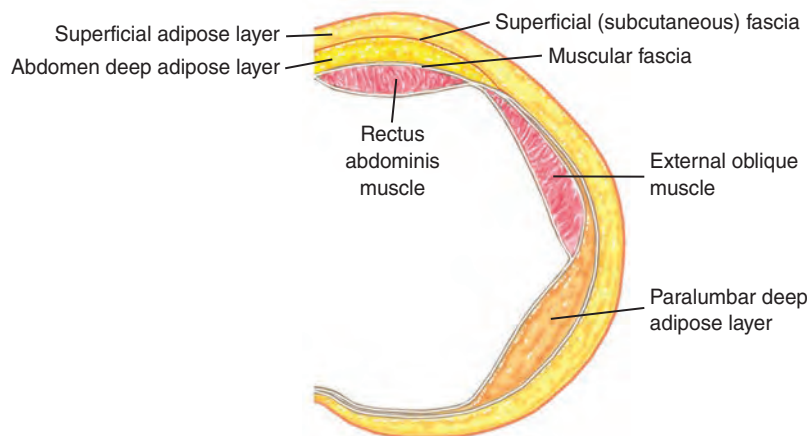


Case courtesy Simeon Wall, Jr., MD

This 39-year-old woman had a history of prior liposuction of the trunk, thighs, and buttocks, with a resultant deep contour deformity in the upper lateral buttock. *SAFE-Lipo* of the circumferential trunk was performed, using some liposhifting to further equalize the contour. Uneven (nonuniform) foam compression was used postoperatively, consisting of 1-inch Reston foam with a cutout in the center to allow the depressed area to expand and maintain the shifted fat. Today, with a defect that is particularly depressed and/or scarred down such as this, I usually add some fat grafting to the standard fat equalization/fat shifting (*SAFE-Lipo*) techniques to ensure that these areas are fully elevated. This approach is in contrast to wider areas of uneven contour, where correction does not usually require formal fat grafting, as seen in the previous case.

Clinical Anatomy of the Subcutaneous Adipose Tissue

For liposuction, the extractability of fat varies, depending on the individual, sex, and anatomic location of the fat. In general, it takes more effort to extract fat in men than in women. A ranking of body regions in order of increasing difficulty of fat removal includes the medial knees, buttocks, lateral thighs, central lower abdomen, medial thighs, upper arms, hips, calves, ankles, flanks, chest wall, and back.



The subcutaneous adipose tissue of the trunk and extremities is organized into a continuous fatty layer or superficial layer and a localized, deep fatty layer that is also present in the abdomen, paralumbar area, and gluteal–upper thigh regions. The subcutaneous fascia, or superficial fascial system, is the fibrous connective tissue network that, depending on the location, contains single or multiple horizontal membranous layers and vertically oriented extensions attaching to the subdermal layer above and the deep fascia layer below.

ZONES OF ADHERENCE



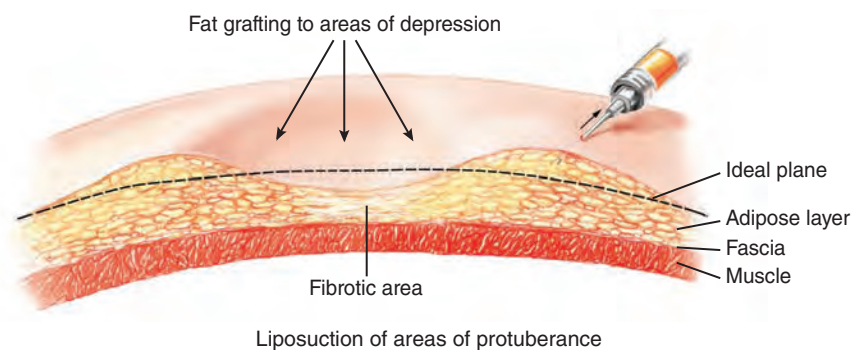
Varying zones of adherence of the superficial fascial system extend over the trunk and extremities. The encased fat produces bulges, valleys, plateaus, creases, and folds. The most adherent zones are found in skin creases and valleys, such as the inframammary fold, groin crease, gluteal crease, the anterior and posterior midline, and lateral gluteal depressions. Zones of least adherence are the bulges of the truncal area and the extremities, where the superficial fascial system forms a roof over the localized deep fatty layer. Intermediate zones of adherence exist in all areas of the trunk and extremities without significant deep fat. Surgical alteration within certain zones of adhesion, such as the lateral gluteal depression and buttock crease, may predispose the patient to postliposuction contour irregularities.

Extractability of the fat depends on its density and the strength of its encasing connective tissue. Loosely organized deep fat tends to be more easily removed than the more compact superficial fat. In lipoplasty, depending on the aesthetic goals, the superficial fatty layer and the deep fatty layer are targeted for fat extraction. However, it is important to leave a smooth, healthy layer of fat beneath the skin after liposuction. To treat postliposuction contour irregularities, corrective liposuction and fat grafting are directed toward modification and restoration of the superficial and deep fatty layers, as needed.

Preoperative Assessment

During the consultation with a patient regarding secondary procedures to correct postliposuction contour irregularities, the surgeon obtains information about the patient's preoperative body appearance, the changes that resulted from the primary surgery, any postoperative complications, the anesthetic technique used, and details of the surgery, if known.

The areas of fat excess and fat deficiency are located, the ideal contour is visualized, and sites of fat harvesting are determined.



Physical examination includes assessment of the thickness of the subcutaneous fatty layer with a skin pinch test. Underlying musculoskeletal contour is assessed by palpation as the patient contracts and relaxes the muscles. Laxity and sagging of the skin are evaluated by lifting the skin up against gravity and observing the body contour as the patient assumes upright, reclined, sitting, and flexed positions.

The surgical plan is discussed with the patient. Areas of fat excess and deficiency can be marked on the patient's skin as the surgical plan is discussed. Photographs are taken during the initial visit to identify areas for correction. Variable retention of the fat graft, realistic expectations, limitations, financial cost, and the potential need for additional procedures are discussed fully with the patient. For major contour irregularities, both early (3 to 6 months) and late interventions appear to be effective.

Preoperative Planning

Markings



A detailed topographic contour map is essential to the planning and execution of corrective surgery. Photographs without flash, using only overhead ceiling lighting, are routinely taken. Areas of maximal depression, areas of maximal protuberance, and the adjacent transition zones are indicated precisely. Markings should reflect differences in the amount of fat to be removed and injected in different areas.



Although skin markers of different colors provide added contrast, all markings can be performed with a black skin marker. Areas of maximal depression are colored black. Areas of maximal protuberance or fat excess are marked with multiple Xs or crosshatching. Transition zones between the two extremes are left unmarked. For complicated cases, I routinely perform the markings the day before surgery. This gives the patient ample opportunity to fully inspect the operative sites, including the donor sites, and ensures that the patient and the surgeon agree on the surgical plan.

The marking is performed with the patient in a standing position. Digital photographs of the surgical markings are used intraoperatively. Areas of maximum depression may be tattooed with methylene blue at the start of surgery to help maintain accurate surgical markings intraoperatively.

Incision Placement

Cannula entry sites for corrective liposuction should be selected to ensure the most direct approach to the areas to be aspirated. Attempts to hide the incision may compromise cannula movement and the final results.

Operative Technique

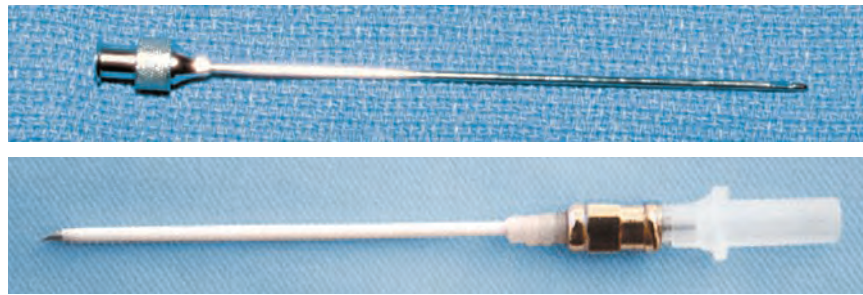
For fat harvesting, infiltration of wetting solution is minimized or avoided to obtain fat of maximum solidity. Lidocaine 0.25% with 1:400,000 to 1:800,000 epinephrine is injected with a 22-gauge spinal needle. Infiltration into the operative site requiring correction is minimized or avoided to facilitate intraoperative evaluation of the contour as fat is aspirated or added. Patients undergoing more extensive and complex procedures are given a general anesthetic.



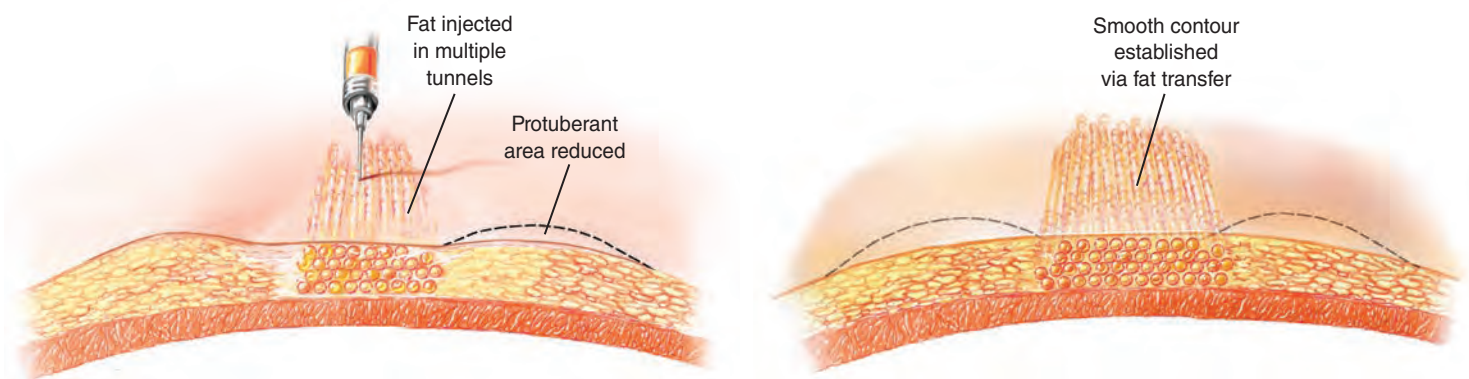
The fat is collected by pouring directly from the patient end of the liposuction tubing or with an interposed sterile specimen trap. Pretunneling before fat removal facilitates localization of the excess fat, helps to establish correct cannula pathways, avoids unwanted fat removal, and maximizes the accuracy of fat extraction. It is important to avoid excessive or full vacuum pressure when harvesting fat for reinjection. I limit the vacuum setting to 26 to 28 mm Hg.



The fat is allowed to settle and the liquid portion is discarded. No special processing is required. If the fat is dilute or if the amount is small, a centrifuge or absorbent gauze can be used to concentrate the fat. A blunt-tipped cannula without suction is passed beneath areas of dense subcutaneous adhesion to make multiple tunnels before fat injection.



Fat is injected with a small blunt-tipped cannula with an outside diameter of 1.5 to 1.8 mm. A blunt-tipped cannula is preferred, because it is less likely to cause bleeding during fat injection. Alternatively, a 16- or 18-gauge hypodermic needle may offer the advantage of more precise and effective fat deposition, especially in densely fibrotic areas.



The process is repeated. The fat is injected in small increments, in multiple passes, and at multiple depths. The pathways of fat injection may be parallel or crisscrossed, as needed. Fat injection may be carried out as a reversal of fat extraction in liposuction. During the injection, incremental change in the contour is correlated with the amount of fat injected. A skin pinch test is used to assess the thickness of the operative sites. Although a small degree of overcorrection is acceptable, excessive tissue turgor or overcorrection should be avoided.

Postoperative Care

The postoperative care of patients who have undergone corrective liposuction and fat grafting is similar to that given to patients who have undergone primary liposuction. If there is any chance that a compression garment may apply uneven pressure to the area that has received fat grafting, such a garment is not used. Postoperative manual massage is applied to areas with prolonged induration and firmness.

Outcomes

In most properly selected patients, secondary procedures for postliposuction contour irregularities are expected to correct or improve deformities. I reported on 22 patients with 43 areas of postliposuction contour irregularities; 2 areas were treated with dermolipectomy, 22 areas were treated with liposuction only, and 19 areas were treated with fat grafting in combination with liposuction. Ninety-five percent of the areas showed improvement, nearly complete correction, or complete correction. Five percent of the areas had overcorrection consisting of minor depressions. The quality of the outcome was also related to the severity of the postliposuction contour irregularities. Thirty-one percent of the areas with major contour irregularities (defined as an area greater than 100 cm², with greater difficulty of correction and increased severity of visual impact) had nearly complete or complete correction. Forty-seven percent of areas of minor contour irregularities had nearly complete or complete correction. Most patients required one or two corrective procedures; two patients required three procedures. The average number of procedures required was 1.4 per patient. The only complication noted was hyperpigmentation in the skin of one patient.

Results

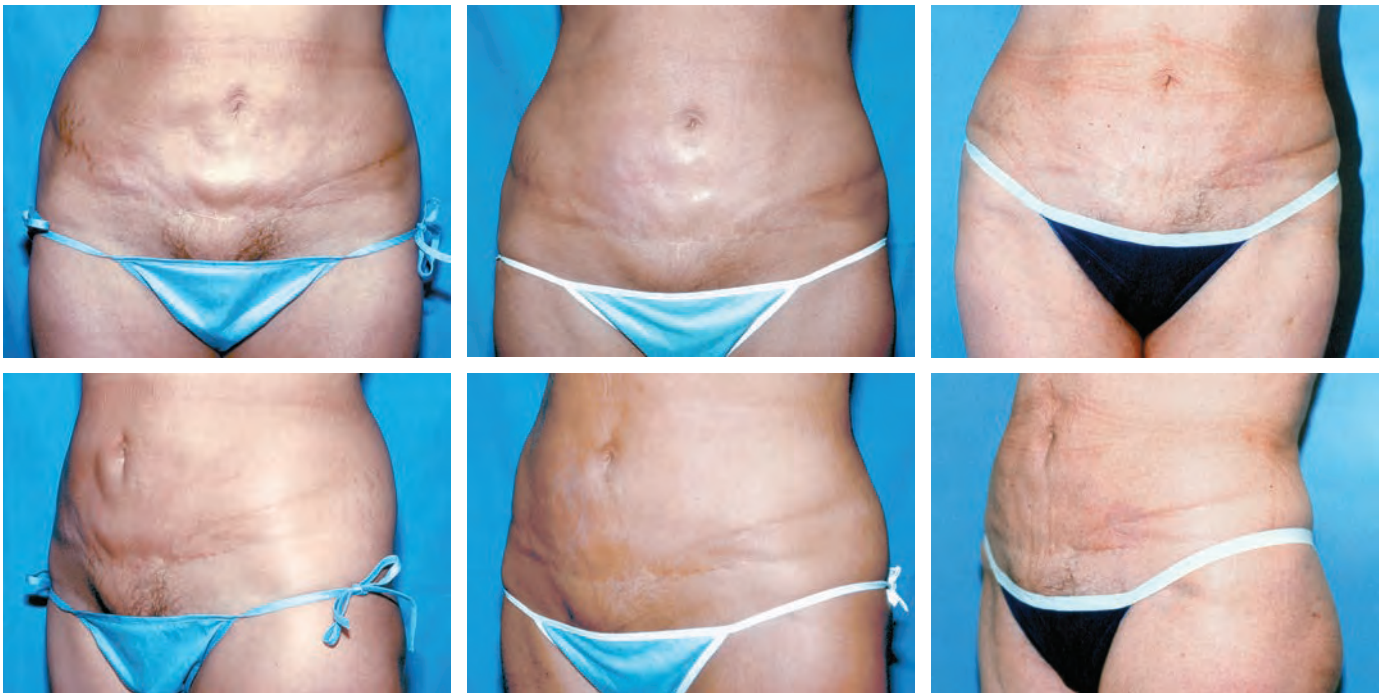
Correction of Contour Irregularities, Protuberances, and Depressions



This 55-year-old woman underwent simultaneous liposuction of the abdomen and mini-abdominoplasty. Her surgeon performed additional liposuction to correct contour irregularities. She presented with multiple contour irregularities in the abdomen 3½ years after the initial operation. Examination revealed an uneven contour, protuberant areas in the lower abdomen, and areas of depression below the umbilicus.

A corrective procedure was performed with the patient under general anesthesia. No wetting solution was used in the abdomen. Umbilical incisions and three lower abdominal incisions were made. A 3 mm Mercedes-type cannula was used to aspirate areas of protuberance in the lower abdomen and around the periumbilical and supraumbilical areas. Liposuction was tapered from the point of maximal protuberance into areas of maximal depression. The adhesions beneath the areas of depression were freed by passing a liposuction cannula without suction to create space for fat grafting.

To obtain fat for grafting, liposuction of the medial thighs and the medial knees was performed after infiltration with 0.25% lidocaine with 1:400,000 epinephrine. With an intravenous catheter, 35 cc of fat was injected into the areas of depression. Additional minor liposuction was performed around the periumbilical area 5 months later.



Improvement is evident 22 months after the major corrective procedure. The result remained stable 9 years and 10 months later, when the patient was 68 years of age. In the meantime, she had an upper abdominal dermolipectomy to correct upper abdominal skin laxity.

Correction of Contour Irregularities, Disproportion, Protuberances, and Indentations



This 55-year-old woman had multiple areas of postliposuction contour irregularities, including bilateral posterior iliac regions, her lateral thighs, and the lateral hip areas. Her surgical correction consisted of liposuction around the areas of indentation and autologous fat grafting. The amount of fat grafting to each area was as follows: 60 cc each to the right and left posterior iliac crest areas, 110 cc to the left lateral hip, 95 cc to the left upper lateral thigh, and 95 cc to the right upper thigh.



Two years and 4 months after the corrective procedure, the indentations in the right and left iliac crest areas, the left lateral hip, and upper thighs were improved, as seen in the posterior and lateral views.

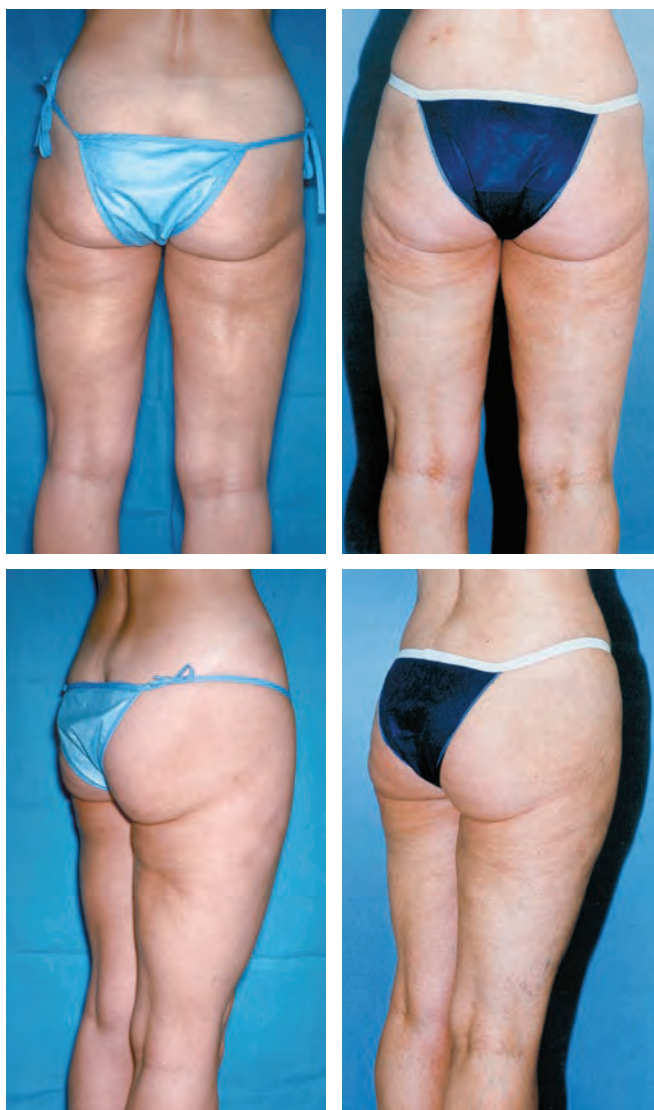
Correction of Areas of Linear and Circular Depression



This 38-year-old woman had undergone liposuction of the thighs, and 2½ years later she presented for corrective surgery. At the time of our consultation, she had already undergone one corrective procedure. On physical examination, we noted linear depressions in the posterior thighs and circular depressions in the lateral thighs.



The preoperative markings include solid red areas, which indicate areas of maximum depression and indentation. Areas of protuberance are indicated with multiple black X's. Transitional zones were noted between the areas marked red and black. Surgery was performed with the patient under general anesthesia and in the prone position. No local anesthetic was injected. Several incisions were made in the buttock crease, lateral thigh, and distal posterior thigh in the midline. Areas of protuberance were aspirated with a 3.7 and 2.4 mm Mercedes-type cannula. A total of 20 cc of aspirated fat was injected into the areas of depression and indentation. Both a blunt-tipped cannula and a sharp needle were used to inject the fat into the depressed areas. Three additional minor corrective procedures were performed over the next several years, and the patient underwent liposuction in the hip area.



Her improvement remained stable 11 years and 10 months postoperatively.

Correction of Indentation in Male Breasts



This 54-year-old man underwent reduction of gynecomastia with UAL. He developed indentations of the right and left breasts; the right side was more pronounced than the left. He also had adhesion of the nipple-areola complex, manifested by retraction during voluntary contraction of the pectoralis major muscle. The adhesion resolved spontaneously. He underwent corrective surgery 3½ years after the original surgery.



The procedure was performed with the patient under intravenous sedation. The fat was aspirated from the right and left flank with a 3 mm cannula; 9 cc was aspirated from the right and left chest with a 1.8 mm cannula, and 35 cc of fat was infiltrated into the right breast, including the subareolar area, with both an 18-gauge needle and a blunt-tipped cannula. At 15 months postoperatively, good correction is evident.

Correction of Large Soft Tissue Deficiency of Thighs and Buttock Ptosis

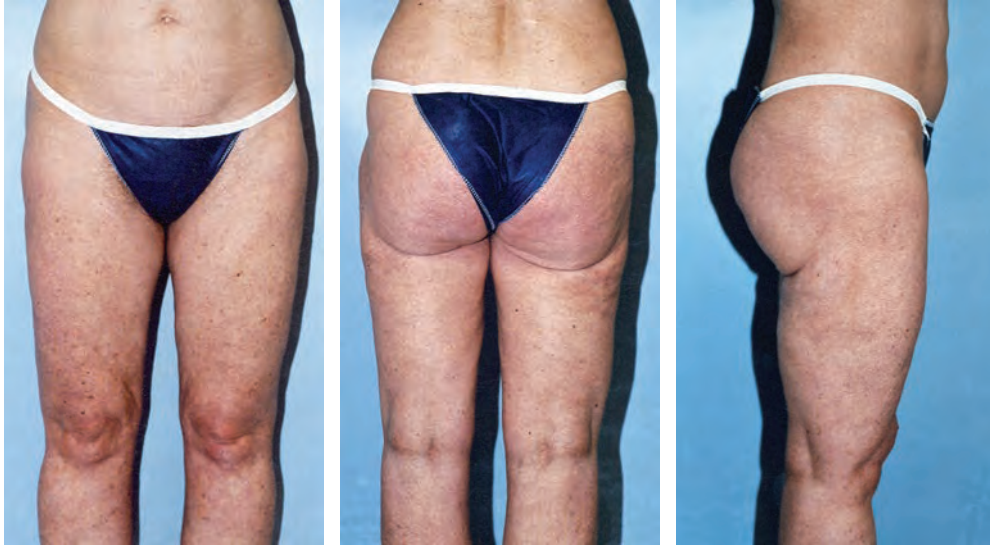


This 46-year-old woman underwent liposuction of the lateral, medial, and anterior thighs and lower leg. She developed contour irregularities at multiple sites. She was particularly concerned with changes in the lateral and medial thighs, around the knees, and in the posterior calves.



Corrective surgery was performed with the patient initially positioned supine. Approximately 200 cc of 0.125% lidocaine with 1:800,000 epinephrine was injected into various sites before fat was aspirated. The recipient areas were pretunneled before the fat was injected with a blunt cannula. Liposuction was performed in the upper medial thighs, medial knees, and anterior-superior knees. The fat was injected into the right anterior thigh (23 cc), right and left midmedial thighs (10 and 55 cc,

respectively), and the abdomen (25 cc). The patient was then placed in a prone position, and liposuction was performed on the posterior thighs. Fat was injected into the right and left posterior lateral thighs (90 and 100 cc), posterior gluteal folds (40 and 20 cc), and the calves (25 and 28 cc). The total amount of fat aspirated was 480 cc; the total amount of fat injected was approximately 420 cc.

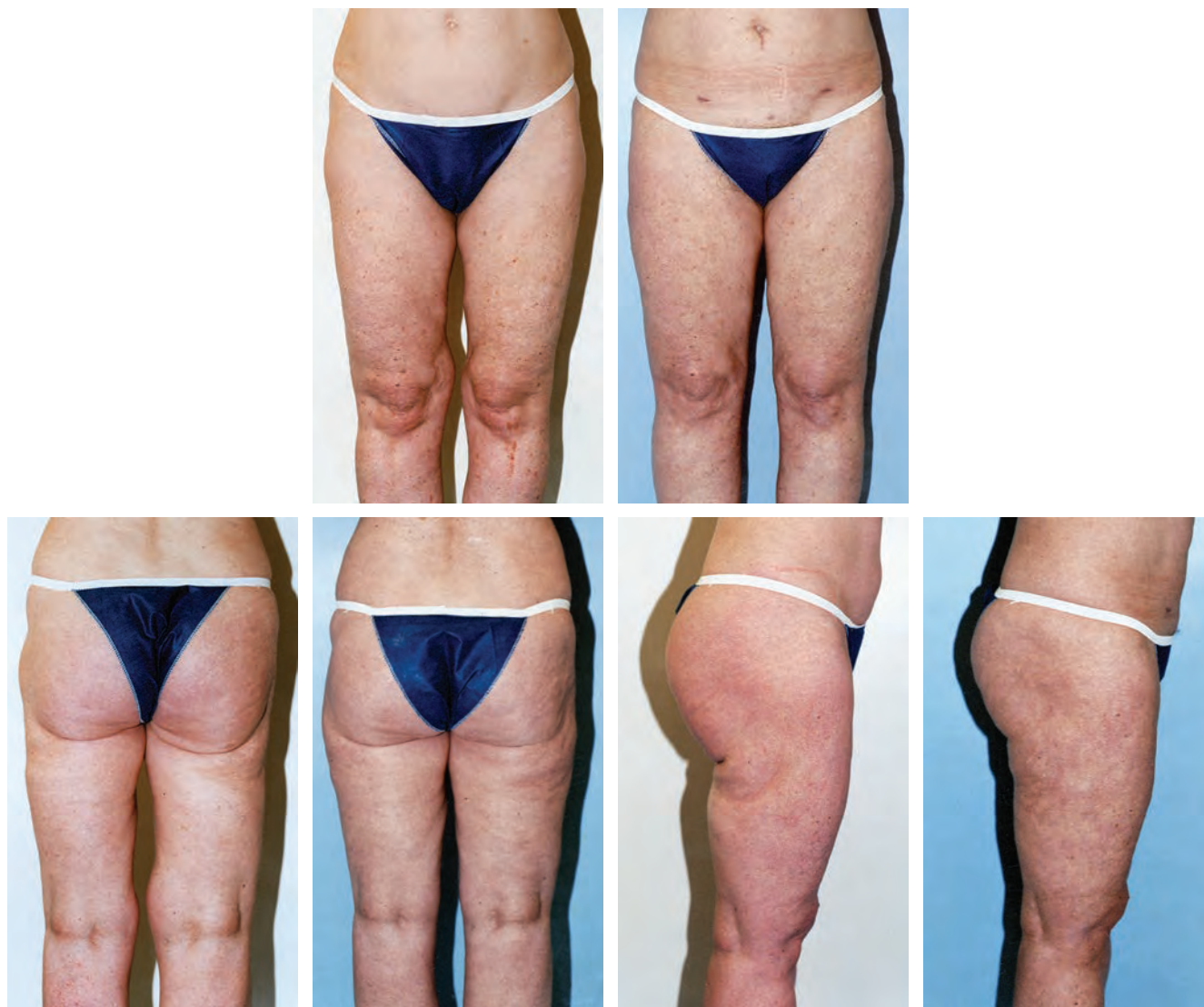


Twenty-five months later, improvement of the contour in the medial, lateral, and posterior thighs, and around the knees is evident. The patient returned to the operating room for additional improvement in the outer thighs, buttocks, knees, and legs.



Liposuction was performed in the abdomen, anterior and medial thighs, anterior-superior knee, and anterior proximal legs. The arms, waist, hips, and the right mid-posterior thighs were aspirated as additional fat donor sites. Fat was injected into

the abdomen (40 cc), right anterior thigh (60 cc), left anterior thigh (30 cc), left leg (20 cc), right leg (10 cc), right and left lateral thigh, gluteal folds and right posterior upper thigh (400 cc). A blunt cannula was used for fat grafting at all the sites. At the right lateral thigh, upper posterior thigh, and gluteal fold, 16- and 18-gauge needles were used in addition to the blunt cannula.

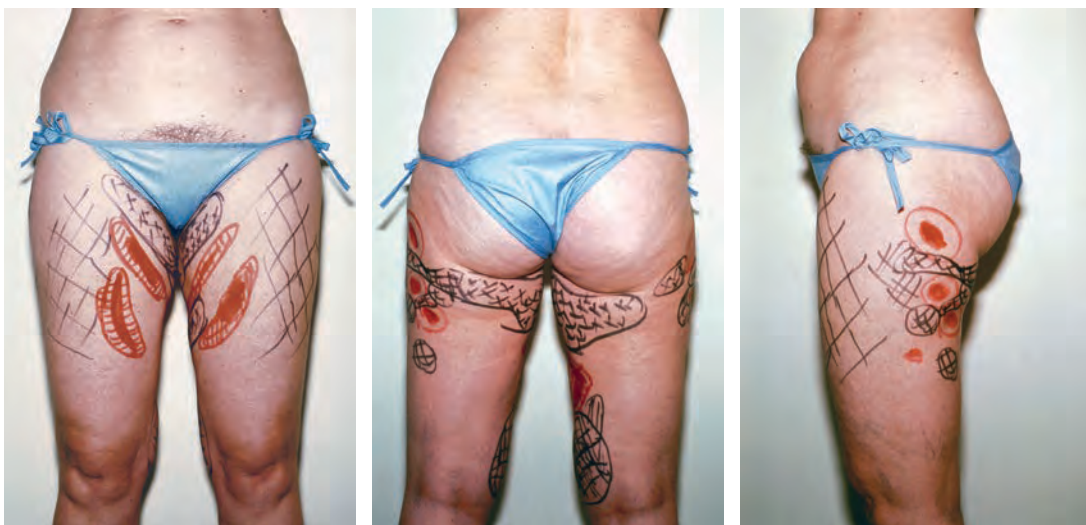


The postoperative result 13 months after the second procedure shows that there is more fullness in the lateral and upper posterior thighs. There is reversal of the soft tissue deficiency and improvement in the sagging at the buttock–upper thighs junction.

Correction of Contour Irregularities and Depressions



This 44-year-old woman underwent liposuction of the thighs, knees, and buttocks 1 year before presentation. Circular, linear, and irregularly shaped depressions were noted in the medial, lateral, and anterior thighs.



Preoperative surgical markings of areas of maximal indentation were made (*solid red*). Intermediate areas of indentation were marked with parallel red lines. Red circles indicated areas with a smaller degree of indentation. Areas of protuberance were crosshatched or marked with X's. Anteromedial thighs and knees were aspirated with the patient in the supine position under general anesthesia. The aspirated fat was injected into the area of depression using 14- and 16-gauge intravenous catheters. The patient was then placed in the prone position, and 1400 cc of fat was aspirated from the thighs; 200 cc was injected into various areas of indentation and depression.



Fourteen months after the first corrective procedure, several areas of the thighs appeared full and out of balance with other areas of the thighs and the body. Some areas of the thighs had received less liposuction than others up to this point; her hips and abdomen also appeared full. Additional liposuction without fat grafting was performed 14 months later.

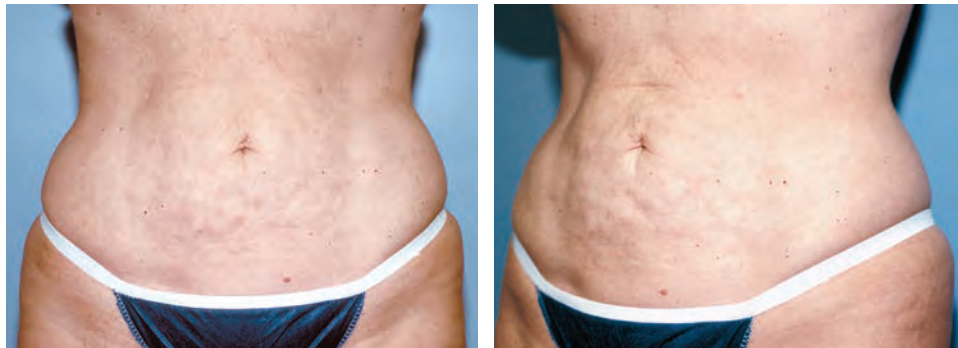


The patient is shown 4 years and 10 months after the first corrective procedure. Good improvement is noted in the anterior, medial, and lateral thighs and in the knees. A slight indentation persisted in the left lateral thigh.



The patient's results remain stable 13 years and 4 months postoperatively.

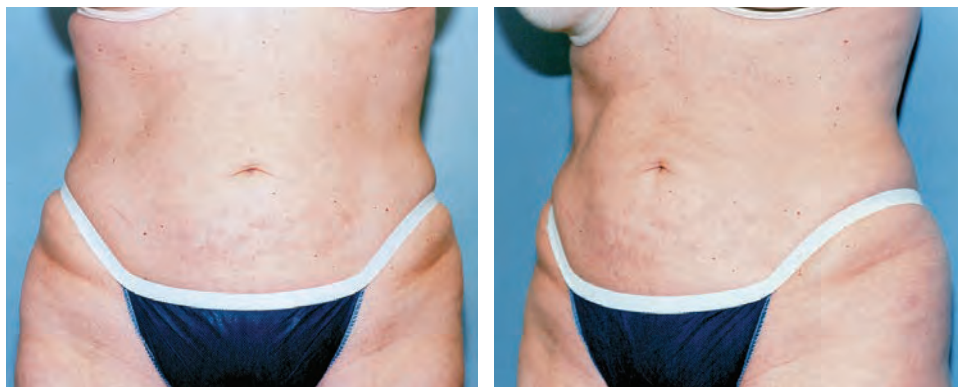
Correction of Diffuse Irregular Indentations, Protuberances, and Skin Excess



This 45-year-old woman underwent liposuction of multiple body areas; the tumescent technique was used. She underwent subsequent revision. A total of 1500 cc of aspirate was removed from the abdomen during the two previous procedures. At our consultation, we noted diffuse, irregular, circular, and oval indentations in the lower abdomen, with redundant skin on the upper abdomen.



Preoperative surgical markings identified areas of protuberance in the right lower lateral abdomen, suprapubic area, supraumbilical areas, and multiple areas of indentation in the lower abdomen. The protuberant regions were infiltrated with 0.25% lidocaine with 1:800,000 epinephrine and treated with SAL. An internal ultrasound device was used to create space for fat grafting in the densely fibrotic tissue. The LySonix 2000 cannula at a power setting of 2 was introduced into the subcutaneous space of the lower abdomen caudal to the umbilicus after wetting solution was infiltrated. The use of an ultrasound cannula permitted breakthrough of the scar, which was confirmed by passing a blunt 2.4 mm cannula without suction. No fat was aspirated during application of the ultrasound. Fifteen cubic centimeters of fat was transferred into the lower abdomen. The deeper level was injected using a blunt-tipped cannula. Sharply circumscribed indentations were injected with an 18-gauge needle at the superficial (subdermal) level. Postoperatively, the abdomen was covered with nonsticky foam and an elastic garment.



Twenty months postoperatively, some improvement in contour is evident. (NOTE: UAL is rarely used in corrective liposuction to maximize fat preservation.)

Concluding Thoughts

The best treatment of postliposuction contour irregularities is *prevention*. The optimal method of fat collection, processing, and transfer remains to be determined. The technique described in this chapter is relatively simple, practical, and does not require elaborate equipment. With appropriate patient selection and proper application of the various surgical techniques, most cases of postliposuction contour irregularities can be improved by various degrees. Multiple procedures may be required for complicated cases.

Clinical Caveats

In patients with complex postliposuction contour irregularities with volume deficiency, surgical correction consists of liposuction of areas of protuberance and around areas of depression with concurrent fat grafting.

Dermolipectomy is indicated for patients with redundant or extensively altered skin.

A detailed contour map delineates areas of maximal protuberance and depression and adjacent transitional zones.

Pretunneling before corrective liposuction facilitates accurate fat extraction.

A blunt-tipped cannula without suction is passed beneath the area of depression to make space for fat grafting if there is dense fibrosis.

Incisions are placed to create the most direct approach to areas requiring correction.

The solidity of the material for fat grafting is maximized by avoiding or minimizing the injection of wetting solution.

During secondary or primary liposuction, if overresection of fat is observed, the volume deficiency should be replaced with immediate fat grafting.

A submaximal vacuum setting (26 to 28 mm Hg) is used to obtain fat for grafting.

Avoid or minimize injection of wetting solution into areas requiring correction so the existing contour can be better visualized.

In densely fibrous areas, fat may be more precisely deposited using sharp needles.

Fat is injected superficially or deep, depending on the location of the soft tissue deficiency.

Overresection should be avoided in secondary lipoplasty.

Multiple procedures may be required for treatment of postliposuction contour irregularities.

Liposhifting offers alternatives to fat grafting in some deformities.

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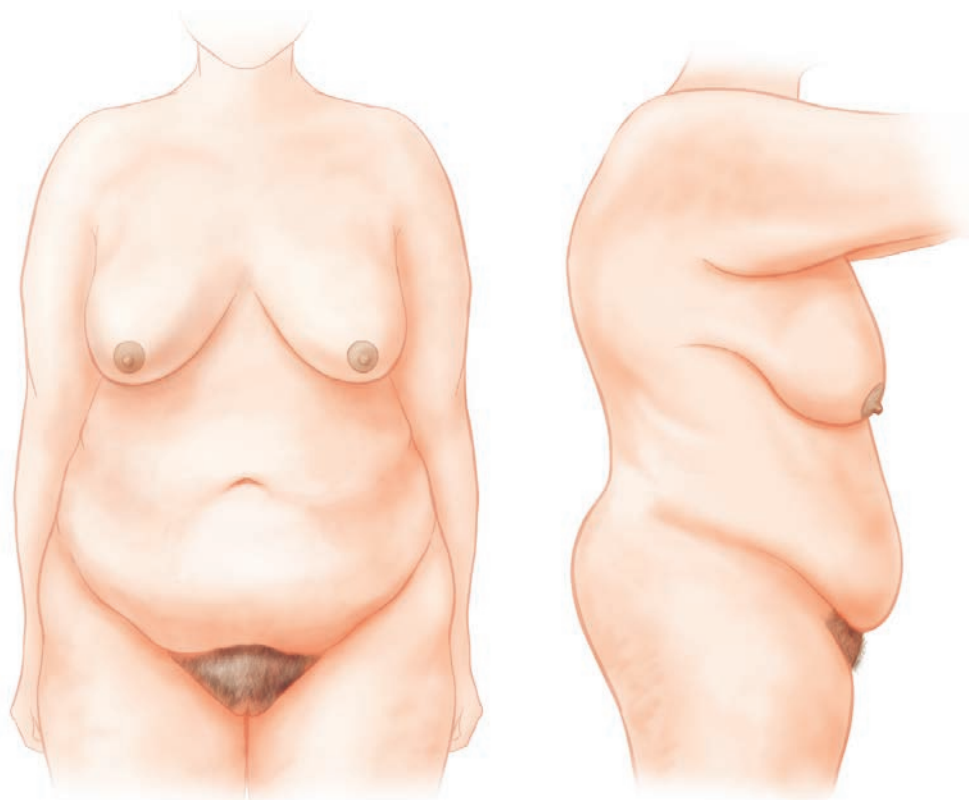
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CHAPTER 89



Special Problems in Reoperative Body Contouring

JOSEPH F. CAPELLA

Reoperative procedures are an important component of a body-contouring practice. There are many factors leading to the need for revisional surgery; most are the result of an unexpected outcome, but some can be related to the plastic surgeon's choice of primary procedure. In an effort to accommodate a patient's busy lifestyle, both the patient and plastic surgeon may be driven toward procedures with the shortest recovery period or the shortest scar. Less-invasive procedures are often innovative and are often reported to produce results similar to more invasive procedures—but frequently have limited supportive data. It is essential that all plastic surgeons, particularly those early in their careers, have a clear understanding of the procedures and clinical scenarios that are most likely to result in patient dissatisfaction and the need for revision.

In this chapter I have selected several body-contouring cases from different regions of the body that resulted in the need for revisional surgery but might have been avoided with a different primary procedure.

Abdomen, Thighs, and Buttocks

Lower Body–Contour Deformities After Liposuction

Contour deformities following liposuction of the lower body in a postpartum or postbariatric patient are among the most frequent complaints leading to reoperative surgery, in my experience. Almost all women have some weight gain during pregnancy, some more than others, leading to an extended period of soft tissue expansion of the abdomen and to some degree the hips, thighs, and abdomen. After delivery, much if not all of the weight is lost and soft tissues retract in varying degrees, depending on multiple factors, including age, number of pregnancies, the amount of weight gained and lost, and the woman's sun exposure, complexion, and tobacco consumption. A postbariatric patient undergoes a similar but more exaggerated experience. However, the result for the two groups is similar: excess soft tissue, and tissues with poor elastic qualities. As has been described by others, an appropriate amount of fat in the soft tissues of the body is an essential element of a youthful appearance. In a postpartum or postbariatric patient, excess fat may be a component of the contour deformity; however, excess soft tissue and limited elasticity are likely to play a larger role. Liposuction alone for these patients will often result in an increase in contour irregularities.



This 36-year-old woman underwent a 32 kg (70-pound) weight change with pregnancy. Her postpartum contour concerns were addressed on two occasions by another physician with liposuction of the abdomen, thighs, and buttocks. She came to me dissatisfied with her extensive contour deformities and loose skin. I performed a circumferential lower abdominal, thigh, and buttock lift. She is shown 30 months postoperatively.

The treatment of postliposuction contour deformities is challenging. An excisional procedure will conceal the fatty deficits by tightening the soft tissue. Injection of fat may be useful for small areas of fat deficiency but is unlikely to be practical over larger areas of the body and when soft tissue excess is the primary problem. My preference is to wait at least 6 months before attempting to address postliposuction deformities with excisional procedures. A history of excessive liposuction, particularly to the anterior abdominal wall, may compromise blood supply to these tissues.

Overall, I have found excisional procedures to be very useful, particularly with regard to deformities closer to the waistline.

Postbariatric Lower Body–Contour Deformities After Abdominoplasty Alone

Following weight loss, patients often present to a plastic surgeon with multiple complaints involving the abdomen, thighs, and buttocks. For both men and women, the abdomen is usually of greatest concern. The thighs and buttocks may be of concern, but the degree of soft tissue excess in these areas is often not completely appreciated by the patient unless he or she is examined in front of a mirror while upward traction is applied to the soft tissues of the lower body.

Postbariatric patients are often advised to undergo abdominoplasty alone or with liposuction to the hips and thighs. These traditional procedures usually only partially address the deformities that result from weight loss and in some instances may produce an unnatural-looking body contour. Abdominoplasty and liposuction can accentuate the soft tissue excess of the hips, thighs, and buttocks and often produce standing cones of tissue.



This 50-year-old man lost 59 kg (130 pounds) following gastric bypass surgery and underwent an abdominoplasty. He came to me with concerns about laxity along the lower abdomen and mons pubis and excess skin and fat along the hips and buttocks. In addition, he thought that his lower abdominal scar was too high. This man's contour deformities are typical of those following abdominoplasty in a massive-weight-loss patient. I addressed his concerns by performing a lower body lift; that is, a transverse thigh and buttock lift and a medial thigh lift with a vertical component. He is shown approximately 3 months after surgery.

Circumferential techniques are far more effective procedures for addressing the deformities of a massive-weight-loss patient; a more balanced aesthetic result can be achieved, and the standing cones of tissue can be avoided. In addition, the infraumbilical portion of the abdomen can usually be made tighter than with abdominoplasty alone, because there is no limitation in scar length.

The Medial Thigh Lift Approach: Thigh–Perineal Crease Alone Versus Thigh–Perineal Crease Plus a Vertical Component

The medial thighs can be of great concern for both postpartum and postbariatric individuals. These patients will often come in for a consultation, stand in front of a mirror, and elevate their medial thighs toward the groin crease, requesting that this be replicated by a surgical procedure. Many plastic surgeons approach medial thigh–lifting techniques with great hesitation. The undesirable outcomes associated with these procedures are well known: labial distortion resulting from excessive tension, descent of scars from the thigh–perineal crease, descent of the pigmented tissues of the groin onto the proximal thigh, and limited or no improvement of the medial thigh contour. Nevertheless, patients are eager to have some kind of intervention. Elevating and securing the sagging medial thigh tissues to an immobile structure such as Colles' fascia appears to be an effective approach to this problem.



This 33-year-old woman lost 78 kg (172 pounds) after a gastric bypass procedure. I initially performed a body-lift procedure on her (simultaneous abdominoplasty and thigh and buttock lift). She was satisfied with the results but had remaining concerns about her medial thighs. I described the thigh–perineal approach to performing a medial thigh lift but explained that a more aggressive approach involving a scar along her medial thigh extending to her knee would result in a better outcome. She was adamantly opposed to this lengthy scar, and at that point in my career, I was receptive to whatever choice was taken by the patient regarding the medial thighs.



I performed a medial thigh lift limited to the thigh perineal crease. The results are self-evident (*left*). The scars have descended, the labia have been distorted, and aesthetically there appears to be no improvement in her result.

The same patient is shown 2 years after a body lift and 6 months after a medial thigh lift with a vertical component (*right*). In addition to producing an improved aesthetic result, the deformity at the thigh–perineal crease has been corrected by the addition of the vertical component.

This case illustrated very clearly to me the factors contributing to the medial thigh deformity in individuals after significant weight loss. There are three elements from outside the medial thighs that affect the medial thighs: descent of the mons pubis toward the medial thighs, descent of the buttocks toward the medial thighs, and inferomedial rotation and descent of the thighs toward the medial thighs. These three consequences of significant weight loss are very effectively addressed by circumferential body-lifting procedures. However, circumferential excess at the thighs is not addressed by body-lift procedures or medial thigh-lift techniques limited to the thigh–perineal crease. Medial thigh lifts with a vertical component very effectively address this remaining excess and produce a far better aesthetic result.

In a weight-loss patient who has undergone a circumferential body-lifting procedure, the addition of a medial thigh lift limited to the thigh–perineal crease is usually of limited benefit. Removing excess tissue in only a vertical vector along the medial thighs and securing the thigh flap to an immobile structure (Colles fascia) will likely produce a suboptimal aesthetic outcome. In an individual who has undergone significant weight loss, the combination of inelastic qualities of soft tissues and the normal and necessary thigh abduction of everyday activities will eventually result in either the descent of the thigh–perineal scar and labial distortion, or recurrence of soft tissue excess along the medial thighs.

Arms

The arms are visible in everyday activities, and their appearance is important to individuals of all ages. Unfortunately, the consequences of many variables, including weight loss, sun exposure, and tobacco consumption, greatly affect the contours of the arms. The ready visibility of the arms makes patients and plastic surgeons particularly averse to scars in this region.

Arm Contour Deformities After Liposuction

As in the rest of the body, poor skin elasticity and excess soft tissue in the arms is likely to lead to a poor outcome after liposuction. From my own experience and from examining patients from other practices, postpartum and postbariatric patients usually do not benefit from arm liposuction alone. The deformities from these procedures may not be immediately recognizable but may appear later with aging and environmental exposure. The effects of skin retraction from liposuction procedures alone are limited.



This 21-year-old woman lost 82 kg (180 pounds) after gastric bypass surgery. She subsequently underwent laser-assisted liposuction of the arms. She presented to my practice with concerns about her arm contour deformities and sagging skin. I performed a brachioplasty that included concomitant liposuction and excision of soft tissue. She is shown 6 months postoperatively and is very pleased with her results, although she has gained significant weight since her surgery.

In many areas of the body, I have found the combination of liposuction and soft tissue excision to be very effective. Liposuction facilitates greater soft tissue excision and provides a readily identifiable plane of dissection.

Short-Scar Versus Traditional Brachioplasty Procedures

The rapid increase in the number of bariatric procedures in the United States and abroad has made brachioplasty a commonly performed surgery for many plastic surgeons. Although before 2000 the procedure was rarely performed by any plastic surgeons, more than 14,000 brachioplasties were performed in the United States in 2009. Excisional procedures are generally accepted as the treatment of choice for individuals who have lost weight, but multiple variations of brachioplasty have been described to minimize or eliminate the scar along the arm (see Chapter 82).



This 57-year-old postpartum woman had lost 20 kg (45 pounds) 10 years earlier through lifestyle changes. Eight months before she came to me, she had undergone liposuction of the arms, and 4 months before she presented, she had a brachioplasty with the scar limited to the proximal arm and axilla. She was disappointed with the results and thought that her best potential arm contour had not been achieved. I performed a traditional brachioplasty with extension of the arm scar to the medial epicondyle. She is shown 3 months postoperatively.

In the obese state, fat is stored in characteristic areas for both men and women. The soft tissues in these areas expand to accommodate fat. The longer the duration of obesity and the greater the weight reached by the patient, the poorer the tissue elasticity will be and the more excess soft tissue will be present. In both men and women, fat along the upper extremity is stored primarily at the axilla and proximal arm. The resulting deformity from weight loss requires that excess tissue be removed along a horizontal vector at the arm. The length of the arm scar required to address the arm contour deformity is determined by the degree of deformity present and the quality of the result desired by the patient.

Concluding Thoughts

The effects of aging, the environment, pregnancy, excessive weight, and weight loss will diminish the elasticity and quality of the soft tissue of the body, which in turn leads to contour deformities. Despite significant advances in plastic surgery, the body-contouring techniques available to us consist primarily of the removal and placement of soft tissue and prostheses. No substantial gains have been made in the way of improving soft tissue quality and elasticity. Thus it is unlikely in the near future that the lengthy scars often needed for effective body contouring can be avoided. Much of our clinical effort in this regard should be directed scar quality and perceptibility and educating our patients about the appropriate procedures available to achieve their goals.

Clinical Caveats

The need for revisional surgery is sometimes affected by the selection of the primary procedure.

Liposuction can produce contour deformities in individuals with excess soft tissue and poor skin elasticity.

Contour deformities secondary to liposuction can be treated in varying degrees by soft tissue excisional procedures.

Abdominoplasty and liposuction alone are unlikely to produce an optimal result in the weight loss patient.

Medial thigh-lift procedures limited to the thigh-perineal crease have limited utility and can be associated with significant complications in a weight-loss patient.

Circumferential body lifting procedures are often an integral component of correcting the medial thigh-lift deformity in a weight-loss patient.

Careful patient selection is critical to effectively implementing short-scar techniques in brachioplasty.

Lengthy scars are likely to be an important part of some body-contouring procedures until substantial advances are made in the science of improving the elasticity of soft tissue.

Annotated Bibliography

Abramson DL. Minibrachioplasty: minimizing scars while maximizing results. *Plast Reconstr Surg* 114:1631-1634; discussion 1635-1637, 2004.

A short-scar brachioplasty or minibrachioplasty technique is described that limits the scar to the axilla and proximal arm. Eight patients were treated with the technique. Brachioplasty techniques with scars limited to the proximal arm are likely to have limited utility in weight-loss patient. Very careful patient selection is critical to properly implement short-scar techniques in brachioplasty.

Baroudi R. Reoperation after liposuction and body contouring surgery. In Grotting J, ed. *Reoperative Aesthetic & Reconstructive Surgery*, 2nd ed. St Louis: Quality Medical Publishing, 2007.

The author reviews complications following a wide array of body-contouring procedures. Causes of patient dissatisfaction after liposuction are discussed, such as insufficient or excess fat removal and skin irregularities and laxity resulting from poor skin retraction. The effects of weight fluctuations after liposuction are illustrated. The use of secondary liposuction, fat injection, and soft tissue excision to address contour irregularities is described.

Capella JF. Body lift. *Clin Plast Surg* 35:27-51; discussion 93, 2008.

I review my first 425 body lifts (simultaneous abdominoplasty, thigh, and buttock lift). The indications for the technique and the limitations and disadvantages of performing abdominoplasty alone in postbariatric patients are discussed. Multiple cases are provided, exemplifying the varied presentation of this patient population. A detailed review of complications after a body lift describes the association between body mass index and pulmonary embolism.

Capella JF. Brachioplasty. Presented at the Baker Gordon Symposium, Miami, Feb 2005.

At this conference I discussed the reasons that medial thigh–lift procedures limited to the thigh–perineal crease are unlikely to be effective in individuals after weight loss. The variables contributing to the medial thigh deformity were reviewed, including ptosis of the mons pubis, inferomedial descent of the thighs, buttock ptosis, and horizontal or circumferential excess thigh soft tissue. Use of a circumferential body lift and medial thigh lift with a thigh–perineal crease and medial longitudinal component to address the medial thigh deformity was reviewed.

Suggested Reading

Richards ME. Minimal incision brachioplasty: a first-choice option in arm reduction surgery. *Aesthet Surg J* 21:301-310, 2001.

PART XIII

FINAL THOUGHTS



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CHAPTER 90



Reflections on the Art of Aesthetic Surgery

FOAD NAHAI

Aesthetic surgery is an art, a visual art. Despite efforts to quantify results and set standards to measure outcomes, our evaluations remain subjective. Beauty is interpreted subjectively by patients and surgeons: the patient's idea of beauty may not be the same as the surgeon's. There are also significant ethnic and cultural differences that define our concept of what features are considered attractive. High-arched eyebrows, the ideal in some cultures, may seem exaggerated or overdone in others. The ideal breast size varies considerably from culture to culture and from one geographic area to another. Whereas a plump or full figure is admired in some regions, in the United States the media promote a slender figure as the ideal. A successful aesthetic surgeon who is mindful of these differences actively elicits the patient's concept of beauty and expectations for a result.

Aesthetic surgery adapts to the times; it is a part of our culture, reflecting current fashions, trends, and fads. Occasionally these trends become exaggerated and divorced from normal standards of appearance and beauty. This can be seen in frozen, expressionless foreheads overtreated with Botox, or excesses in lip augmentation where these delicate structures are inflated beyond proportion, or augmented breasts with exaggerated upper pole fullness, a characteristic seen so frequently that some people accept this as normal. It is our responsibility to educate our patients and the public so that they understand the difference between a normal enhanced appearance and one that has been unnaturally altered.

Aesthetic surgery is also, first and foremost, a surgical discipline, and in that respect no different from any other surgical specialty. It cannot be taught overnight or practiced effectively without a strong surgical background. Aesthetic surgery does not exist in a vacuum. This is a discipline based on sound knowledge of anatomy and physiology combined with an understanding of the psychosocial aspects of altering the face and body. Principles of surgery, specifically physiologic responses to surgical trauma, wound healing, and the prevention and management of complications, apply as much to aesthetic surgery as to any other surgical specialty. Years of experience in basic surgical technique, training in reconstructive surgery, and exposure to detailed anatomy in the laboratory are prerequisites for practicing aesthetic surgery. For me this experience began in the anatomy lab, culminating in an honors degree in anatomy, followed by years spent restoring form and function through anatomic research and clinical applications. My current interest in aesthetic surgery was a natural extension of this reconstructive and anatomic training. What I have come to realize is that whether we are restoring form and function or enhancing body or facial appearance, we are guided by the same aesthetic principles and goals. Expertise and competence in aesthetic surgery is not gained through a weekend course, a few days spent observing an expert, or an hour viewing a DVD.

I love this specialty because there are so many ways of solving problems, regardless of whether we are rejuvenating the aging face, correcting changes in the shape and size of the breast, or recontouring the body. Each of the approaches is right for the right patient. Because the specifications will vary for each individual, depending on the patient's physical situation and desire for change, the surgeon should be skilled in a number of different techniques, but not necessarily all, which can be applied or modified accordingly. Clinical decision-making, which contributes to patient satisfaction, must also take into account the patient's motivation for seeking aesthetic surgery, degree of concern over the perceived problem, and expectations. Choices can only be made after listening to the patient and setting goals that are in balance with his or her lifestyle. A patient seeking facial rejuvenation who has only a few days for full recovery and whose lifestyle will not permit sun avoidance is obviously not a candidate for a fully invasive face lift or laser resurfacing. In this situation, the patient must either agree to temporarily alter that lifestyle and have the invasive procedures or be willing to accept a less than ideal result with injectables, other noninvasive procedures, and skin care.

The pendulum swings; fads come and go. We should not precipitously embrace every new technique, treatment, or technology that is advanced until each has been evaluated, its value, safety, and efficacy established, and the appropriate role or indications defined. Regrettably, many manufacturers are promoting their products directly to the public before physicians have the opportunity to scientifically evaluate them to verify their safety and efficacy. I am concerned that these companies no longer view us as their customers, preferring to drive demand by targeting the public, who lack the scientific background for judging these products and may be more gullible and accepting of exaggerated claims. To ensure that our patients receive the best care with the safest products, we need to find a way to get back into the mix and to resume our proper role in monitoring this process.

Aesthetic surgery, as is true of all surgery, carries risks. When I discuss these with my patients, I advise them to forget the word "cosmetic" and remember the word "surgery." I explain that all surgery, even in the best of hands, carries risks. The best we can offer our patients is reduction of this risk by taking the necessary measures to minimize complications and morbidity. The patient is responsible for selecting the surgeon; the surgeon is responsible for the patient's safety, comfort, and privacy.

Ensuring patient safety and minimizing risk begins with the initial consultation and history-taking and continues with preoperative preparation, intraoperative measures, postoperative care, and follow-up. Patient selection is a key part of this process. The medical history should elucidate factors that will affect outcomes in aesthetic surgery, such as smoking, hypertension, other general medical conditions, medications, allergies, and history of psychological problems. If necessary, or if there is any doubt about the patient's health, the patient should be referred to his or her primary

care physician, counselor, or psychiatrist for a thorough evaluation before any operation is undertaken.

The type and length of procedure and the combination of procedures have an impact on patient safety. Where the operation is performed (the physician's office, a freestanding certified outpatient surgical facility, or the hospital) is also relevant. These decisions are normally made by the surgeon with little if any input from the patient. However, given concerns about expense, and with the advent of the fascination by the media and public with extreme makeovers, where multiple procedures are performed simultaneously for a complete, rapid transformation, it is not unusual today for patients to request or even demand multiple simultaneous procedures. Although in some patients this may be safe, it is prudent for the surgeon to point out the increased risks of these long, multiprocedure operations. Patient safety should not under any circumstances be compromised by financial concerns or succumb to the patient's insistence that everything be done at once. Similarly, the choice of facility where the operation will be performed should be based on sound surgical judgment rather than financial concerns.

It is the role of the surgeon working with the surgical team to coordinate patient comfort and safety in the operating room. This includes proper functioning of all instruments and equipment, positioning and protection of pressure points, protection of the cornea, appropriate placement of grounding plates, maintenance of patient body temperature, and deep venous thrombosis prophylaxis, to mention only a few.

After the operation, the patient should be cared for in an appropriate setting. This will range from their home to overnight or longer in a suitable overnight facility or a hospital. This decision is based on the type of procedure and the patient's general medical condition. For multiple body-contouring procedures, I recommend hospitalization with at least one overnight stay. For facial aesthetic surgery, I prefer to take care of them in our own freestanding certified surgical center with at least one overnight stay in our facility. Breast augmentations and small volume liposuction are outpatient procedures performed in our surgicenter; however, I do ask these patients to stay within 20 minutes' reach of our office for the first postoperative night. Although immediate complications are very rare in this group, I do not think it is wise to allow them to travel long distances, and I prefer to have them in close proximity in the unlikely event of a complication.

Postoperative patient management after discharge from the facility should include directions for the specific procedure and general information on the prevention and management of postoperative nausea and vomiting, pain and discomfort, and temperature changes. The patients are also instructed to look for any sudden or unusual swelling or change in the operative site which may indicate hematoma. All patients undergoing surgical facial rejuvenation remain in our facility overnight and are continuously monitored for elevation of blood pressure, nausea, and pain and discomfort.

Trends in aesthetic surgery are toward procedures that are less invasive, less expensive, require less recovery, have less morbidity, and require less time. However, less is not necessarily more; in fact, it may be less, except in younger individuals who are seeking aesthetic surgery in ever-larger numbers. For some of these patients, skin care, injectables, and noninvasive treatments can be as effective as a full face lift in older individuals. These trends are growing rapidly as younger and younger patients with minimal or moderate aging changes seek early rejuvenation and as older individuals increasingly request less-invasive procedures. Therefore it seems only logical to predict that the demand for complex, extensive surgical procedures requiring prolonged recoveries has declined and will continue to decline. However, this prediction does not hold true for all patients. There is an emerging new group of candidates for aesthetic surgery, massive-weight-loss patients, whose only effective options are all extensive, complex facial and body-contouring procedures.

Medical tourism is another trend that has grown in popularity, in some cases posing a potential threat to patient safety. Contrary to what we knew as medical tourism in the past, where wealthy individuals from developing countries travelled to Western Europe and North America in search of excellence, today the trajectory has been reversed as patients travel to developing countries in search of bargains in health care in general and in aesthetic surgery in particular. Clearly, there are many well-qualified, skilled physicians and first-rate facilities in these developing countries, but the fact remains that it is a risky business when patients choose caregivers based solely on price considerations. Regrettably, there are numerous unscrupulous, untrained practitioners who offer bargain prices to unwitting consumers; these practitioners are frequently aided by tour organizers, vacation resorts, and even national governments who promote these services while downplaying the serious nature and risks of surgery. Instead, they focus on the vacation and the tourist attractions available, conveniently glossing over issues of recovery and the potential complications associated with any surgical intervention. Although we cannot slow this trend, we can provide some balance and help to educate the public and our patients about potential dangers. For those of us who treat patients who travel long distances to see us, it is essential to make sure that these patients are well informed and that arrangements are made for safe follow-up care on their return home.

Aesthetic surgery is evolving. Procedures are continually being revised and refined to offer our patients the best care possible. As new techniques and technologies are introduced, established techniques are reevaluated and even abandoned. This evolutionary process is necessary; it should and will continue. It is my hope that this second edition will mirror the ongoing evolution and contribute to the advancement of our specialty. Ultimately, aesthetic surgery is an art form; it is creative, dynamic, and for me, it represents completion of my personal lifelong fascination and passion with the practice of plastic surgery.

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